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IMPROVING THE DIDACTIC SYSTEM OF SCHOOL PREPARATION BASED ON THE DEVELOPMENT OF COGNITIVE ACTIVITY IN PRESCHOOL CHILDREN

Annotation: *This article examines methodological approaches to improving the didactic system of preparing preschool children for school through the development of cognitive activity. Particular attention is given to the development of attention, memory, thinking, perception, imagination, and independent reasoning. The study considers age-appropriate educational tasks, didactic games, problem-based situations, observation, practical activities, and teacher-child interaction as important components of an effective preparation system. The article also emphasizes the need to consider children's individual developmental characteristics when organizing educational activities.*

Keywords: *preschool education, cognitive activity, school readiness, didactic system, cognitive development, educational methods, preschool children.*

Theoretical foundations of cognitive development in preschool children. Preparing a child for school is a complex educational process that cannot be reduced to teaching letters, numbers, reading, or simple writing skills. A child entering school encounters a new social and educational environment in which he or she is expected to listen carefully, understand instructions, remember information, complete tasks independently, communicate with others, and respond appropriately to unfamiliar situations. Therefore, effective school preparation should focus not only on what a child knows but also on how the child learns, thinks, explores, and uses newly acquired information. Cognitive activity is one of the central components of this preparation. It reflects the child's active process of understanding the surrounding world, acquiring information, comparing objects and events, establishing relationships between them, asking questions, solving simple problems, and drawing conclusions. In preschool education, cognitive development is closely connected with the child's everyday experience. Children learn not only during specially organized lessons but also while playing, communicating, observing nature, constructing objects, asking questions, and participating in practical activities. The preschool period is particularly important because many basic cognitive processes develop rapidly during these years. Attention gradually becomes more purposeful, memory becomes more organized, and thinking moves toward more complex forms of comparison, classification, and reasoning. However,

these abilities do not develop automatically at the same level in every child. They require an appropriate educational environment and systematic pedagogical support. For this reason, the organization of preschool education should create conditions in which children can actively explore and make sense of their experiences rather than simply reproduce information provided by an adult.

One of the important characteristics of cognitive development at preschool age is the strong relationship between curiosity and learning. Children naturally want to know why things happen, how objects work, and what may happen if a situation changes. Questions such as “Why does this happen?”, “What will happen if we change it?”, or “How can we do it differently?” demonstrate an emerging need for explanation and reasoning. Instead of immediately providing the correct answer, a teacher can use such questions as an opportunity to encourage independent thinking. In this situation, the teacher becomes not merely a source of information but a guide who helps the child search for an answer. The development of attention is another important element of cognitive preparation for school. At school, children need to listen to instructions, concentrate on a task, and complete activities within a certain period. Preschool activities can gradually develop these abilities through age-appropriate exercises. For example, children may be asked to identify differences between pictures, find a missing object, continue a sequence, remember the location of several objects, or follow a sequence of instructions. Such activities should not be organized only as repetitive exercises. Their content should be varied and connected with meaningful situations so that children remain interested and actively involved.

Memory development is also closely related to school readiness. However, memorization should not be understood simply as the ability to reproduce large amounts of information. It is more valuable when children learn strategies for remembering and recalling information. Stories, pictures, objects, movements, and associations can be used to help children organize information in a meaningful way. When a child retells a short story, reconstructs the order of events, or remembers the characteristics of several objects, memory develops together with language and thinking. Thinking occupies a particularly important place in cognitive development. Preschool children gradually learn to compare objects, identify similarities and differences, classify things according to certain characteristics, establish simple cause-and-effect relationships, and make conclusions. These abilities can be developed through practical tasks rather than through abstract explanations. For instance, instead of simply explaining the concept of classification, a teacher can provide several objects and ask children to group them according to color, shape, size, function, or material. The child then has to decide which characteristic should be used and explain the choice.

Problem-based tasks can make this process even more meaningful. A problem situation does not necessarily have to be complicated. A simple question such as “How can we arrange these objects so that everyone can see them?” or “Which container can hold more water, and how can we check it?” encourages children to make predictions, test ideas, and compare results. Through such activities, children

begin to understand that a problem may have several possible solutions and that an assumption can be checked through practical action. The didactic system used for school preparation should therefore be based on the gradual development of cognitive abilities. Tasks should correspond to children's developmental levels while providing enough intellectual challenge to encourage further progress. If activities are too simple, children may lose interest; if they are excessively difficult, they may experience frustration. A balanced approach allows the child to experience success while still requiring effort and reasoning.

An important condition of this system is the recognition of individual differences. Preschool children do not develop at exactly the same pace. One child may demonstrate strong verbal reasoning, while another may show greater ability in visual or practical tasks. Some children may concentrate for a longer period, whereas others may require shorter activities with more frequent changes. Therefore, effective preparation for school should provide different forms of participation and allow children to demonstrate their abilities in various ways. The theoretical analysis shows that cognitive development should be considered a central component of school preparation. A child who is able to observe carefully, ask meaningful questions, remember relevant information, compare alternatives, and search for solutions has a stronger foundation for further learning. Consequently, improving the didactic system of preschool education requires a shift from simply transmitting knowledge toward organizing meaningful cognitive experiences in which the child becomes an active participant in the learning process.

Didactic conditions for developing cognitive activity. An effective didactic system for school preparation should create conditions in which preschool children are able to learn through active participation. The teacher’s task is not simply to provide information but to organize situations that encourage children to observe, compare, question, experiment, and make simple conclusions. Such an approach makes learning more meaningful and supports the development of cognitive independence. One important condition is the use of developmentally appropriate tasks. Activities should correspond to children's age, previous experience, and individual abilities. Tasks that are too easy do not provide sufficient intellectual challenge, while excessively difficult activities may reduce motivation. Therefore, the level of difficulty should gradually increase as children's abilities develop.

Play-based learning is particularly valuable at this stage. Through didactic games, children can develop memory, attention, logical thinking, language, and problem-solving skills without feeling that they are performing formal academic exercises. Research on preschool education also emphasizes the importance of combining child-led and teacher-guided activities and providing opportunities for play and exploration. Another important condition is a supportive learning environment. Children should have access to visual materials, construction objects, puzzles, natural materials, and other resources that encourage independent exploration. Such an environment transforms the classroom from a place where children mainly receive information into a space where they can discover relationships and test their ideas. Thus, the didactic system should combine

purposeful teaching with children's natural curiosity, ensuring that cognitive development becomes a continuous part of everyday preschool activities.

Methods and activities for improving school preparation. The methodological improvement of school preparation requires the selection of activities that develop several cognitive abilities simultaneously. Rather than separating attention, memory, thinking, and language into completely independent exercises, teachers can integrate them into common educational situations. Problem-based activities are particularly useful. A teacher may present a simple situation and ask children to suggest possible solutions. For example, children can be asked how to divide objects equally, arrange pictures according to a sequence, or determine which material is suitable for constructing a particular object. Children first express their assumptions and then test them through practical activity. This process develops reasoning and encourages them to understand that an answer can be found through investigation.

Observation and comparison should also occupy an important place in preschool activities. Children can compare objects according to size, shape, color, function, or material and explain the reason for their classification. Such tasks gradually develop analytical thinking. Story-based activities can strengthen both memory and language. After listening to a short story, children may be asked to reconstruct the sequence of events, identify the main character's actions, or suggest another ending. This allows several cognitive processes to work together.

Importantly, the teacher should provide children with opportunities to explain their answers. The explanation is often more valuable than the answer itself because it reveals how the child is thinking. Systematic use of such activities can make school preparation more purposeful and cognitively rich. Evidence from school-readiness research also indicates that effective preparation involves not only academic knowledge but listening, self-regulation, curiosity, independence, and problem-solving.

Individualization and evaluation of cognitive development. Improving the didactic system also requires a more flexible approach to evaluating children's cognitive development. Preschool children differ considerably in their pace of development, interests, communication abilities, and preferred ways of learning. Therefore, assessment should not be limited to whether a child gives the correct answer. The process through which the child approaches a task should also be considered.

Pedagogical observation can provide valuable information about how children concentrate, remember instructions, communicate their ideas, solve problems, and respond to difficulties. Based on these observations, teachers can adjust the complexity and form of subsequent activities. Individualization does not mean creating a separate educational program for every child. Instead, the same learning objective can be achieved through different levels of support. One child may complete a task independently, while another may need visual guidance, additional questions, or a practical demonstration. Gradually reducing this support can encourage greater independence. The learning environment should also allow

children to work individually, in pairs, and in small groups. Different forms of interaction provide opportunities to develop both cognitive and social skills. Recent research on preschool interventions similarly emphasizes that school readiness includes attention, self-regulation, and other competencies alongside early academic abilities. Therefore, an improved didactic system should be flexible, child-centered, and based on continuous pedagogical observation. Its effectiveness should be judged by the child's growing ability to think independently, understand instructions, find solutions, and apply acquired knowledge in new situations.

Conclusion

Improving the didactic system of school preparation based on the development of cognitive activity requires a shift from simple transmission of knowledge toward the organization of meaningful learning experiences. Preschool children need opportunities to observe, question, compare, experiment, communicate, and find solutions independently. Such activities help develop attention, memory, thinking, imagination, language, and other cognitive abilities that are important for successful adaptation to school.

The effectiveness of school preparation depends not only on the content of educational activities but also on how these activities are organized. Age-appropriate tasks, didactic games, problem-based situations, practical exercises, and supportive teacher-child interaction can create an environment in which children learn through active participation. At the same time, individual developmental differences should be considered when selecting tasks and evaluating children's progress.

A well-organized didactic system should therefore combine purposeful pedagogical guidance with children's natural curiosity and independence. Continuous observation and flexible adjustment of learning activities can help teachers identify children's needs and provide appropriate support. In this sense, cognitive development should be viewed not as an additional element of preschool education, but as one of the central foundations of meaningful school preparation. Quality early childhood education provides an important foundation for further learning and long-term development.

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DUAL TA’LIM SHAROITIDA TA’LIM VA ISHLAB CHIQARISH INTEGRATSIYASI SAMARADORLIGINI RIVOJLANTIRISH YO‘NALISHLARI VA XUSUSIYATLARI

Annotatsiya. *Mazkur maqolada dual ta’lim sharoitida ta’lim va ishlab chiqarish integratsiyasini samarali tashkil etishning nazariy, tashkiliy va pedagogik jihatlari tahlil qilingan. Ta’lim dasturlarini ishlab chiqarish talablariga moslashtirish, professor-o‘qituvchi va ishlab chiqarish ustozi hamkorligi, talabalarni real ishlab chiqarish jarayonlariga jalb etish hamda kasbiy kompetensiyalarni baholash masalalariga alohida e’tibor qaratilgan. Shuningdek, Andijon qishloq xo‘jaligi va agrotexnologiyalar institutining 60810100 – Qishloq xo‘jaligini mexanizatsiyalashtirish yo‘nalishida dual ta’limni tashkil etish tajribasi yoritilgan.*

Kalit so‘zlar*: dual ta’lim, ta’lim va ishlab chiqarish integratsiyasi, kasbiy kompetensiya, ishlab chiqarish amaliyoti, qishloq xo‘jaligi mexanizatsiyasi, ishlab chiqarish ustozi.*

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DIRECTIONS AND FEATURES OF DEVELOPING THE EFFECTIVENESS OF EDUCATION–PRODUCTION INTEGRATION IN THE CONTEXT OF DUAL EDUCATION

Annotation. *This article analyzes the theoretical, organizational, and pedagogical aspects of effectively organizing the integration of education and production in the context of dual education. Particular attention is paid to adapting educational programs to production requirements, cooperation between academic teaching staff and industry mentors, involving students in real production processes, and assessing professional competencies. The article also highlights the experience of Andijan Institute of Agriculture and Agrotechnologies in organizing dual education within the educational program 60810100 – “Agricultural Mechanization.”*

Keywords: *dual education, education–production integration, professional competence, industrial practice, agricultural mechanization, industry mentor.*

Bugungi kunda oliy ta’limning muhim vazifalaridan biri mehnat bozori talablariga mos, zamonaviy texnologiyalarni amaliyotda qo‘llay oladigan va ishlab chiqarish jarayonlarida mustaqil qaror qabul qiladigan mutaxassislarni

tayyorlashdir. Texnologiyalarning jadal rivojlanishi nazariy bilimlar bilan bir qatorda amaliy ko‘nikmalarni ham talab qilmoqda.

Shu nuqtai nazardan, dual ta’lim ta’lim jarayonini ishlab chiqarish bilan uzviy bog‘lashning samarali shakllaridan biridir. Dual ta’limda ishlab chiqarish korxonasi oddiy amaliyot bazasi emas, balki talabaning kasbiy tayyorgarligida bevosita ishtirok etuvchi hamkor sifatida namoyon bo‘ladi. Talaba OTMda olgan nazariy bilimlarini real ishlab chiqarish sharoitida qo‘llaydi, muammolarni tahlil qiladi va mustaqil qaror qabul qilish ko‘nikmalarini rivojlantiradi.

Tadqiqotning maqsadi dual ta’lim sharoitida ta’lim va ishlab chiqarish integratsiyasi samaradorligini ta’minlovchi omillarni aniqlash va ularning amaliy mexanizmlarini asoslashdan iborat. Tadqiqotda tizimli va qiyosiy tahlil, pedagogik kuzatuv, amaliy tajribani umumlashtirish hamda ta’lim va ishlab chiqarish hamkorligi natijalarini tahlil qilish usullaridan foydalanilgan.

Dual ta’limdagi integratsiya quyidagi izchil jarayon asosida shakllanadi:

OTM – korxona hamkorligi → ta’lim mazmunini muvofiqlashtirish → ishlab chiqarish muhitiga integratsiya → amaliy faoliyat → kasbiy kompetensiya → mehnat bozoriga tayyor mutaxassis.

Bunda o‘quv rejalari va fan dasturlari ishlab chiqarish ehtiyojlari bilan uyg‘unlashtiriladi. Talaba nazariy bilimlarini real ishlab chiqarish jarayonlarida sinab ko‘radi va texnologik muammolarni hal qilish, texnikadan samarali foydalanish, jamoada ishlash kabi kompetensiyalarni egallaydi.

Dual ta’lim samaradorligini rivojlantirish uchun quyidagi yo‘nalishlar muhim:

1. O‘quv dasturlarini zamonaviy ishlab chiqarish talablariga moslashtirish.
2. Nazariy va amaliy ta’limning uzviyligini ta’minlash.
3. Ishlab chiqarish ustozi institutini kuchaytirish.
4. Talabalarni real ishlab chiqarish jarayonlariga jalb etish.
5. Qishloq xo‘jaligidagi mavsumiy texnologik jarayonlardan samarali foydalanish.
6. OTM va korxonalar o‘rtasida uzoq muddatli hamkorlikni rivojlantirish.
7. Talabalarning kasbiy kompetensiyalarini OTM va korxona vakillari ishtirokida baholash.
8. Dual ta’limni raqamli monitoring qilish va elektron portfoliodan foydalanish.
9. Ishlab chiqarishdagi real muammolarni kurs, diplom va ilmiy tadqiqot mavzulariga integratsiya qilish.
10. Ish beruvchilarning fikrlarini ta’lim dasturlarini takomillashtirishda hisobga olish.

Andijon qishloq xo‘jaligi va agrotexnologiyalar instituti tajribasi 60810100 – Qishloq xo‘jaligini mexanizatsiyalashtirish ta’lim yo‘nalishida dual ta’lim ishlab chiqarish korxonalari bilan hamkorlikda tashkil etilmoqda. Talabalar nazariy bilimlarini real ishlab chiqarish sharoitida mustahkamlash imkoniyatiga ega.

2026–2027 o‘quv yilida talabalar qishloq xo‘jaligining mavsumiy texnologik jarayonlariga jalb qilinmoqda. Jumladan, ular Boshiran 4MZD rusumli paxta terish

mashinalarining tuzilishi, ishlash prinsipi, texnologik imkoniyatlari va ekspluatatsiyasini amaliy sharoitda o‘rganmoqda. Shuningdek, texnik xizmat ko‘rsatish, diagnostika, nosozliklarni aniqlash va bartaraf etish, ta’mirlash hamda texnikalarni sozlash bo‘yicha amaliy ko‘nikmalar shakllantirilmoqda.

Keyingi bosqichlarda talabalar yerga ishlov berish, haydash, ekish, ekinlarni parvarishlash va o‘simliklarni himoya qilish jarayonlarida ishtirok etadilar. Natijada dual ta’lim qishloq xo‘jaligi ishlab chiqarishining real texnologik sikli bilan bog‘lanadi.

Dual ta’limning pedagogik samaradorligi talabaning nazariy bilimlarni real ishlab chiqarish sharoitida qo‘llashi orqali namoyon bo‘ladi. Bunday yondashuv texnik obyektni tahlil qilish, mashina va agregatlarni ishga tayyorlash, texnologik parametrlarni sozlash, texnik diagnostika o‘tkazish, nosozliklarni aniqlash, texnik xizmat va ta’mirlash hamda mehnat xavfsizligi talablariga rioya qilish kabi kasbiy kompetensiyalarni rivojlantiradi.

Dual ta’lim samaradorligini faqat amaliyot soatlari bilan emas, balki talabalar kompetensiyasi, nazariy bilimlarni amaliyotda qo‘llash qobiliyati, ish beruvchi bahosi, ishga joylashish darajasi, OTM va korxona hamkorligi hamda natijalarni monitoring qilish kabi mezonlar asosida baholash maqsadga muvofiq.

Tadqiqot natijalari shuni ko‘rsatadiki, dual ta’lim samaradorligi ta’lim muassasasi va ishlab chiqarish korxonasini oddiy mexanik birlashtirish bilan emas, balki ularning maqsadlari, ta’lim mazmuni, resurslari, amaliy faoliyati va baholash mezonlarini integratsiyalash orqali ta’minlanadi.

Dual ta’limda integratsiya uch asosiy bosqichda namoyon bo‘ladi: institutsional, tashkiliy va pedagogik integratsiya.

Andijon qishloq xo‘jaligi va agrotexnologiyalar institutining 60810100 – Qishloq xo‘jaligini mexanizatsiyalashtirish yo‘nalishidagi tajribasi ta’lim mazmunini real ishlab chiqarish jarayonlari bilan bog‘lash imkoniyatini ko‘rsatadi. Dual ta’limning strategik maqsadi talabani shunchaki ishlab chiqarish muhitiga olib kirish emas, balki ishlab chiqarish muhitini ta’lim jarayonining tarkibiy qismiga aylantirish orqali mehnat bozori talablariga mos raqobatbardosh mutaxassis tayyorlashdan iborat.

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ON THE INTERRELATIONSHIP BETWEEN AVERAGE ANNUAL AND GROWING SEASON STREAMFLOW OF RIVERS IN THE CHIRCHIK-OHANGARON BASIN

Abstract. *The article is devoted to the study of the relationship between the average annual and vegetation period flows of the rivers of the Chirchik-Akhangaron basin. For this purpose, rivers with a natural hydrological regime located in this basin were selected and they were brought into a single hydrological series. The average (hydrological) annual and vegetation period water flows were determined for each river. The correlation graphs of the hydrological year and vegetation period water flows were drawn. Regression equations of these relationships were constructed, and it was found that the values of the correlation coefficients vary in the range* r_0*=0,978±0,004÷0,991±0,001.*

Keywords: *mountain rivers, vegetation period, hydrological series, hydrological year, water discharge, regression equation, correlation coefficient, estimation.*

Introduction. The problems of forecasting the flow of mountain rivers during the vegetation period are of great practical importance in agriculture, in ensuring the stable and efficient operation of water management systems, in hydropower and in other sectors of the economy that use water and are water consumers. Therefore, the first studies aimed at studying this problem were carried out by E. M. Oldekop, L. K. Davidov, P. M. Mashukov, E. I. Girnik, A. M. Ovchinikov, B. A. Apollov, E. G. Popov, N. K. Lukina, N. F. Befani, I. P. Druzhinin, V. E. Chub and others. Currently, research in this area is being continued at the Hydrometeorological Research Institute of the Agency of the Republic of Uzbekistan - Uzhydromet - GMITI, by L.M. Karandaeva, and by researchers such as F.H. Hikmatov, G.H. Yunusov, and R.R. Ziyaev, D.M. Turgunov at the National University of Uzbekistan.

However, in these studies, the issues of correlation between the average annual and vegetation period flows of mountain rivers were neglected by researchers.

The main purpose of this work is the description of the relationship between the average annual and vegetation period flows of mountain rivers and their application in practice. In order to achieve the aim of the work, the following tasks were defined: to select rivers with a natural hydrological regime located in the Chirchik-Ohangaron basin and bring them to the same hydrological series; determination of average (hydrological) annual and vegetation water consumption for each selected dayo; draw graphs of interrelation of hydrological year and

vegetation water consumption ($Q_{gy}=f(Q_v)$); to determine the regression equations and correlation coefficients of these associations.

Analysis and results. In accordance with the purpose of the research and the tasks defined in it, 7 natural regime rivers in the Chirchik-Ohanagaron basin were selected as research objects (table 1).

Table 1

Some of the rivers of the Chirchik-Ohangaron basin hydrological indicators

T.r.	River – Station	F*, km²	H**, m	Observations		Recharge type***
				years	count	
1	Chotqol – Khudoydotsoy v.	6580	2660	1965-2021	56	S
2	Ugom – Khojakent v.	869	2700	1961-2021	60	S
3	Piskom – Mullala v.	2540	2740	1965-2021	56	SG
4	Oygaying – Confluence	1010	3010	1961-1968 1970-1997 2001-2021	56	SG
5	Maydontol – Confluence	471	3130	1961-2021	60	SG
6	Qizilcha – Ertosh v.	51,6	2340	1961-2021	60	S
7	Ohangaron – Ertosh r.c.	1110	2600	1971-2021	50	SR

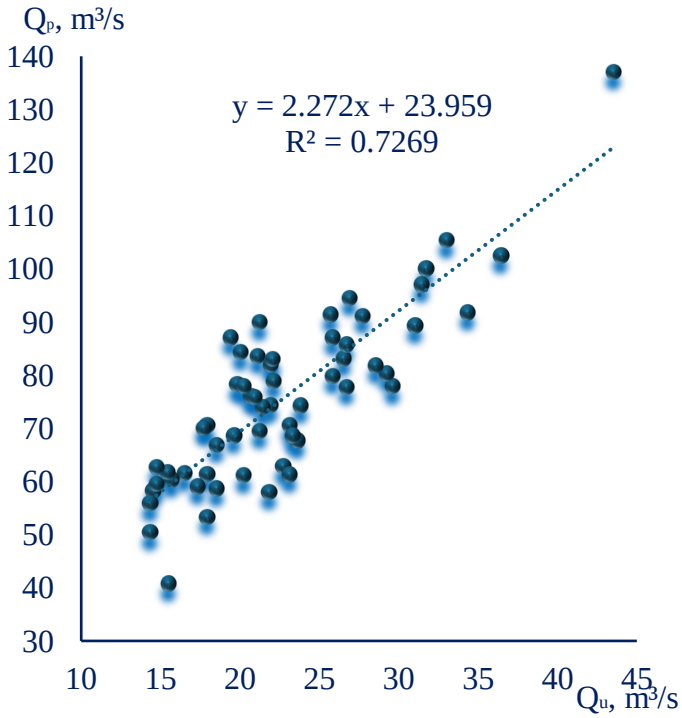
Note: *F* - water catchment (basin) area; H** - average height of the basin; *** - according to the classification of O.P.Shcheglova: QM - snow-ice, Q - snow, QYo - snow-rainwater.*

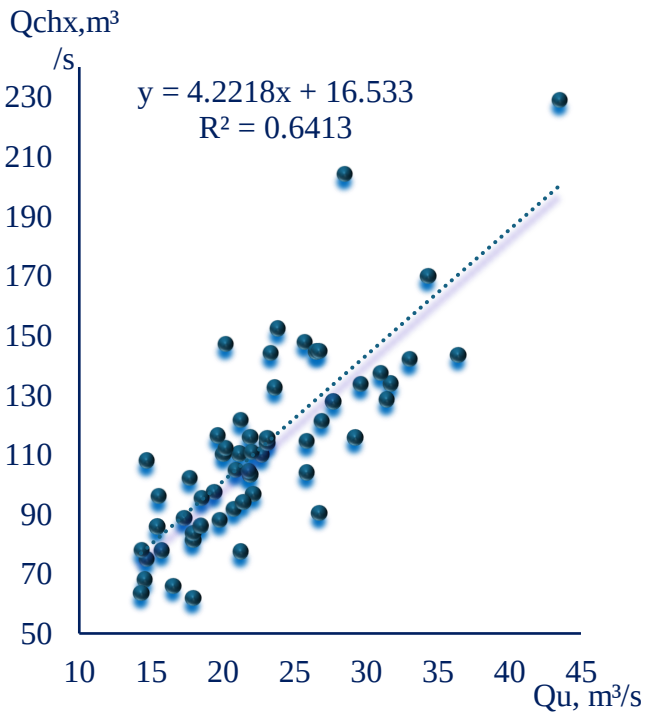
The data in the table above shows that there are some breaks in the years of observation. For example, in the Chatkal (Khudoydotsoy) and Piskom (Mullala) rivers, observations began in 1965, while in the Ahangaran (Ertosh) river, they began in 1971. There are breaks in the observation series in the Oigaing River in 1969, 1998-2000. In order to restore them, the relationships between the average monthly and annual water discharges of the Ugam River, which has a long series, and the short-range Chatkal, Piskom, Oigaing, and Ahangaran rivers were statistically evaluated (Figure 1). The correlation coefficients of the relationships between the average monthly and annual water discharges of the rivers were calculated (Table 2).

Table 2

Correlation coefficients of connections between average monthly and annual water consumption of rivers

T.r.	River	Ugom – Khojakent v.												
		Q_{I}	Q_{II}	Q_{III}	Q_{IV}	Q_{V}	Q_{VI}	Q_{VII}	Q_{VIII}	Q_{IX}	Q_{X}	Q_{XI}	Q_{XII}	Q_{y}
1	Chotqol	0,484	0,544	0,732	0,827	0,743	0,636	0,811	0,826	0,662	0,503	0,684	0,501	0,801
2	Ugom	0,609	0,551	0,580	0,789	0,733	0,728	0,910	0,786	0,669	0,642	0,717	0,517	0,853
3	Oygaying	0,503	0,409	0,351	0,371	0,660	0,885	0,915	0,775	0,430	0,487	0,811	0,482	0,882
4	Ohangaron	0,576	0,691	0,867	0,659	0,608	0,656	0,819	0,711	0,408	0,379	0,558	0,787	0,741





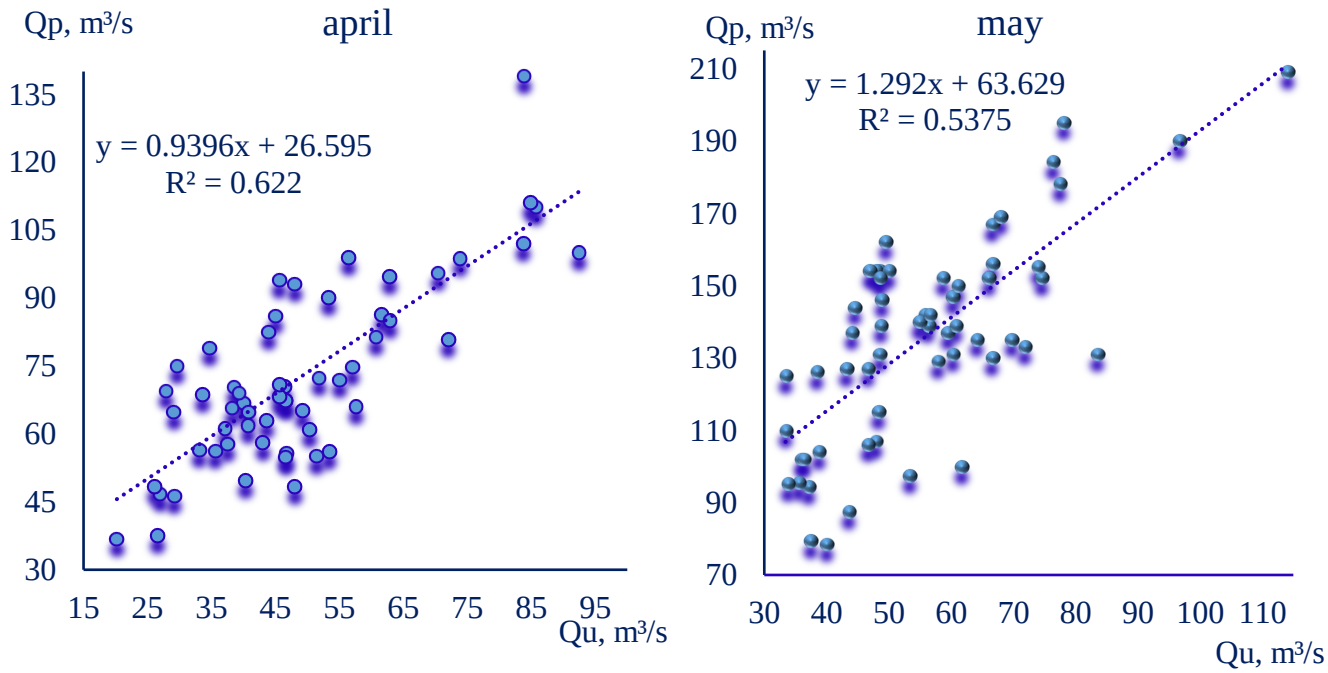
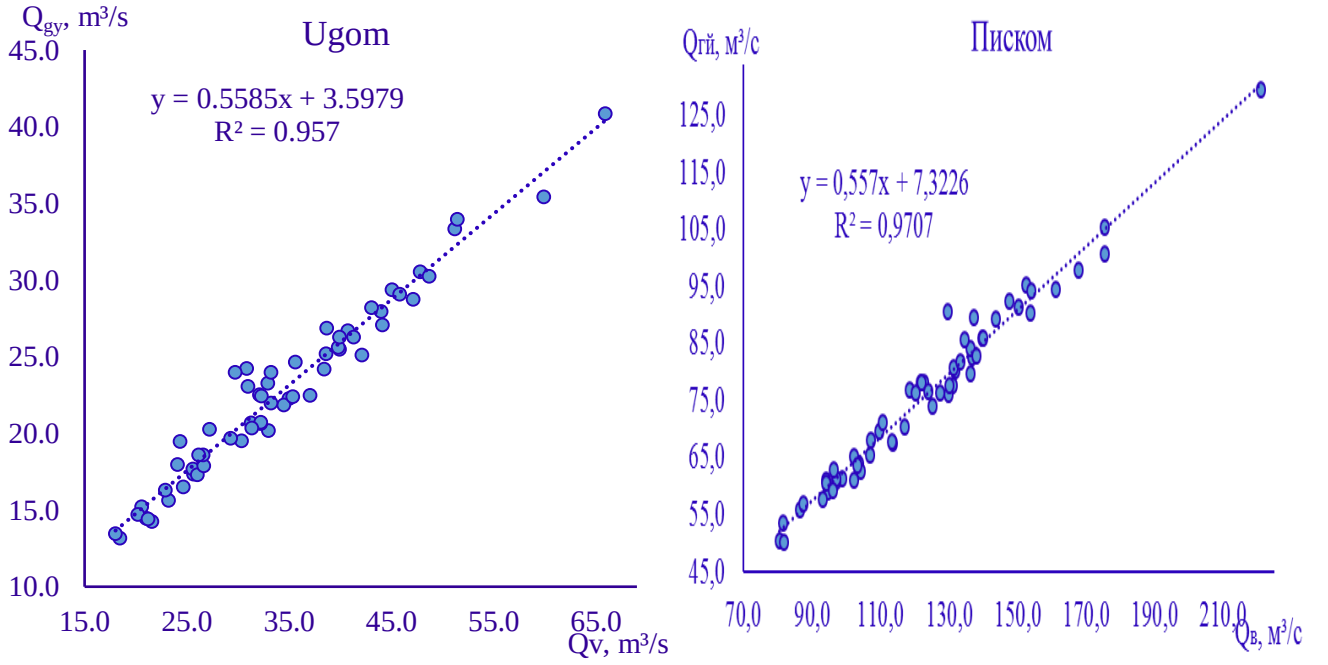


Figure 1. Correlation of average annual and monthly water discharges between short-series (Q_P, Q_{Chx}) and long-series (Q_U) analog rivers.

Note: *Q_P – Pskem (Mullala), Q_{Chx} – Chotqol (Khudoydotsoy), Q_U – Ugam (Khojikent).*

The pairwise correlation coefficients of the above-mentioned relationships and their error values were in the range of r=0,371±0,075÷0,915±0,014. The accuracy of these relationships fully meets the requirements for the accuracy of empirical equations recommended for use in hydrological calculations.



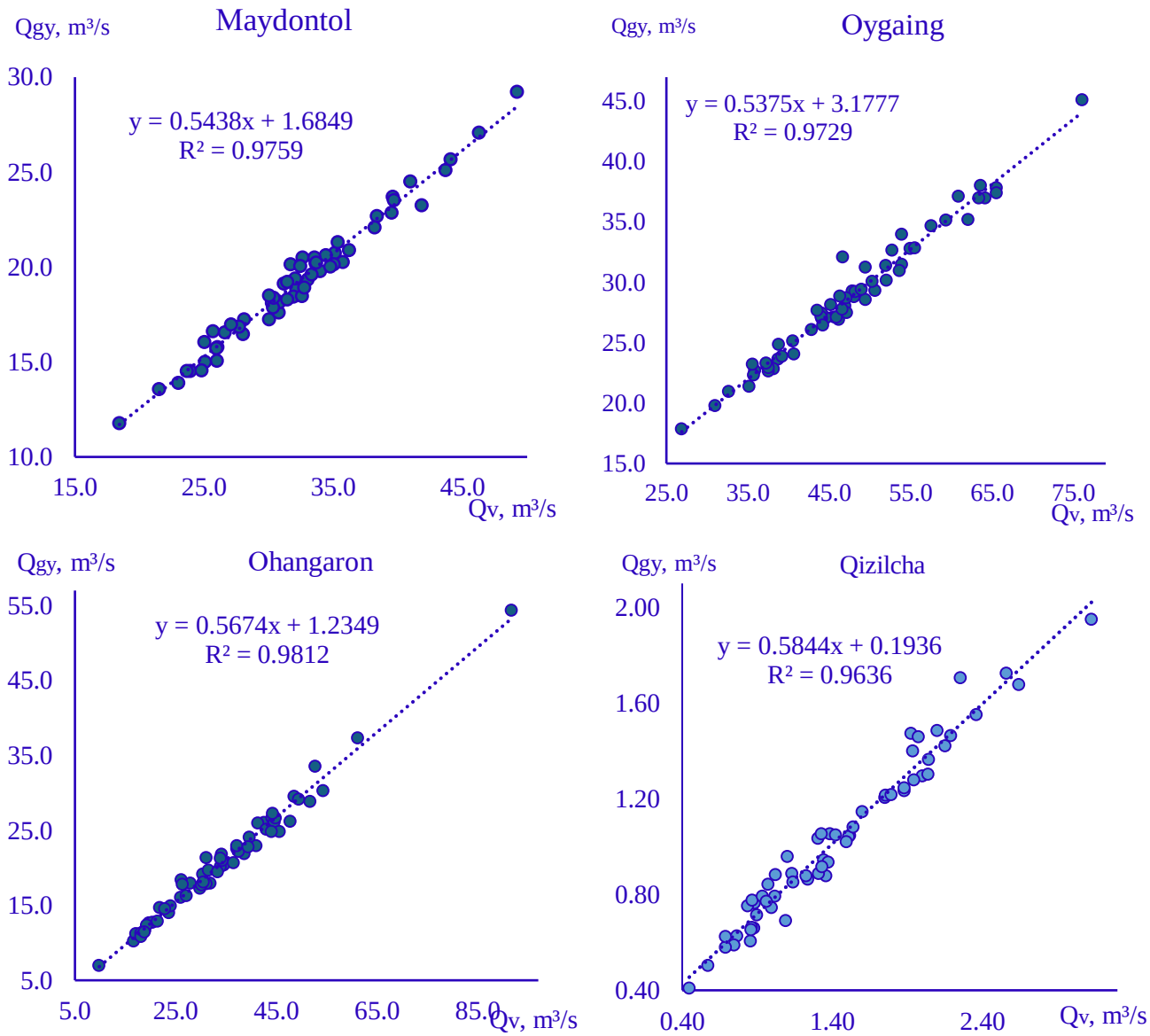


Figure 2. Graphs showing the relationship between water discharge rates for the hydrological year and the growing season

Taking into account this positive result, regression equations for all pairs were constructed. With their help, the existing discontinuities in the water discharges of the Chatkal, Piskom, Oigaing and Ahangaran rivers were restored. As a result, the water discharge data of the studied rivers were brought into a hydrological series covering the same calculation period, that is, 1961-2021. Based on the goals and objectives set in the study, the correlations between the hydrological year and the vegetation period water discharges for each river under study ($Q_{gy}=f(Q_v)$) were statistically evaluated (Fig. 2). Regression equations for these relationships were constructed, correlation coefficients were calculated, and their accuracy and error were assessed (Table 3).

Table 3

Regression equations and their accuracy

T.r.	River – Station	Regression equations	$r_0 \pm \sigma_{ro}$
1	Chotqol – Khudoydotsoy v.	$Q_{gy}=0,5585 \cdot Q_v +3,5979$	0,988 ± 0,002
2	Ugom – Khojakent v.	$Q_{gy}=0,756 \cdot Q_v +0,458$	0,978 ± 0,004
3	Piskom – Mullala v.	$Q_{gy}=0,557 \cdot Q_v +7,3226$	0,985 ± 0,003
4	Oygaying – Confluence	$Q_{gy}=0,756 \cdot Q_v +0,458$	0,986 ± 0,003
5	Maydontol – Confluence	$Q_{gy}=0,5438 \cdot Q_v +1,6849$	0,988 ± 0,002
6	Qizilcha – Ertosh v.	$Q_{gy}=0,756 \cdot Q_v +0,458$	0,982 ± 0,003
7	Ohangaron – Ertosh r.c.	$Q_{gy}=0,756 \cdot Q_v +0,458$	0,991 ± 0,001

Note: *$r_0 \pm \sigma_{ro}$ is the correlation coefficient and its error.*

The correlation coefficients of the regression equations presented in the table above varied in the following range: $r_o=0,978 \pm 0,004 \div 0,991 \pm 0,001$. Thus, their accuracy fully meets the requirements for expressions recommended for use in hydrological calculations and forecasts.

Conclusion. The results obtained in this study, carried out on the example of the rivers of the Chirchik-Akhangaron basin, have a certain scientific and practical significance. They can be used to solve issues related to hydrological calculations and forecasts related to the rivers of this basin. In the future, their importance will increase in predicting the amount of water discharged by rivers from existing and future reservoirs in the basin.

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THE IMPORTANCE OF THE INTERNET OF THINGS (IOT) IN IMPROVING THE EFFICIENCY OF FINANCIAL REPORTING FOR PRIVATE COMPANIES

Abstract: *This research aims to demonstrate the importance of financial reporting systems in providing information relevant to economic activity and to highlight the role of modern technologies, particularly the Internet of Things (IoT). It also examines the impact of IoT technology on improving and developing financial reporting systems in Iraq. Given the potential contribution of IoT to the Iraqi economy, the study explores ways of promoting its adoption in private companies and examines the extent to which company management can benefit from this technology.*

The researcher used an inductive approach to review and analyze studies related to corporate financial reporting and the use of the Internet of Things, and a deductive approach based on a field survey of financial managers, information technology managers, and specialists in financial reporting in Iraqi private companies. The questionnaire achieved a response rate of 84%, and the resulting data were used to test the research hypothesis and present the findings.

The researcher concluded that IoT technology can enhance the efficiency and effectiveness of accounting information systems by monitoring, measuring, and recording transactions and by facilitating the preparation of periodic financial reports through digital platforms. Furthermore, the study found a statistically significant relationship between the application of IoT technology and the efficiency and transparency of financial reporting in private companies.

Keywords: *Internet of Things (IoT), efficiency, financial reporting, private companies, international standards.*

Introduction

Contemporary accounting is facing rapidly evolving technological challenges associated with the Fourth Industrial Revolution. Traditional accounting information systems alone are increasingly insufficient to meet the needs of financial statement users in a dynamic and complex environment. Within this digital transformation, the Internet of Things (IoT) has emerged as an important

technological development. By connecting physical assets and operational processes and enabling data to flow automatically to accounting systems, IoT applications can enhance the efficiency and effectiveness of accounting functions through the monitoring, measurement, and recording of economic, environmental, and social transactions, as well as the preparation and delivery of periodic reports through digital platforms.

The Internet of Things (IoT) philosophy in the organizational environment is based on connecting physical devices and equipment to a digital network that enables data exchange without human intervention, creating an integrated information environment that merges operational and financial aspects. This technological integration primarily aims to address the shortcomings of traditional accounting models that rely on historical and periodic data, and to shift towards a "continuous accounting" model. This ensures the flow of high-quality financial information at a lower time cost. The importance of studying the impact of the Internet of Things on financial reporting is highlighted through two main axes: the first relates to the quality of accounting information; this technology contributes to enhancing the characteristics of relevance and honest representation by reducing human error and providing accurate measurements of inventory, production costs, and depreciation of fixed assets based on actual use rather than time estimates. The second relates to the efficiency of financial reports and their ability to support decision-making; real-time monitoring allows management and investors to access timely performance indicators that reflect the company’s actual financial condition at a given time, thereby reducing the information gap between stakeholders.

However, adopting IoT in financial reporting raises important questions concerning data security, privacy, and the ability of existing accounting standards to accommodate the large volume and variety of data generated by connected devices. Accordingly, this research explores the relationship between the use of IoT technologies and the efficiency of financial reporting, with particular attention to their potential role in improving financial transparency and confidence in accounting information. The research problem therefore concerns how IoT can be implemented, the challenges associated with its adoption, and its potential relationship with the efficiency of financial reporting. The study aims to determine the extent to which IoT technology affects the efficiency and quality of financial reporting in Iraqi private companies and to assess its potential contribution to the national economy.

Research hypothesis: The study is based on the following hypothesis: IoT technology has a statistically significant effect on the efficiency of financial reporting in private companies.

The theoretical background of the research:

Internet of Things (IoT)

The Internet of Things (IoT) is one of the most prominent technological transformations in the digital age. It refers to an interconnected network of physical devices equipped with sensors and software that enable them to collect, exchange, and analyze data over the internet without direct human intervention [1]. The core

idea is to transform traditional objects (industrial equipment, meters, vehicles, and machines) into smart companies capable of communicating, interacting and making semi-autonomous decisions based on the data flowing to them, and thus the role of the information system information system can move beyond merely recording events toward managing operations in a real-time and continuous manner [2].

The Internet connects people through social and commercial networks and through systems that facilitate business transactions, such as online banking and e-commerce [3]. In contrast, the Internet of Things connects machines and systems through sensors and actuators, enabling them to collect useful information and perform actions that can improve productivity and efficiency. IoT therefore extends the concept of connectivity beyond people to physical objects and operational systems. The technology has the potential to reduce waste, costs, and inconvenience while improving efficiency and the quality of services [4].

Objectives of the Internet of Things (IoT):

The objectives of the Internet of Things (IoT) are to integrate the physical and digital worlds in order to improve operational efficiency and information quality. A primary objective is to reduce operating costs through continuous process monitoring and the early detection of errors or deviations, thereby enabling rapid corrective action. IoT can also improve productivity by optimizing resource use and reducing waste and losses [5]. In accounting and finance, IoT can improve the accuracy and timeliness of accounting measurements by automating transaction recording and reducing the risk of human error. It can also provide real-time information to support decision-makers in assessing financial and operational performance [6].

In the Iraqi context, these objectives can contribute to supporting administrative and financial reform plans, especially given the need to improve transparency and oversight. Linking production systems to accounting enables the tax administration to access more accurate information about the volume of economic activity. Furthermore, IoT can support broader digital transformation by generating large datasets that can be analyzed using data analytics and artificial intelligence. This may improve market efficiency and reduce information gaps among stakeholders. Therefore, the objectives of IoT extend beyond process improvement to include strengthening trust in the wider economic environment [7].

Benefits of the Internet of Things: It offers many benefits, including: [8]

- Using smart technology in homes and offices can lead to reduced energy expenses, alter the interiors of buildings as per requirements of residents, offer safe security by way of consistent monitoring, and use proactive means such as informing the police authorities in case of a security risk.
- Remote patients and use of technology to provide better healthcare services.
- Reiteration of some assignments like the payment of utility bills and parking payment.
- Establishment of automatic streetlights and signals.
- Remote monitoring of production site can ensure improved productivity, dependability, and safety in manufacturing.

- Smart vehicles that can notify about potential troubles while also regulating the speed of the car as per environmental conditions.

These statistics illustrate the growth of the IoT market. The global private-market segment was valued at US$17.85 billion in 2018 and was projected to reach US$116.27 billion by 2026, representing growth of 26.5% during the forecast period. The Asia-Pacific region accounted for an 18.77% share of the global market in 2018. The increasing use of cloud-based IoT platforms is expected to accelerate IoT adoption across many financial sectors [9].

The Internet of Things consists of financial companies. In this case, it indicates the network of smart connected devices, including phones, household helpers, and pay systems, among others. These smart devices ensure improved payment and banking service provided to customers. The devices have efficient sensors integrated with the Internet infrastructure. The Internet connection is responsible for sending/receiving messages from these devices to each other through one platform.

Moreover, IoT solutions include hardware and software components that facilitate the transmission and receipt of relevant data between financial institutions and customers. These solutions can be used to understand customer demand, analyze customer behavior, and provide real-time analytics related to services such as credit and lending [10].

In banking, financial service providers can use IoT solutions to improve service availability and operational efficiency. For example, banks can monitor ATM usage in different locations and use this information to support decisions about whether to install, relocate, or remove ATMs. Non-bank financial companies (NBFCs) may also use IoT solutions to reduce operating costs [11].

Limitations of Internet of Things (IoT) Use:

Despite these benefits, the use of IoT also raises concerns about security and privacy. Smart meters, for example, can track the presence or absence of people in a home and can automatically control energy-consuming devices [12]. If such information falls into unauthorized hands, however, it may create significant security risks. Monitoring patients or older adults may also raise privacy concerns. More broadly, IoT can have unintended social consequences and may affect people’s behavior. Questions therefore remain regarding what data are collected, who can access them, and how they are used.

Concerns about privacy are not unique to IoT or other emerging technologies. Similar concerns have accompanied the introduction of new digital technologies, including email and cloud computing. How companies and organizations that provide IoT technologies address privacy and security concerns will significantly influence the outcomes of their adoption.

Components of the Internet of Things

An IoT system consists of interconnected components that work together to achieve specific objectives. The first component comprises smart devices and sensors, which collect data from the surrounding environment, including financial, production, and environmental data. These sensors initiate the information cycle

and are essential for obtaining data that accurately reflects real-world conditions. The second component comprises communication networks, which transmit data from connected devices to processing centers. These networks include the Internet, wireless networks, and other modern communication technologies. In Iraq, developing communications infrastructure is an important condition for successful IoT implementation, as unreliable connectivity can hinder the effective transmission of data [15].

The third component consists of data-processing and analytics platforms, where raw data are transformed into useful information. Big data analytics can be used to derive financial indicators that support financial reporting. Finally, application systems present the results to decision-makers and support appropriate action. In accounting, these applications can be integrated directly with accounting information systems to facilitate automated reporting [16]. Through the integration of these components, IoT can become a strategic tool for improving the efficiency and transparency of financial reporting in Iraq.

The Concept of Financial Reporting:

Financial reports are defined as the final output of an accounting information system, and they aim to communicate the results of accounting measurements to stakeholders in a clear and organized manner. They do not simply present figures, but also include interpretation and analysis that help users understand the financial position and economic performance of the entity. In the Iraqi context, financial reports are of particular importance due to the reliance of tax authorities and investors on them for decision-making. However, challenges facing the accounting system, such as weak disclosure or delays in reporting, affect the quality of available information [17].

Financial reporting is viewed as a means of achieving transparency and accountability, enabling external parties to assess management's efficiency in resource utilization. It also serves as a tool for measuring compliance with laws and regulations, including tax laws. Therefore, developing a financial reporting system in Iraq requires improving data quality and accuracy, which can be achieved through the integration of modern technologies such as the Internet of Things [18].

From the foregoing, financial reporting can be understood as more than the disclosure of financial statements. It also encompasses related disclosures, mechanisms for verifying the accuracy of reported information, and the provision of information that helps users make decisions. Accordingly, financial reporting is an important part of the broader organizational environment and is closely linked to the culture and ethical practices within it [19].

On the other hand, some believe that the task of financial accounting does not stop at producing accounting information, but rather it must deliver this information to the beneficiaries in a way that makes it easier for them to understand it, because it is not expected that all of those parties will have knowledge of accounting rules and terminology. This additional task of financial accounting is what is called financial reporting. The researcher believes that financial reporting refers to accounting for the financial performance of economic units, especially companies,

and the process of delivering it to the parties interested in the performance evaluation process, assuming that the information recorded in the report is for making decisions related to investment, borrowing, or acquisition to provide financial assistance. It also relates to the amount of taxes due on those economic units [20]. Reporting is not an end in itself, but rather a means of delivering data and information related directly or indirectly to the outputs of the accounting system. This gives the dynamic (non-stability) character to the objectives sought from financial reporting.

Financial reports are an important source of information for investors, creditors, and regulatory bodies when making decisions. They support assessments of profitability, liquidity, and solvency and can help users estimate future cash flows. In Iraq, financial reports are also important for determining the tax base because tax authorities rely on reported information when assessing taxable income. Consequently, weaknesses in the accuracy or transparency of financial reports may result in inaccurate or unfair assessments [21].

Financial reports also contribute to building trust between organizations and their stakeholders by demonstrating compliance with applicable accounting standards. Improving reporting quality through advanced digital systems may reduce opportunities for fraud and manipulation and may enhance the credibility of financial information in the Iraqi market.

Types of Financial Reports: International Accounting Standard (IAS) 1 specifies presentation requirements for financial statements and the information that should be included. The study identifies the following statements and disclosures [22]:

- Statement of Business Results (Income Statement), sometimes called the Profit and Loss Statement, shows the result of the company's business at the end of the fiscal year, whether it is a profit or a loss, according to generally accepted accounting principles and according to the accrual basis and matching the revenues of the financial period with its expenses.

- The statement of profit and loss distribution: Sometimes called the statement of retained earnings, it is considered an appendix to the income statement. The purpose of preparing it is to show how profits and losses are distributed, and to show that part of them that has not been distributed, which is called retained earnings, or carried forward to the next year.

- Statement of Financial Position (Balance Sheet). This includes the classification of assets and liabilities: the company must present a detailed classification of the balance sheet based on current and non-current assets and liabilities. If presenting the balance sheet based on the degree of liquidity of assets and liabilities provides more relevant and reliable information, the current and non-current categories can be omitted. In all cases, the company must separate items expected to be recovered within (12) months or paid after (12) months. This list shows the company's assets and liabilities at a specific point in time, which is the end of the financial year, and it must be balanced by applying the balance sheet equation: Assets = Liabilities or Assets = Liabilities and Equity.

- Statement of Changes in Financial Position: Sometimes called the statement of sources and uses of funds, it shows all the changes that have occurred to the elements of the financial position, whether increases or decreases. These changes are classified into sources of funds and their uses. This classification may be according to the effect of these changes on net working capital (the difference between current assets and current liabilities), and it must also be balanced [23].

- Notes: The notes should disclose the basis for the preparation of the financial statements, significant accounting policies, information required by International Financial Reporting Standards (IFRS) but not disclosed in the statements themselves, and additional information contained in the statements but required for further understanding. Notes should be presented regularly, and a reference should be made to the relevant note for each item in the statements.

The Impact of the Internet of Things on the Efficiency of Financial Reporting in the Iraqi Environment:

Implementing the Internet of Things (IoT) improves the efficiency of financial reporting by recording transactions instantly and reducing reliance on manual data entry. This minimizes errors and enhances data reliability. It also helps reduce information asymmetry, as different parties can access up-to-date and accurate data simultaneously. In Iraq, where institutions are striving to enhance transparency, this aspect is a crucial factor in building trust [24].

IoT can also support internal control systems through continuous monitoring of operational processes, potentially reducing opportunities for manipulation and fraud. Linking operational activities with accounting systems may improve the accuracy and timeliness of information used for tax assessment. Therefore, integrating IoT into the Iraqi business environment may contribute not only to technological improvement but also to institutional development, greater tax-system efficiency, and broader digital transformation [25].

The practical aspect of the study:

Population and Sample: The study population comprised individuals working in the technology sector and in financial reporting within Iraqi private companies. A total of 178 questionnaires were distributed, of which 150 were completed and returned, yielding a response rate of 84%.

Sample Characteristics: Table 1 presents the characteristics of the research sample.

Table (1) Properties of the research sample

Characteristics	**Numerical**	**%**
Gender		
Male	66	44%
Female	84	56%
Experience		

Characteristics	Numerical	%
Under 5	23	16%
5–10	44	29%
11–25	62	41%
Over 25	21	14%
Education		
Bachelor's	111	74%
Diploma	18	12%
Master's	16	11%
PhD	5	3%

- Gender: The results of the study indicate that the number of males was (66), which is 44% of the study sample, and the number of females was (84), which is 56% of females, which indicates that most of the employees in companies represented by banks are females.

- Number of years of experience: Regarding the number of years of experience, 41% of the study sample have 11–25 years of experience, and the lowest percentage, 14% of the study sample, has more than 25 years of experience. This indicates that experienced individuals are relied upon to perform duties in order to avoid any errors.

- Educational attainment: Those with a bachelor's degree constituted 74% of the study sample, representing the highest percentage, followed in second place by those with a diploma and a master's degree at 12% and 11%, respectively, and then a doctorate at 3%.

This can be represented as follows:

Figure 2: Description of the study sample

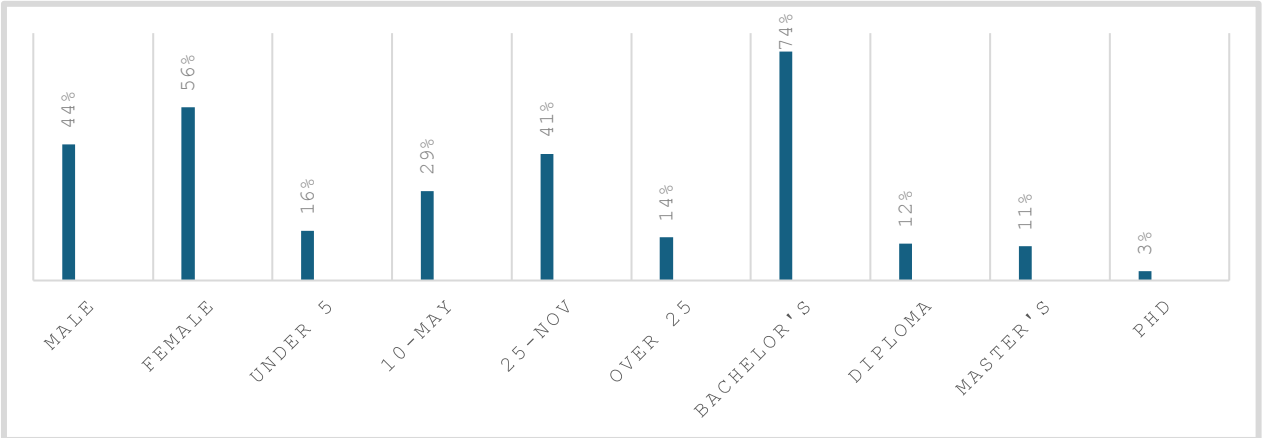


Table 2 presents the extent to which company management is interested in adopting Internet of Things (IoT) technology, based on respondents' answers to the questionnaire items.

Table 2: Analyzing the Results of the Importance of the Internet of Things

Number	Paragraph	Arithmetic Mean	Standard Deviation
1	The need for technology stems from the fact that the current systems and regulations prevailing in the company do not help to streamline performance and control its movement.	3.50	0.820
2	Adopting Internet of Things technology in all aspects of the work, where the company's management is keen to provide information and knowledge to stakeholders.	4.13	1.074
3	The company's current traditional systems do not help achieve speed of completion and economic performance.	4.00	0.695
4	The company's management sets expectations for changes in automation and the adoption of new technologies, including the Internet of Things.	3.80	0.925
5	Company management allocates a sufficient balance for research and development activities and the use of technology.	3.43	0.890
6	The company's management places great importance on research and development and the use of technology in order to design and develop its processes, products, and services to meet customer expectations.	4.07	0.907
7	The company's management is keen to identify the training needs of employees by relying on modern scientific methods of the Internet of Things.	3.73	1.015
8	The company's organizational structure allows for a rapid response to changes in different circumstances, reflecting its high flexibility due to the availability of a specialized technology department.	4.10	0.607

The table shows that Item 2, concerning the adoption of IoT technology across all aspects of work and the provision of information and knowledge to stakeholders, received the highest mean score (4.13) with a standard deviation of 1.07. This suggests a relatively high level of interest in adopting IoT technology and automating work processes. By contrast, Item 5, concerning the allocation of an adequate budget for research and development and technology, received the lowest

mean score (3.43) with a standard deviation of 0.89. This suggests that greater attention may be needed for technological investment and support.

Table 3 presents respondents' assessments of the relationship between IoT technology and financial reporting based on their responses to the relevant questionnaire items.

Table 3: The Relationship of Influence Between Variables

Arithmetic Mean	Standard Deviation	Paragraph	Number
4.23	0.679	Financial reports accurately reflect a company's results, operations, financial capabilities, and creditworthiness.	9
4.13	0.629	The financial report based on Internet of Things technology includes an explanation of the activity map that the company follows and an explanation of each step it takes.	10
4.37	0.809	Internet of Things (IoT) technology helps sustain financial reporting and create competitive value for the company through financial reports prepared accordingly.	11
4.43	0.626	Internet of Things (IoT) technology contributes to the analysis, presentation, and display of data and information in financial reports in a manner convenient for users.	12
4.37	0.809	Companies place paramount importance on the quality and efficiency of financial reporting in order to achieve competitiveness by adopting Internet of Things technology.	13
4.13	0.730	Private companies are interested in developing detailed policies that serve to improve the efficiency of financial reporting as a source of essential information for them.	14
3.37	0.159	Modern technology is influencing changes in the structure of financial reports.	15

The results in Table 3 indicate that Item 12, stating that IoT technology contributes to the analysis and presentation of financial-reporting data in a user-friendly manner, received the highest mean score (4.43) with a standard deviation of 0.626. This finding highlights respondents' strong assessment of the role of IoT in presenting financial information. Item 15, concerning the effect of modern technology on the structure of financial reports, received the lowest mean score (3.37) with a standard deviation of 0.159. This suggests that respondents perceive the primary effect of technology to be on reporting efficiency rather than on the structure of the reports.

3.4 Corrected Hypothesis Testing (ANOVA)

To test the research hypothesis, a simple linear regression analysis was conducted. Based on the sample size ($N = 150$), the degrees of freedom (df) for the regression model are $k = 1$, for the residual $N - k - 1 = 148$, and total $N - 1 = 149$. The recalculated ANOVA results are presented below:

Table 4: Corrected Hypothesis Testing (ANOVA Table, N = 150)

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	**4.223**	**1**			
Residual	**19.165**	**148**	**4.223**	**32.610**	**0.000**
Total	**23.388**	**149**	**0.1295**		

The statistical test yields an F-statistic of 32.610 with a significance level of $p = 0.000$ ($p < 0.05$). Consequently, the null hypothesis is rejected and the main research hypothesis is supported: *IoT technology has a statistically significant positive effect on the efficiency of financial reporting in private financial and banking institutions in Iraq.*

Conclusion

The Internet of Things (IoT) offers a range of potential benefits, including improved customer services, enhanced security, streamlined processes, and data-driven decision-making. As IoT technology continues to develop, its use may increasingly influence financial services by supporting innovation and operational efficiency. For financial institutions, appropriate adoption of IoT can therefore contribute to competitiveness and the ability to respond to changing customer needs in the digital age.

Financial reports also play a vital role in defining and shaping a company's financial policy. Furthermore, financial reporting, as represented by financial reports, has significantly contributed to the development of accounting by raising companies' awareness of the importance of using the Internet of Things (IoT) through organized training courses. The training explains the requirements and how to use such a mechanism to improve the quality of financial reports and to strengthen investor confidence in it, thereby increasing investment opportunities, especially in a technological environment, as it is witnessing information changes that have led to the emergence of many electronic applications. Business management should give the use of the Internet of Things (IoT) the attention and importance it deserves. This mechanism improves the efficiency of financial reporting, thereby reducing the level of accounting information asymmetry, and this is what the research hypothesis proved.

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LABALAR AXBOROT KOMPETENTLIGINING TARKIBIY TUZILMASI: XALQARO RAMKALARNING QIYOSIY TAHLILI ASOSIDA

Annotatsiya. *Maqolada raqamli ta’lim muhitida talabalarning axborot kompetentligini tavsiflovchi xalqaro ramkalar – DigComp 2.2, ACRL, SCONUL “Yetti ustun” modeli va YUNESKO raqamli savodxonlik global ramkasi qiyosiy tahlil qilingan. Tahlil natijasida ramkalar axborot faoliyatining kognitiv va operatsion jihatlarida yakdil ekani, motivatsion-qadriyatli va refleksiv jihatlar esa notekis yoritilgani aniqlangan. Shu asosda “talabalarning axborot kompetentligi” tushunchasining ishchi ta’rifi va uning motivatsion-qadriyatli, kognitiv, operatsion-faoliyatli hamda refleksiv-baholovchi komponentlardan iborat tarkibiy tuzilmasi taklif etilgan.*

Kalit so‘zlar: *axborot kompetentligi, axborot savodxonligi, raqamli kompetensiya, DigComp, raqamli ta’lim muhiti, oliy ta’lim, ta’lim platformasi.*

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THE STRUCTURE OF STUDENTS’ INFORMATION COMPETENCE: A COMPARATIVE ANALYSIS OF INTERNATIONAL FRAMEWORKS

Abstract. *The article presents a comparative analysis of international frameworks describing students’ information competence in the digital learning environment: DigComp 2.2, the ACRL Framework, the SCONUL Seven Pillars model and the UNESCO Global Framework of Reference on Digital Literacy Skills. The frameworks were found to converge on the cognitive and operational aspects*

of information activity, while the motivational-value and reflective aspects are unevenly represented. On this basis, a working definition of students' information competence and its structure comprising motivational-value, cognitive, operational-activity and reflective-evaluative components are proposed.

Keywords: *information competence, information literacy, digital competence, DigComp, digital learning environment, higher education, learning platform.*

Kirish. Oliy ta'limning raqamli transformatsiyasi bitiruvchiga qo'yiladigan talablarni tubdan o'zgartirdi. Bilimlar tez eskiradigan, axborot esa ko'p, sifati turlicha va tobora ko'proq sun'iy intellekt tomonidan yaratiladigan sharoitda axborotga bo'lgan ehtiyojni anglash, uni topish, tanqidiy baholash va mas'uliyat bilan foydalanish qobiliyati oliy ta'limning asosiy natijalaridan biriga aylandi.

Respublikamizda oliy ta'limni raqamlashtirish davlat siyosatining ustuvor yo'nalishi sifatida belgilangan. Oliy ta'lim tizimini 2030-yilgacha rivojlantirish konsepsiyasi [1] va "Raqamli O'zbekiston – 2030" strategiyasi [2] OTMlarda raqamli texnologiyalarni keng joriy etish vazifasini qo'ygan. Barcha OTMlarda yagona HEMIS axborot tizimi faoliyat yuritmoqda. Biroq bu tizimdan asosan boshqaruv maqsadlarida foydalanilmoqda [16], uni talabalar axborot kompetentligini rivojlantirishga yo'naltirish uchun esa avvalo ushbu kompetentlikning aniq tarkibiy tuzilmasi zarur.

Xalqaro miqyosda axborot kompetentligini tavsiflovchi bir nechta ramka mavjud. Ular turli atamalar (savodxonlik, kompetensiya, ko'nikma), turli tavsif birliklari (soha, freym, ustun) va baholashga turlicha yondashuvlardan foydalanadi. Shu bois OTM yoki ta'lim platformasini loyihalovchi mutaxassis qaysi elementlarni qabul qilish va ularni qanday uyg'unlashtirish masalasiga duch keladi.

Maqolaning maqsadi – axborot kompetentligini tavsiflovchi yetakchi xalqaro ramkalarni qiyosiy tahlil qilish va talabalar axborot kompetentligining integrativ tarkibiy tuzilmasini ishlab chiqishdan iborat.

Adabiyotlar tahlili. "Axborot savodxonligi" atamasini 1974-yilda P.Zurkowski ilmiy muomalaga kiritgan va uni muammolarni hal qilishda axborot vositalari hamda manbalaridan foydalanish qobiliyati bilan bog'lagan [3]. Keyinchalik Amerika kutubxonalar assotsiatsiyasi axborot savodxonligini axborotga ehtiyojni anglash, uni topish, baholash va samarali foydalanish qobiliyati sifatida ta'rifladi [4]. C.Bruce fenomenografik tadqiqot asosida axborot savodxonligi yagona ko'nikmalar to'plami emas, balki axborot bilan munosabatning sifat jihatdan turli tajribalari ekanini ko'rsatdi [5].

MDH pedagogikasida esa "axborot madaniyati" va "axborot kompetentligi" atamalari keng tarqalgan. Ular kompetensiyaviy yondashuvga tayanadi va kompetentlikni bilim, ko'nikma, tajriba hamda motivatsiyani birlashtiruvchi integrativ shaxsiy sifat sifatida talqin etadi [11; 12]. F.Weinert ham kompetensiyani kognitiv qobiliyatlar, motivatsion yo'nalganlik va ularni muammolarni hal qilishda qo'llash qobiliyatining birligi sifatida ta'riflagan [10].

Ta’limni axborotlashtirish va o‘qituvchilarning axborot-kommunikatsiya kompetentligi masalalari I.V.Robert [17], M.P.Lapchik [18], Ye.K.Xenner va A.P.Shestakova [19], M.B.Lebedeva va O.N.Shilova [20] tadqiqotlarida, respublikamizda esa U.Sh.Begimqulov [21], A.A.Abduqodirov [22] va boshqalarning ishlarida o‘rganilgan. Muallifning avvalgi tadqiqotida raqamli pedagogik muhitda talabalarning axborot kompetentligini rivojlantirish modeli hamda baholashning reproduktiv, produktiv va ijodiy darajalariga asoslangan mezonlar ishlab chiqilgan [23; 24]. Mazkur maqola ushbu natijalarni davom ettirib, axborot kompetentligining tarkibiy tuzilmasini xalqaro ramkalar bilan qiyoslash asosida aniqlashtiradi.

Tadqiqotda uchta yaqin tushuncha farqlandi. *Axborot savodxonligi* – axborot bilan ishlashning bazaviy ko‘nikmalari; *axborot madaniyati* – axborot faoliyatining qadriyat va me’yorlar tizimi; *axborot kompetentligi* – bilim, ko‘nikma, tajriba va shaxsiy sifatlarni real o‘quv va kasbiy vazifalarda qo‘llashga tayyorlik. *Raqamli kompetensiya* esa axborot kompetentligini o‘z tarkibiga oluvchi kengroq tushunchadir.

Tadqiqot metodologiyasi. Tadqiqotda qiyosiy hujjatlar tahlili usuli qo‘llanildi. Ramkalar to‘rt mezon asosida tanlandi: xalqaro miqyosga egalik; oliy ta’lim yoki talabalarni qamrab oluvchi aholi uchun mo‘ljallanganlik; amaldagi rasmiy maqom; to‘liq hujjatlarning ochiqligi. Ushbu mezonlarga DigComp 2.2 [8], ACRL ramkasi [6], SCONUL “Yetti ustun” modeli [7] va YUNESKO raqamli savodxonlik global ramkasi [9] javob berdi.

Tahlil uch bosqichda olib borildi. Birinchi bosqichda har bir ramkaning maqsadi, tavsif birligi va darajalar tuzilmasi aniqlandi. Ikkinchi bosqichda ramkalar mazmuni kompetensiyaviy yondashuvdan kelib chiqqan beshta o‘lchov bo‘yicha kodlandi: kognitiv, operatsion, motivatsion-qadriyatli, refleksiv va axloqiy-huquqiy. Har bir o‘lchovning yoritilganligi “aniq”, “qisman” yoki “bilvosita” deb baholandi. Uchinchi bosqichda natijalar umumlashtirilib, integrativ tuzilma ishlab chiqildi.

Natijalar. Tahlil qilingan ramkalarning asosiy tavsifi 1-jadvalda keltirilgan.

1-jadval. Tahlilga kiritilgan xalqaro ramkalar

Ramka	Ishlab chiquvchi, yil	Tavsif birligi	Darajalar
DigComp 2.2	Yevropa Komissiyasi (JRC), 2022	5 soha, 21 kompetensiya	8 daraja
ACRL ramkasi	Amerika kollej va tadqiqot kutubxonalari assotsiatsiyasi, 2016	6 freym: bilim amaliyotlari va dispozitsiyalar	Rasmiy darajalar yo‘q
SCONUL “Yetti ustun”	Buyuk Britaniya milliy va universitet kutubxonalari jamiyati, 2011	7 ustun: “tushunadi” va “qila oladi” tavsiflari	Boshlovchidan ekspertgacha, operatsionallashtirilmagan
YUNESKO global ramkasi	YUNESKO statistika instituti, 2018	DigComp asosida 7 soha	DigComp darajalari

DigComp 2.2 axborot kompetentligini raqamli kompetensiyaning birinchi sohasi – “axborot va ma’lumotlar savodxonligi” sifatida tavsiflaydi. U axborotni izlash va saralash, baholash hamda boshqarish kompetensiyalarini o‘z ichiga oladi. Mualliflik huquqi va shaxsiy ma’lumotlarni himoya qilish kabi elementlar boshqa sohalarda joylashgan. Ramka o‘lchash va o‘z-o‘zini baholash uchun mo‘ljallangan.

ACRL ramkasi ko‘nikmalar ro‘yxatidan voz kechib, oltita o‘zaro bog‘liq freymga tayanadi. Masalan, “Obro‘ kontekstual va konstruktsiya qilingan” hamda “Axborot qadrga ega” freymlari bilim amaliyotlari va dispozitsiyalar orqali tavsiflanadi. Bu ramka shaxsiy-qadriyatli jihatni aniq yoritadi, ammo daraja va baholash vositalarini belgilamaydi.

SCONUL modeli axborot vazifasi mantiqiga mos yetti ustunni ajratadi: aniqlash, qamrovni belgilash, rejalashtirish, yig‘ish, baholash, boshqarish va taqdim etish. YUNESKO ramkasi esa DigComp tuzilmasini qabul qilib, uni qurilma va dasturlar bilan ishlash hamda kasbga oid kompetensiyalar bilan to‘ldiradi.

O‘lchovlar bo‘yicha qiyosiy tahlil natijalari 2-jadvalda berilgan.

2-jadval. Ramkalarda kompetentlik o‘lchovlarining yoritilganligi

O‘lchov	DigComp 2.2	ACRL	SCONUL	YUNESKO
Kognitiv	Aniq	Aniq	Aniq	Aniq
Operatsion	Aniq	Qisman	Aniq	Aniq
Motivatsion-qadriyatli	Qisman	Aniq	Qisman	Qisman
Refleksiv	Qisman	Aniq	Qisman	Qisman
Axloqiy-huquqiy	Aniq	Aniq	Qisman	Aniq

Izoh: baholar muallifning manba hujjatlarni kodlashi natijasidir.

Jadvaldan uchta qonuniyat ko‘rinadi. Birinchidan, barcha ramkalar axborot faoliyatining kognitiv va operatsion yadrosida yakdil: ehtiyojni aniqlash, izlash, baholash, boshqarish va taqdim etish ketma-ketligi har bir ramkada turli nomlar bilan uchraydi. Ikkinchidan, motivatsion-qadriyatli va refleksiv o‘lchovlar notekis yoritilgan: ko‘nikmaga yo‘naltirilgan ramkalarda ular asosan misollar orqali berilgan, ACRLda esa aniq yoritilgan, lekin darajalar tuzilmasisiz. Natijada birorta ramka rivojlangan shaxsiy o‘lchovni o‘lchanadigan darajalar bilan uyg‘unlashtirmaydi. Uchinchidan, axloqiy-huquqiy jihatlar barcha ramkalarda mavjud, ammo generativ sun’iy intellektdan axborot manbai sifatida foydalanish masalasi hali batafsil yoritilmagan, garchi uning baholash va akademik halollikka ta’siri keng muhokama qilinayotgan bo‘lsa ham [13].

Tahlil asosida quyidagi ishchi ta’rif taklif etiladi: *talabalarning axborot kompetentligi – raqamli ta’lim muhitida o‘quv va kasbiy vazifalarni hal qilish uchun axborotga bo‘lgan ehtiyojni aniqlash, uni izlash, tanqidiy baholash, qayta ishlash, yangi axborot yaratish va undan xavfsiz hamda akademik halollik me’yorlariga muvofiq foydalanishga tayyorlik va qobiliyatni ifodalovchi integrativ shaxsiy-kasbiy sifat.*

Ushbu ta’rif asosida axborot kompetentligining to‘rt komponentli tuzilmasi ishlab chiqildi (3-jadval). Barcha ramkalarga xos operatsion yadro operatsion-

faoliyatli komponentni tashkil etadi. Motivatsion-qadriyatli va refleksiv-baholovchi komponentlar ACRL dispozitsiyalari va kompetensiyaviy yondashuvga tayanib, aniqlangan bo‘shliqni to‘ldiradi. Axloqiy-huquqiy me’yorlar alohida komponent sifatida emas, balki barcha komponentlarni qamrab oluvchi talab sifatida qaraldi. Chunki akademik halollik bir vaqtning o‘zida qadriyat, bilim, amaliyot va refleksiya obyektidir.

3-jadval. Talabalar axborot kompetentligining tarkibiy tuzilmasi

Komponent	Mazmuni	Ko‘rsatkichlar
Motivatsion-qadriyatli	Axborot faoliyatiga ehtiyoj va qiziqish, akademik halollikni qadriyat sifatida qabul qilish	Axborotni mustaqil izlashga intilish; manbaga havola berish zaruratini anglash
Kognitiv	Manba turlari, qidiruv strategiyalari, ilmiy bazalar, mualliflik huquqi, axborot xavfsizligi haqidagi bilimlar	Ilmiy va noilmiy manbalarni farqlash; qidiruv operatorlari va bazalarni bilish
Operatsion-faoliyatli	Axborotni izlash, baholash, qayta ishlash, yaratish va taqdim etish ko‘nikmalari	Ishonchli manbani tanlash; axborotni umumlashtirib yangi mahsulot yaratish
Refleksiv-baholovchi	O‘z axborot faoliyatini tahlil qilish va takomillashtirish	O‘z xatolarini aniqlash; natijani mezon asosida baholash

Baholash uchun DigComp darajalar mantiqini muallifning avvalgi tadqiqotida qo‘llangan reproduktiv, produktiv va ijodiy darajalar bilan uyg‘unlashtirish mumkin [23]. Bu har bir komponent, jumladan motivatsion va refleksiv komponentlar bo‘yicha ham mezon va darajalarni ishlab chiqishga imkon beradi.

Muhokama. Natijalar sohadagi tarqoqlik ziddiyatdan ko‘ra urg‘ular farqi ekanini ko‘rsatadi. Ramkalar talaba axborot bilan nima qila olishi kerakligi borasida kelishadi, ammo kompetentlik talabaning axborot foydalanuvchisi sifatidagi motivlari, qadriyatlari va o‘zini anglashini ham qamrab olishi kerakmi degan savolda farqlanadi. Taklif etilgan tuzilma umumiy operatsion yadroni saqlab qolgan holda kompetensiyaviy yondashuv ta’kidlaydigan shaxsiy o‘lchovni tiklaydi.

Tuzilma raqamli ta’lim muhitini loyihalash uchun bevosita ahamiyatga ega. Ta’lim platformalari talabalar faoliyati haqida katta hajmdagi ma’lumotlarni saqlaydi, o‘quv analitikasi esa ularni o‘qish jarayoni haqidagi dalillarga aylantiradi [14]. Platformadagi o‘quv topshiriqlari to‘rt komponent asosida loyihalansa, platforma nafaqat kontent yetkazish, balki axborot kompetentligini tizimli rivojlantirish va monitoring qilish vositasiga aylanadi. Bu barcha OTMlarda qo‘llaniladigan HEMIS kabi yagona milliy tizimlar uchun ayniqsa muhim: umumiy tuzilma asosidagi pedagogik yechimlarni respublika miqyosida joriy etish mumkin bo‘ladi. Shuningdek, aniq tuzilma o‘qituvchilarga texnologik, pedagogik va mazmuniy bilimlarni integratsiyalagan holda [15] topshiriq va baholashni rejalashtirish uchun umumiy asos beradi.

Xulosa. Tadqiqotda axborot kompetentligini tavsiflovchi to‘rtta xalqaro ramka qiyosiy tahlil qilindi. Ularda kognitiv va operatsion elementlardan iborat barqaror umumiy yadro borligi, motivatsion, refleksiv va axloqiy o‘lchovlar esa

notekis yoritilgani aniqlandi. Shu asosda talabalar axborot kompetentligining ishchi ta’rifi va to‘rt komponentli tuzilmasi taklif etildi, axloqiy-huquqiy me’yorlar esa barcha komponentlarni qamrab oluvchi talab sifatida belgilandi.

Keyingi tadqiqotlarda taklif etilgan tuzilmani ekspert baholash va talabalar ma’lumotlari asosida empirik tasdiqlash, har bir komponent uchun baholash vositalarini ishlab chiqish hamda HEMIS platformasida ushbu tuzilma asosida loyihalangan o‘quv faoliyatining samaradorligini tekshirish rejalashtirilgan.

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MADANIYATLARARO KOMPETENSIYA MODELLARINING TIPOLOGIYASI VA ULARNING TALABALAR MADANIYATLARARO KOMMUNIKATIV SALOHIYATINI TADQIQ ETISHDAGI AHAMIYATI

Annotatsiya. *Maqolada madaniyatlararo kompetensiyaning xorijiy nazariy modellari B. Spitsberg va G. Changnon tipologiyasi asosida qiyosiy tahlil qilingan. Komponentli, birgalikda yo‘nalganlik, rivojlanish, moslashuv va sabab-oqibatli modellarning mazmuni, kuchli tomonlari va cheklovlari ochib berilgan. M. Byram, A. Fantini, M. Bennett, Y.Y. Kim, W. Gudykunst, D. Deardorff modellari hamda Yevropa Kengashining demokratik madaniyat kompetensiyalari doirasi qiyoslangan. Tahlil asosida talabalarning madaniyatlararo kommunikativ salohiyatini tadqiq etishning integrativ yondashuvi taklif etilgan: salohiyat tarkibi komponentli va birgalikda yo‘nalganlik modellari, darajalari rivojlanish modeli, rivojlanish mexanizmi esa sabab-oqibatli model asosida belgilanadi.*

Kalit so‘zlar: *madaniyatlararo kompetensiya, model tipologiyasi, komponentli model, rivojlanish modeli, sabab-oqibatli model, madaniyatlararo kommunikativ salohiyat, integrativ yondashuv, lingvomadaniy yondashuv.*

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A TYPOLOGY OF INTERCULTURAL COMPETENCE MODELS AND ITS RELEVANCE FOR RESEARCHING STUDENTS' INTERCULTURAL COMMUNICATIVE POTENTIAL

Abstract. *The article compares foreign models of intercultural competence using the typology proposed by B. Spitzberg and G. Changnon. It examines the content, strengths and limitations of compositional, co-orientational, developmental, adaptational and causal path models. The models of M. Byram, A. Fantini, M. Bennett, Y.Y. Kim, W. Gudykunst and D. Deardorff, as well as the*

Council of Europe's Reference Framework of Competences for Democratic Culture, are compared. Based on the analysis, an integrative approach to researching students' intercultural communicative potential is proposed: its structure is defined through compositional and co-orientational models, its levels through a developmental model, and its development mechanism through a causal path model.

Keywords: *intercultural competence, typology of models, compositional model, developmental model, causal path model, intercultural communicative potential, integrative approach, linguocultural approach.*

KIRISH

Ta'limning globallashuvi sharoitida madaniyatlararo kompetensiya oliy ta'lim bitiruvchisining asosiy natijalaridan biri sifatida qaralmoqda. Biroq bu tushunchani tadqiq etishda jiddiy metodologik muammo mavjud: xorijiy adabiyotda madaniyatlararo kompetensiyaning yigirmadan ortiq modeli ishlab chiqilgan va ular tarkib, tuzilma hamda rivojlanish mexanizmini turlicha talqin qiladi [1]. Til va madaniyatlararo kommunikatsiya bo'yicha xalqaro qo'llanmalarda ham ushbu yondashuvlarning xilma-xilligi alohida ta'kidlanadi [2].

Modellarning ko'pligi pedagogik tadqiqotchi oldiga muhim tanlov qo'yadi. Bir modelni tanlash tadqiqotning boshqa jihatlarini e'tibordan chetda qoldirishi mumkin, modellarni tizimsiz aralashtirish esa nazariy asosning izchilligini buzadi. D. Deardorff ta'kidlaganidek, madaniyatlararo kompetensiyani talaba natijasi sifatida baholash uchun avvalo uning aniq nazariy ta'rifi va tuzilmasini belgilash zarur [3].

Maqolaning maqsadi – madaniyatlararo kompetensiyaning asosiy xorijiy modellarini tipologik asosda qiyosiy tahlil qilish va talabalarning madaniyatlararo kommunikativ salohiyatini tadqiq etish uchun integrativ nazariy asosni asoslash.

TADQIQOT METODOLOGIYASI

Tadqiqotda nazariy tahlil, qiyosiy-tipologik tahlil, tizimlashtirish va umumlashtirish usullari qo'llanildi. Modellarni tasniflash uchun B. Spitsberg va G. Changnon tipologiyasi tanlandi [1]. Ushbu tipologiyaga ko'ra modellar besh guruhga ajratiladi: komponentli (kompozitsion), birgalikda yo'nalganlik (ko-orientatsion), rivojlanish, moslashuv va sabab-oqibatli (kauzal) modellar.

Har bir guruhdan oliy ta'lim va chet tili ta'limida eng ko'p qo'llaniladigan modellar tanlab olindi. Ular to'rt mezon bo'yicha qiyoslandi: model turi, asosiy tarkibiy qismlari, til omilining o'rni va talabalarning madaniyatlararo kommunikativ salohiyatini tadqiq etish uchun ahamiyati.

NATIJALAR VA MUHOKAMA

Komponentli modellar. Bu guruhdagi modellar madaniyatlararo kompetensiyaning tarkibiy qismlarini – bilimlar, ko'nikmalar, munosabatlar va motivatsiyani – sanab o'tadi, biroq ular o'rtasidagi aloqa mexanizmini ochib bermaydi [1]. Mazkur guruhning tipik namunasi D. Deardorffning piramidal modelidir: unda munosabatlar (hurmat, ochiqlik, qiziquvchanlik) asosni tashkil etadi, ular ustida bilim va ko'nikmalar, yuqorida esa ichki va tashqi natijalar joylashadi [3].

Keng qamrovli komponentli yondashuvning zamonaviy namunasi Yevropa Kengashining demokratik madaniyat kompetensiyalari doirasidir. Unda qadriyatlar, munosabatlar, koʻnikmalar hamda bilim va tanqidiy tushunish guruhlariga birlashtirilgan 20 ta kompetensiya ajratilgan va ularning har biri uchun deskriptorlar ishlab chiqilgan [4]. Komponentli modellarning afzalligi – tarkibning aniqligi va oʻlchashga qulayligi; cheklovi – rivojlanish dinamikasini aks ettirmasligi.

Birgalikda yoʻnalganlik modellari. Bu modellar madaniyatlararo muloqotda maʼnolarning oʻzaro kelishilishi, umumiy tushunishga erishish jarayonini tavsiflaydi. Ular muloqotning dialogik tabiatini taʼkidlaydi va madaniyatlararo vositachilik koʻnikmalarini rivojlantirishga asos boʻladi [1].

B. Spitsberg va G. Changnon ushbu guruhga M. Byramning madaniyatlararo kommunikativ kompetensiya modelini kiritadi. M. Byram modelida lingvistik, sotsiolingvistik va diskursiv kompetensiyalar madaniyatlararo kompetensiya bilan birlashadi. Madaniyatlararo kompetensiya esa bilimlar, talqin qilish va bogʻlash koʻnikmalari, kashf etish va oʻzaro taʼsir koʻnikmalari, munosabatlar hamda tanqidiy madaniy anglashdan iborat [5]. Muloqot ishtirokchisi bu yerda “ona tili sohibi”ga taqlid qiluvchi emas, balki madaniyatlar oʻrtasida vositachilik qiluvchi “madaniyatlararo soʻzlovchi” sifatida qaraladi.

Mazkur guruhga A. Fantini modeli ham kiradi. Olim madaniyatlararo kompetensiyaning toʻrt oʻlchovini (bilimlar, munosabatlar, koʻnikmalar, anglash – awareness) va uch sifat xususiyatini (munosabatlarni oʻrnatish va saqlash, minimal buzilishlar bilan muloqot qilish, umumiy manfaat uchun hamkorlik qilish) ajratadi hamda mezbon mamlakat tilini bilishni kompetensiyaning muhim sharti deb hisoblaydi [6]. Bu guruh modellari til omiliga eng katta ahamiyat beradi, shuning uchun ular lingvomadaniy yondashuv bilan bevosita uygʻun keladi.

Rivojlanish modellari. Bu modellar madaniyatlararo kompetensiyaning vaqt davomida bosqichma-bosqich rivojlanishini tavsiflaydi. Ularning eng mashhuri M. Bennettning madaniyatlararo sezgirlik rivojlanishi modeli (DMIS) boʻlib, unda etnotsentrik (inkor, himoyalanish, minimallashtirish) va etnorelyativ (qabul qilish, moslashish, integratsiya) bosqichlar ajratiladi [7]. Shu model asosida M. Hammer, M. Bennett va R. Wiseman madaniyatlararo rivojlanish inventarini (IDI) yaratgan [8]. Rivojlanish modellari salohiyat darajalarini aniqlashda nazariy tayanch boʻladi, biroq ular kompetensiyaning lingvistik jihatini deyarli qamrab olmaydi.

Moslashuv modellari. Bu guruh modellari madaniyatlararo muloqot jarayonida shaxsning oʻzga madaniy muhitga moslashuvini markazga qoʻyadi. Y.Y. Kimning integrativ nazariyasiga koʻra, madaniyatlararo moslashuv “stress – moslashuv – oʻsish” dinamikasi orqali kechadi va shaxsning muloqot kompetensiyasi bu jarayonning asosiy omili hisoblanadi [9]. Moslashuv va noaniqlik muammosiga yaqin yondashuvni W. Gudykunstning xavotir va noaniqlikni boshqarish (AUM) nazariyasi taklif etadi: unga koʻra samarali muloqot xavotir va noaniqlik darajasini maqbul chegarada ushlab turish va ongli eʼtibor bilan bogʻliq [10]. Bu yondashuvlar salohiyatning refleksiv-shaxsiy, emotsional-irodaviy jihatlarini asoslashda muhim.

Sabab-oqibatli modellar. Bu modellar kompetensiya tarkibiy qismlari o‘rtasidagi bog‘liqliklarni va ularning muloqot natijalariga ta’sirini tavsiflaydi [1]. D. Deardorffning jarayonli modeli shu guruhning eng ko‘p qo‘llaniladigan namunasidir: unda munosabatlar bilim va ko‘nikmalarni shakllantiradi, ular ichki natija (moslashuvchanlik, empatiya, etnorelyativ qarash) va tashqi natijaga (samarali va maqbul muloqot) olib keladi. Jarayon esa uzluksiz davom etuvchi spiral tarzida kechadi: tashqi natija munosabatlarga qayta ta’sir qiladi [3]. Bu model kompetensiyani “tugallanadigan” natija emas, balki umr bo‘yi rivojlanadigan jarayon sifatida talqin qilish imkonini beradi.

Modellarning qiyosiy tahlili. Tahlil qilingan modellarning asosiy xususiyatlari 1-jadvalda umumlashtirilgan.

1-jadval. Madaniyatlararo kompetensiyaning asosiy nazariy modellari qiyosiy tahlili

Model (muallif)	Model turi	Asosiy tarkibiy qismlar	Til omilining o‘rni	Tadqiqot uchun ahamiyati
D. Deardorff, piramidal model (2006)	Komponentli	Munosabatlar, bilim va ko‘nikmalar, ichki va tashqi natija	O‘rtacha: sotsiolingvistik anglash bilim tarkibida	Salohiyat tarkibini aniqlash
Yevropa Kengashi (2018)	Komponentli (keng qamrovli)	Qadriyatlar, munosabatlar, ko‘nikmalar, bilim va tanqidiy tushunish (20 kompetensiya)	Yuqori: lingvistik, kommunikativ va plyurilingval ko‘nikmalar	Mezon va deskriptorlarni ishlab chiqish
M. Byram (1997)	Birgalikda yo‘nalganlik	Bilimlar, talqin va bog‘lash, kashf etish va o‘zaro ta’sir ko‘nikmalari, munosabatlar, tanqidiy madaniy anglash	Markaziy: lingvistik, sotsiolingvistik va diskursiv kompetensiyalar bilan birlikda	Tarkib va ta’lim maqsadlarini belgilash
A. Fantini (2009)	Birgalikda yo‘nalganlik	Bilimlar, munosabatlar, ko‘nikmalar, anglash; mezbon til	Yuqori: mezbon tilni bilish muhim shart	Lingvomadaniy komponentni asoslash
M. Bennett (1993)	Rivojlanish	Etnotsentrik va etnorelyativ bosqichlar	Bilvosita	Salohiyat darajalarini ajratish
Y.Y. Kim (2001), W. Gudykunst (2004)	Moslashuv	Stress – moslashuv – o‘sish; xavotir va noaniqlikni boshqarish, ongli e’tibor	Bilvosita	Refleksiv-shaxsiy komponentni asoslash
D. Deardorff, jarayonli model (2006)	Sabab-oqibatli	Munosabatlar → bilim va ko‘nikmalar → ichki va tashqi natija (spiral)	O‘rtacha	Rivojlanish mexanizmini asoslash

Qiyosiy tahlil shuni ko‘rsatadiki, modellarning birortasi ham madaniyatlararo muloqotga tayyorlikning barcha jihatlarini to‘liq qamrab olmaydi. Komponentli modellar tarkibni aniq belgilaydi, lekin rivojlanish dinamikasini aks ettirmaydi. Rivojlanish modellari esa, aksincha, bosqichlarni tavsiflaydi, biroq lingvistik omilni deyarli e’tiborga olmaydi. Til omiliga eng katta ahamiyat beruvchi birgalikda yo‘nalganlik modellari esa kompetensiyaning rivojlanish bosqichlarini aniq ajratmaydi.

Integrativ yondashuv. Aniqlangan cheklovlar talabalarning madaniyatlararo kommunikativ salohiyatini tadqiq etishda modellarni integrativ asosda birlashtirish zarurligini ko‘rsatadi. Taklif etilayotgan yondashuvda har bir model guruhi salohiyatni tadqiq etishning muayyan jihatiga javob beradi (2-jadval).

2-jadval. Integrativ yondashuvda model guruhlarining vazifalari

Tadqiqot jihati	Tayanch model(lar)	Pedagogik natija
Salohiyatning tarkibi	Komponentli va birgalikda yo‘nalganlik modellari (M. Byram, A. Fantini, Yevropa Kengashi)	Motivatsion-qadriyatli, kognitiv-lingvomadaniy, kommunikativ-faoliyatli va refleksiv-shaxsiy komponentlar
Salohiyat darajalari	Rivojlanish modeli (M. Bennett)	Reproduktiv, produktiv va ijodiy darajalar
Rivojlanish mexanizmi	Sabab-oqibatli model (D. Deardorff)	Uzluksiz, spiral tarzida kechuvchi rivojlanish jarayoni
Emotsional-refleksiv jihat	Moslashuv modellari (Y.Y. Kim, W. Gudykunst)	Noaniqlikka chidamlilik va refleksiv o‘zini-o‘zi boshqarish
Birlashtiruvchi o‘q	Til va madaniyat birligi (C. Kramsch, A. Liddicoat, A. Scarino)	Lingvomadaniy mazmun barcha komponentlarni bog‘laydi

Integrativ yondashuvda lingvomadaniy komponent barcha tarkibiy qismlarni birlashtiruvchi o‘q vazifasini bajaradi. Bu C. Kramschning til va madaniyatni ajralmas birlikda o‘qitish haqidagi qarashlariga [11] hamda A. Liddicoat va A. Scarinoning madaniyatlararo til ta’limi tamoyillariga [12] mos keladi. Salohiyat darajalarini baholashda esa CEFR qo‘shimcha jildidagi plyurimadaniy repertuar va vositachilik deskriptorlaridan foydalanish maqsadga muvofiq [13].

XULOSA

O‘tkazilgan tahlil asosida quyidagi xulosalarga kelindi.

1. B. Spitsberg va G. Changnon tipologiyasi madaniyatlararo kompetensiya modellarini tizimli tahlil qilish va ularning har biri kompetensiyaning qaysi jihatini yoritishini aniqlash imkonini beradi.

2. Komponentli modellar tarkibni, birgalikda yo‘nalganlik modellari muloqotning dialogik va lingvistik tabiatini, rivojlanish modellari bosqichlarni, moslashuv modellari emotsional-refleksiv jihatni, sabab-oqibatli modellar esa rivojlanish mexanizmini yoritadi.

3. Modellarning birortasi ham madaniyatlararo muloqotga tayyorlikni to‘liq qamrab olmaganligi sababli talabalarning madaniyatlararo kommunikativ salohiyatini tadqiq etishda integrativ yondashuv maqsadga muvofiq.

4. Integrativ yondashuvda lingvomadaniy komponent birlashtiruvchi o‘q vazifasini bajaradi. Bu esa salohiyatni takomillashtirishning pedagogik modelini ishlab chiqish uchun izchil nazariy asos yaratadi.

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YO‘LOVCHI TASHISH BOZORIDA RAQOBATBARDOSH XIZMATLARNING IQTISODIY MOHIYATI VA MAZMUNI

Annotatsiya: *Maqolada yo‘lovchi tashish bozorida «raqobatbardosh xizmat» kategoriyasining iqtisodiy mohiyati yoritilgan, xizmatni iqtisodiy ne'mat sifatida va raqobatni xo‘jalik yurituvchi subyektlar o‘rtasidagi o‘zaro ta'sir shakli sifatida tushunishga oid nazariy yondashuvlar umumlashtirilgan. Yo‘lovchi tashish raqobatbardosh xizmatining mazmuni uning tarkibiy elementlari — narx, sifat, vaqt, servis va raqamli elementlar — orqali aniqlangan, shuningdek ushbu bozordagi raqobatning ikki tomonlama xarakteri (turlararo va turichi) ochib berilgan. Yo‘lovchi tashish xizmatlarining raqobatbardoshligini shakllantiruvchi omillar temir yo‘l transportini isloh qilishning hozirgi bosqichi doirasida tizimlashtirilgan.*

Kalit so‘zlar: *xizmat, raqobat, raqobatbardosh xizmat, yo‘lovchi tashish, transport xizmatlari bozori, raqobatbardoshlik, temir yo‘l transporti.*

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THE ECONOMIC ESSENCE AND CONTENT OF COMPETITIVE SERVICES IN THE PASSENGER TRANSPORTATION MARKET

Abstract: *The article reveals the economic essence of the category «competitive service» as applied to the passenger transportation market, summarizes theoretical approaches to understanding service as an economic good and competition as a form of interaction among economic entities. The content of a competitive passenger transportation service is defined through its structural elements — price, quality, time, service and digital — and the dual nature of competition in this market (inter-modal and intra-modal) is disclosed.*

Keywords: *service, competition, competitive service, passenger transportation, transport services market, competitiveness, railway transport.*

Kirish. Bozor xo‘jalik yuritish tamoyillariga o‘tish va avvalgi yagona temir yo‘l operatorining mustaqil xo‘jalik yurituvchi subyektlarga institutsional bo‘linishi sharoitida yo‘lovchi tashish bozorining faoliyat yuritishi «raqobatbardosh xizmat» kategoriyasining iqtisodiy mazmunini aniqlashtirish zaruratini obyektiv ravishda

dolzarblashtiradi. Umuman olganda raqobat nazariyasi va xizmatlar iqtisodiyotiga bag‘ishlangan sezilarli tadqiqotlar mavjud bo‘lishiga qaramay, yo‘lovchi tashishning o‘ziga xosligiga — tabiiy monopoliya belgilarini (infratuzilma) va potensial raqobatbardosh segmentni (bevosita tashish) birlashtiruvchi tarmoq sohasiga — nisbatan ushbu kategoriya etarli darajada ishlab chiqilmagan. Bu esa xizmatlarning raqobatbardoshligini baholash, tarif siyosatini shakllantirish va yo‘lovchi tashish operatorlarining rivojlanish strategiyalarini ishlab chiqishda uslubiy qiyinchiliklarni keltirib chiqaradi, bu esa 2023-yilda boshlangan O‘zbekiston Respublikasi temir yo‘l transportini isloh qilish tajribasida o‘z tasdig‘ini topmoqda.

Maqolaning maqsadi — xizmatlar iqtisodiyoti va raqobat nazariyasiga oid nazariy yondashuvlarni umumlashtirish asosida yo‘lovchi tashish bozorida «raqobatbardosh xizmat» kategoriyasining iqtisodiy mohiyatini aniqlashtirish va mazmunini ochib berishdan iborat.

Asosiy qism. Iqtisodiy nazariyada xizmat an'anaviy ravishda bir qator o‘ziga xos belgilarga ega bo‘lgan alohida turdagi iqtisodiy ne'mat sifatida qaraladi: nomoddiylik (xizmatni iste'mol qilinguncha sezgi organlari orqali baholab bo‘lmaydi); manbadan ajralmaslik (xizmatni ishlab chiqarish va iste'mol qilish jarayonlari, odatda, vaqt jihatidan bir-biriga to‘g‘ri keladi); sifat beqarorligi (xizmat sifati ijrochiga, ko‘rsatilish joyi va vaqtiga bog‘liq); saqlanmaslik (xizmatni zaxiraga ishlab chiqarib, omborda saqlab bo‘lmaydi). Yo‘lovchi tashish xizmatiga nisbatan ushbu belgilar eng yaqqol shaklda namoyon bo‘ladi: poyezd jo‘nab ketguncha sotilmagan o‘rindiqni keyinchalik sotib bo‘lmaydi, bu esa tashuvchi operatorlar uchun daromadni boshqarish (revenue management)ning alohida ahamiyatini belgilaydi.

Klassik iqtisodiy nazariyada «raqobat» kategoriyasi bozor subyektlarining o‘zaro ta'sir shakli sifatida ta'riflanadi, bunda ularning mustaqil harakatlari har birining bozordagi tovar va xizmatlar muomalasining umumiy shartlariga bir tomonlama ta'sir ko‘rsatish imkoniyatini samarali cheklaydi. Zamonaviy raqobat strategiyalari nazariyasining asoschisi M. Porter beshta raqobat kuchi modelini (mavjud o‘yinchilar o‘rtasidagi raqobat, yangi ishtirokchilar tahdidi, o‘rnini bosuvchi tovarlar tahdidi, etkazib beruvchilarning bozor kuchi va iste'molchilarning bozor kuchi) asoslab bergan bo‘lib, u tarmoq o‘ziga xosligini hisobga olgan holda yo‘lovchi tashish bozori tahliliga moslashtirilishi mumkin: o‘rnini bosuvchi tovarlar tahdidi bu erda turlararo raqobat (aviatsiya, avtomobil transporti) sifatida, mavjud o‘yinchilar o‘rtasidagi raqobat esa turli toifadagi poyezd operatorlari o‘rtasidagi turichi raqobat sifatida namoyon bo‘ladi.

«Xizmat» va «raqobat» kategoriyalarining sintezi «raqobatbardosh xizmat» tushunchasini — bozordagi o‘xshash yoki o‘rnini bosuvchi xizmatlarga nisbatan iste'molchi tomonidan barqaror afzal ko‘rilishini ta'minlaydigan iste'mol xususiyatlari (narx, sifat, vaqt) majmuiga ega bo‘lgan xizmat sifatida — shakllantirish imkonini beradi.

Shuni ham hisobga olish lozimki, yo‘lovchi tashish xizmati bir vaqtning o‘zida shaxsiy va ijtimoiy ahamiyatga molik ne'mat belgilariga ega. Bir tomondan,

u individual iste'molchi tomonidan pulli asosda sotib olinadi va talab-taklifning umumiy qonunlariga bo'ysunadi; ikkinchi tomondan, aholining keng qatlamlari uchun ommaviy yo‘lovchi tashishning mavjudligi an'anaviy ravishda davlat tomonidan ijtimoiy infratuzilma elementi sifatida qaraladi, bu esa raqobat rivojlangan sharoitda ham ayrim tashish turlari bo‘yicha tartibga solinadigan tariflarning saqlanib qolishini belgilaydi. Ushbu holat yo‘lovchi tashish raqobatbardosh xizmatini klassik tovar bozorlaridagi raqobatbardosh xizmatlardan sezilarli farqlaydi va uning iqtisodiy mazmunini tahlil qilishda alohida uslubiy yondashuvni talab qiladi.

Yo‘lovchi tashish raqobatbardosh xizmatining mazmuni uning iste'mol qiymatini va shunga mos ravishda bozordagi raqobat mavqeini shakllantiruvchi o‘zaro bog‘liq tarkibiy elementlar majmui orqali ochib beriladi (jadval).

Jadval

Yo‘lovchi tashish raqobatbardosh xizmatining tarkibiy elementlar

Tarkibiy element	Element mazmuni	Ko‘rsatkichlarga misollar
Narx	Yo‘l narxining aholi daromadlari va muqobil transport turlari tariflari bilan solishtirilgan holati	1 yo‘lovchi-km uchun tarif, aholi daromadiga nisbati
Sifat	Harakatlanuvchi tarkibning qulayligi, sanitariya-gigiyena sharoitlari, safar xavfsizligi	Vagon yoshi va klassi, avariyalik ko‘rsatkichlari
Vaqt	Vokzal/stansiyaga borish va kutish vaqtini ham o‘z ichiga olgan yo‘ldagi umumiy vaqt	Yo‘lda o‘tgan vaqt, jo‘nab ketish chastotasi
Servis	Safar davomida va vokzalda ko‘rsatiladigan qo‘shimcha xizmatlar	Ovqatlanish, Wi-Fi, vokzal infratuzilmasining holati
Raqamli	Onlayn bron qilish, elektron chipta va axborot bilan ta'minlash imkoniyati	Elektron sotuvlar ulushi, mobil ilova mavjudligi

Yo‘lovchi tashish bozorining o‘ziga xosligi raqobatning ikki tomonlama xarakteridan iborat. Turlararo raqobat temir yo‘l, aviatsiya va avtomobil transporti o‘rtasida bir xil yo‘nalishlardagi yo‘lovchi oqimi uchun yuzaga keladi, bunda har bir transport turi o‘ziga xos raqobat afzalliklariga ega: aviatsiya transporti asosan vaqt omili bo‘yicha, avtomobil transporti — qisqa masofalarda marshrut moslashuvchanligi va narx bo‘yicha, temir yo‘l transporti esa narx, xavfsizlik va bashorat qilinuvchanlik nisbati bo‘yicha raqobatlashadi. Turichi raqobat esa temir yo‘l transportining o‘zi ichida operatorlar va poyezd toifalari o‘rtasida namoyon bo‘ladi — masalan, ommaviy (plaskart, umumiy) tashishlar bilan yuqori qulaylikdagi tashishlar o‘rtasida, sohaning institutsional bo‘linishi sharoitida esa

bozorning turli segmentlarini (tezyurar va ommaviy tashishlarni) xizmat koʻrsatuvchi mustaqil operatorlar oʻrtasida.

Ta'kidlash joizki, yoʻlovchi tashish raqobatbardosh xizmatining mazmuni faqat narx omiliga bogʻliq emas. Avvalgi yagona temir yoʻl operatorining tarmoq tashkilotlariga institutsional boʻlinishidan keyingi sohaning amaliyoti shuni koʻrsatadiki, tegishli sifat va vaqt samaradorligi darajasi bilan qoʻllab-quvvatlanmagan narx afzalligi faqat cheklangan va beqaror raqobatbardoshlikni ta'minlaydi, chunki aholi daromadlarining oʻsishi bilan iste'molchi afzalliklari xizmatning sifat parametrlari tomon siljiy boradi.

Koʻrsatilgan tarkibiy elementlar oʻzaro almashinuv va oʻzaro kuchayish munosabatlarida boʻladi. Xizmatning sifat komponenti etarli darajada boʻlmasa (masalan, eskirgan harakatlanuvchi tarkib), bu qisman narx afzalligi bilan qoplanishi mumkin, biroq bunday qoplashning obyektiv chegaralari mavjud: iste'molchi kutgan sifat bilan mavjud sifat oʻrtasidagi nomuvofiqlik ma'lum chegaradan oshganda, narx afzalligi yoʻlovchi oqimini ushlab turishni toʻxtatadi, bu esa yoʻlda oʻtgan vaqt farqi sezilarli boʻlgan yoʻnalishlarda yoʻlovchi oqimining asta-sekin aviatsiya va avtomobil transporti foydasiga qayta taqsimlanishida oʻz tasdigʻini topmoqda. Aksincha, xizmatning raqamli va servis komponentlarini yaxshilash (masalan, elektron chiptani va axborotlandirish tizimini joriy etish) tarifni bevosita oshirmasdan xizmatning idrok etiladigan qiymatini kuchaytirishga, ya'ni iste'molchi xarajatlari oʻzgarmagan holda raqobatbardoshlikni oshirishga qodir.

Uslubiy nuqtai nazardan yoʻlovchi tashish xizmatining statik va dinamik raqobatbardoshligini farqlash maqsadga muvofiqdir. Statik raqobatbardoshlik ma'lum bir vaqt momentida operator xizmatining tarkibiy elementlari bilan uning raqobatchilari xizmati oʻrtasidagi joriy nisbatni aks ettiradi va tariflar, yoʻldagi vaqt hamda sifat xususiyatlarini qiyosiy tahlil qilish orqali oʻlchanishi mumkin. Dinamik raqobatbardoshlik esa operatorning oʻz xizmati tarkibini vaqt davomida iste'molchilarning oʻzgaruvchan afzalliklariga va raqobatchilarning harakatlariga moslashtira olish qobiliyatini tavsiflaydi, bu esa tarif tartibga solinishining bosqichma-bosqich liberallashuvi va yoʻlovchi tashish bozorida yangi ishtirokchilarning paydo boʻlishi sharoitida alohida ahamiyat kasb etadi.

Yoʻlovchi tashish xizmatlari raqobatbardoshligini shakllantiruvchi omillar.

Yoʻlovchi tashish xizmatlari raqobatbardoshligini shakllantirishga ta'sir etuvchi omillarni boshqaruv darajalari boʻyicha tizimlashtirish maqsadga muvofiqdir. Makrodarajada davlat tarif va investitsiya siyosati, infratuzilma va tashish faoliyatining institutsional boʻlinish darajasi, raqobat qonunchiligining rivojlanish darajasi hal qiluvchi ahamiyatga ega. Mezodarajada (tarmoq va hudud darajasida) transport infratuzilmasining holati, transport tarmogʻining zichligi, muayyan yoʻnalishlarda muqobil qatnov turlarining mavjudligi kabi omillar amal qiladi. Mikrodarajada (alohida operator darajasida) raqobatbardoshlik harakatlanuvchi tarkibning holati, daromadni boshqarish sifati, xizmatlarning

raqamlashtirish darajasi va marketing siyosatining samaradorligi ta'sirida shakllanadi.

Taklif etilgan omillar tizimlashtirilishining amaliy ahamiyati shundaki, u yo‘lovchi tashish operatorlariga raqobatbardoshlikni boshqarishning tabaqalashtirilgan strategiyasini shakllantirish imkonini beradi: o‘zining (mikrodaraja) sa'y-harakatlarini bevosita boshqarish mumkin bo‘lgan xizmat tarkibiy elementlariga (xizmat sifati, raqamli servislar, daromadni boshqarish) yo‘naltirish bilan bir vaqtda, mezo- va makrodarajadagi o‘zgarishlar (infratuzilma operatori bilan hamkorlik, sohaning tarif va investitsiya siyosatini shakllantirishda ishtirok etish) tashabbuskori sifatida ham chiqish.

Xulosa. O‘tkazilgan tadqiqot shuni xulosa qilish imkonini beradiki, yo‘lovchi tashish raqobatbardosh xizmati narx, sifat, vaqt, servis va raqamli komponentlarning birligi orqali mazmuni ochib beriladigan murakkab, ko‘p elementli iqtisodiy kategoriyadir. Ushbu bozordagi raqobatning ikki tomonlama xarakteri — turlararo va turichi — yo‘lovchi tashish operatorlaridan ham narx, ham narxsiz raqobatbardoshlik omillarini hisobga oluvchi tabaqalashtirilgan raqobat xatti-harakati strategiyasini shakllantirishni talab qiladi. Maqolada aniqlashtirilgan «raqobatbardosh xizmat» kategoriyasining iqtisodiy mazmuni, jumladan O‘zbekiston Respublikasi islohot qilinayotgan temir yo‘l tarmog‘i sharoitida faoliyat yurituvchi aniq yo‘lovchi tashish operatorlariga nisbatan raqobatbardoshlikni baholash metodikalarini va uni oshirish bo‘yicha amaliy tavsiyalarni ishlab chiqish uchun nazariy asos bo‘lib xizmat qilishi mumkin.

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EKOTURIZM FAOLIYATINI SHAKLLANISHINING TARIXIY ASPEKTLARI VA GEOGRAFIK HUSUSIYATLARI

Annotatsiya: *Ushbu maqolada global turizm sanoatining jadal rivojlanayotgan va ekologik barqarorlikni ta'minlashga qaratilgan yo'nalishi bo'lmish ekoturizmning shakllanish tarixi va geografik xususiyatlari ilmiy va nazariy jihatdan tahlil qilinadi. Ekoturizm tushunchasining kelib chiqishi, XX asrning ikkinchi yarmidagi ekologik harakatlar hamda uning bugungi kundagi regional tarqalish qonuniyatlari ko'rib chiqilgan. Tadqiqotda ekoturistik resurslarning dunyo mintaqalari bo'yicha taqsimlanishi, geografik omillarning ekoturizm klasterlariga ta'siri va mahalliy hamjamiyatlar bilan integratsiyalashuvi baholanadi.*

Kalit so'zlar: *ekoturizm, barqaror turizm, geografik omillar, rekreatsiya resurslari, milliy parklar, biologik xilma-xillik.*

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EKOTURIZM FAOLIYATINI SHAKLLANISHINING TARIXIY ASPEKTLARI VA GEOGRAFIK HUSUSIYATLARI

Annotation: *This article provides a scientific and theoretical analysis of the historical development and geographical features of ecotourism, one of the rapidly developing sectors of the global tourism industry aimed at ensuring environmental sustainability. It examines the origins of the concept of ecotourism, the environmental movements of the second half of the twentieth century, and the patterns of its current regional distribution. The study evaluates the distribution of ecotourism resources across different regions of the world, the influence of geographical factors on the formation of ecotourism clusters, and their integration with local communities.*

Keywords: *ecotourism, sustainable tourism, geographical factors, recreational resources, national parks, biodiversity.*

So'nggi o'n yilliklarda ommaviy turizmning atrof-muhitga ko'rsatayotgan salbiy ta'siri (antropogen bosim, resurslarning tugashi, ekotizimlarning tanazzuli) tufayli alternativ turizm turlariga talab keskin ortdi. Ekoturizm — tabiatni muhofaza qilish, mahalliy aholi farovonligini oshirish va sayohatchilarning ekologik madaniyatini yuksaltirishga xizmat qiluvchi mas'uliyatli sayohat shaklidir. Ushbu tadqiqotning dolzarbligi ekoturizm faoliyatining tarixiy ildizlarini o'rganish va uning geografik mintaqalarda namoyon bo'lish xususiyatlarini aniqlash orqali hududiy rejalashtirish imkoniyatlarini kengaytirishdan iborat.

Ekoturizm va uning rivojlanish bosqichlari bo'yicha dunyo va mahalliy ilmiy adabiyotlarda keng ko'lamli tadqiqotlar olib borilgan:

Ekoturizm tushunchasi va tarixiy kelib chiqishi: "Ecotourism" atamasi birinchi marta 1980-yillar boshida meksikalik ekolog Hektor Ceballos-Lascurain tomonidan ilmiy muomalaga kiritilgan. Shuningdek, K. Lindberg va D. Hawkins ekoturizmning iqtisodiy hamda ekologik muvozanatni ta'minlashdagi rolini ilmiy jihatdan asoslab bergan.

Geografik va hududiy yondashuvlar: Geograf tadqiqotchilardan D. Fennell va M. Honey ekoturizm joylashuvining geografik shart-sharoitlari, muhofaza qilinadigan tabiiy hududlar (MQTH) bilan bog'liqligi hamda rekreatsion sig'im tushunchalarini atroflicha tahlil qilgan.

Ekoturizm (ekologik turizm) — atrof-muhitning tabiiy holatiga zarar yetkazmagan holda tabiatni o‘rganish, undan bahramand bo‘lish va mahalliy aholining ijtimoiy-iqtisodiy farovonligini oshirishga qaratilgan barqaror turizm yo‘nalishidir.

Ushbu sohaning shakllanishi bir necha o‘n yillik davomida iqtisodiy, ijtimoiy va ekologik omillar ta'sirida rivojlanib kelgan.

Ekoturizmning Shakllanishi va Rivojlanishining Tarixiy Aspektlari

Ekoturizm g‘oyasining paydo bo‘lishi insoniyatning tabiatga bo‘lgan munosabati va atrof-muhit muammolarining keskinlashuvi bilan uzviy bog‘liq.

A. Dastlabki Shart-sharoitlar va Ibtidoiy Davr (XX asr o‘rtalarigacha)

- Muhofaza etiladigan hududlarning tashkil topishi: 1872-yilda AQSHda dunyodagi birinchi milliy park — Yellouston (Yellowstone) tashkil etildi. Bu hodisa tabiatni saqlab qolish va bir vaqtning o‘zida insonlarga uni tomosha qilish imkonini beruvchi ilk amaliy qadam bo‘ldi.
- Ilmiy ekspeditsiyalar: XX asr boshlarida sayyohlik asosan ilmiy-tadqiqot, ovchilik va yangi yerlarni kashf etish xarakterida bo‘lib, u hali ommaviy xarakterga ega emas edi.

B. Omaviy Turizm Inqirozi va Yangi Konsepsiya (1960–1970-yillar)

- Ikkinchi jahon urushidan so‘ng dunyoda ommaviy turizm (mass tourism) jadal rivojlandi. Reyslarning arzonlashishi va infratuzilmaning kengayishi kurortlar, plyajlar va tarixiy shaharlarda resurslarning haddan tashqari tushishiga (overtourism) olib keldi.
- Sanoatlashuv va atrof-muhitning ifloslanishi oqibatida jamiyatda "yashil harakatlar" (Green Movements) shakllandi. Odamlarda tabiatga qaytish, uni asl holida saqlash va "yumshoq turizm" (soft tourism) turlariga talab ortdi.

C. Konsepsiyaning Shakllanishi va Atamaning Paydo Bo‘lishi (1980-yillar)

- Atamaning muomalaga kirishi: 1983-yilda meksikalik iqtisodchi va ekolog Hektor Seballos-Laskurain (Hector Ceballos-Lascurain) birinchilardan bo‘lib "ekoturizm" atamasiga rasmiy ta'rif berdi.
- U ekoturizmni: *"Buzilmagan va ifloslanmagan tabiiy hududlarga u yerdagi o‘simlik hamda hayvonot dunyosini, shuningdek madaniy obyektlarni o‘rganish, bahramand bo‘lish maqsadida qilinadigan mas'uliyatli sayohat"* deb baholadi.

D. Institutlashuv va Global Tan Olinish (1990-yillardan hozirgacha)

TIES tashkil etilishi

1990-yil

AQSHda Xalqaro Ekoturizm Jamiyati (The International Ecotourism Society — TIES) tuzildi va u ekoturizm standartlarini ishlab chiqishda yetakchiga aylandi.

Riodagi Yer Sammiti

1992-yil

BMTning Rio-de-Janeyro sammitida "21-asr kun tartibi" (Agenda 21) qabul qilindi. Unda ekoturizm barqaror rivojlanishning asosiy vositalaridan biri deb e'lon qilindi.

Xalqaro Ekoturizm Yili

2002-yil

BMT Bosh Assambleyasi 2002-yilni "Xalqaro Ekoturizm Yili" deb e'lon qildi va Kvebekda (Kanada) Butunjahon Ekoturizm Sammiti o‘tkazildi.

BRM va Barqaror Turizm

2015-yil va hozir

Ekoturizm BMTning 2030-yilgacha mo‘ljallangan Barqaror Rivojlanish Maqsadlari (BRM/SDGs) bilan integratsiya qilindi.

Ekoturizmning Geografik Xususiyatlari

Ekoturizm o‘zining geografik tarqalishi, hududiy tuzilishi va tabiiy resurslarga bog‘liqligi bo‘yicha an'anaviy turizmdan tubdan farq qiladi.

A. Makoniy (Geografik) Joylashuvi va O‘ziga Xosligi

1. AOHUTlarga bog‘liqlik: Ekoturizm marshrutlarining 80% dan ortig‘i Alohida Muhofaza Etiladigan Tabiiy Hududlar — milliy parklar, davlat qo‘riqxonalari, biosfera rezeratlari va zakazniklar hisobiga to‘g‘ri keladi.

2. Chekka (Periferik) Hududlar: Ekoturizm obyektlari yirik shaharlardan va sanoat markazlaridan yiroqda, inson ta'siri kam teggan (rekreatsion sig‘imi yuqori bo‘lgan) joylarda joylashgan.

3. Mavsumiylik va Iqlim Omillari: Sayohatlar iqlim o‘zgarishlari, hayvonlarning migratsiya davri yoki o‘simliklarning gullash mavsumiga qat'iy bog‘langan bo‘ladi.

B. Global Geografik Rayonlashtirish va Markazlar

Geografik jihatdan dunyoda ekoturizmning resurs beruvchi (sayohatga boriladigan) va reproduktiv (sayyoh jo‘natuvchi) hududlari aniq ajralib turadi:

- Ekoturistlarni jo‘natuvchi mamlakatlar: AQSH, Germaniya, Buyuk Britaniya, Yaponiya, Avstraliya, Kanada (aholisining daromadi va ekologik madaniyati yuqori bo‘lgan davlatlar).
- Ekoturistlarni qabul qiluvchi asosiy geografik mintaqalar:

Mintaqa	Asosiy Davlatlar	Geografik va Rekreatsion Resurslar
Lotin Amerikasi	Kosta-Rika, Ekvador (Galapagos), Braziliya, Peru	Tropik yomg‘irli o‘rmonlar (Amazoniya), baland biologik xilma-xillik, endemik turlar.
Afrika	Keniya, Tanzaniya, JAR, Botsvana, Madagaskar	Savannalar, mashhur "Katta beshlik" (sher, fil, karkidon, qoplon, buvol) safarilari, milliy parklar.
Osiyo va Tinch okeani	Nepal, Indoneziya, Malayziya, Tailand	Himolay tog‘ trekinglari, marjon riflari, tropik orollar va dengiz fauna parklari.
Shimoliy Amerika va Yevropa	AQSH, Kanada, Norvegiya, Shveysariya	Geyserlar, fiyordlar, Alp va Qoyali tog‘ tizmalari, infratuzilmasi rivojlangan milliy parklar.

O‘zbekiston Ekoturizmining Geografik Aspektlari

O‘zbekiston Markaziy Osiyoda o‘zining xilma-xil landshaftlari bilan ekoturizmni rivojlantirish uchun katta geografik salohiyatga ega.

A. Tabiiy-Geografik Zonalar va Ularning Imkoniyatlari

- Tog‘li va Tog‘oldi Hududlari (G‘arbiy Tyanshan, Hisor-Zarafshon):
  - Ugam-Chotqol milliy bog‘i, Zaamin milliy parki, Hisor davlat qo‘riqxonasi.
  - *Faoliyat:* Ekologik treking, alpinizm, botanik va speleotizim (g‘orlar) turizmi.
- Cho‘l va Yarim Cho‘l Zonasi (Qizilqum, Ustyurt platosi):
  - *O‘ziga xosligi:* Ekstremal ekoturizm, tuya va o‘tov lagerlari, Orol dengizi tubidagi (Aralqum) o‘zgarayotgan ekotizimni kuzatish.
- Gidrolojik Obyektlar va Suv-Botqoqlik Hududlari:
  - Aydar-Arnasoy ko‘llar tizimi, Tudakul va Kuyumazar ko‘llari, Sudoche ko‘llar tizimi (Orolbo‘yi).
  - *Faoliyat:* Ornitologik turizm (qushlarni kuzatish — birdwatching), baliqchilik va suv ekotizimlarini o‘rganish.

O‘zbekiston Ekoturizm Landshaftlari:
- Tog‘lar: Zaamin, Chotqol, Hisor (Treking va Flora/Fauna)
- Cho‘llar: Qizilqum, Ustyurt (O‘tov lagerlari, Ekstremal turizm)
- Suv havzalari: Aydar-Arnasoy, Sudoche (Ornitologiya va Qushlar migratsiyasi)

Ekoturizmning Asosiy Tamoyillari va Asoratlari

An'anaviy va ekoturizm o‘rtasidagi geografik va funksional farq uning tamoyillarida namoyon bo‘ladi:

1. Atrof-muhitga minimalist ta'sir: Sayyohlar iz qoldirmaydi, chiqindi tashlamaydi va mahalliy florani payhon qilmaydi.

2. Rekreatsion sig‘im (Carrying Capacity): Har bir tabiiy hududga bir vaqtning o‘zida kirishi mumkin bo‘lgan sayyohlar soni geografik va biologik imkoniyatdan oshmasligi shart.

3. Eko-ta'lim va ma'rifat: Sayyoh faqat dam olmaydi, balki ushbu ekotizimning ishlash mexanizmini va uni muhofaza qilish muhimligini anglaydi.

4. Lokal iqtisodiy foyda: Daromad to‘g‘ridan-to‘g‘ri mahalliy giydlar, oilaviy mehmonxona egalari va qo‘riqxona fondlariga yo‘naltiriladi.

Xulosa

Ekoturizmning geografik omillariga nazar tashlasak, rivojlanayotgan mamlakatlar (Lotin Amerikasi va Afrika) asosan boy tabiiy biologik resurslarga tayanadi, rivojlangan mamlakatlar (Yevropa va Shimoniy Amerika) esa yuqori darajada tartiblangan va atrof-muhitga ta'siri minimal bo'lgan infratuzilmaga urg'u beradi.

O'zbekiston sharoitida ekoturizm kontseptsiyasini tahlil qilganda, mamlakatning unikal chorraha geografiyasi (cho'l va adirlar, Zarafshon hamda Tyan-Shan tog' ekotizimlari, Orolboyi va uning hududiy o'zgarishlari) katta salohiyatga egaligini ko'ramiz. Biroq, infratuzilmaning yetarli darajada rivojlanmagani hamda mahalliy hamjamiyatlarning turizm daromadlaridagi ulushi pastligi ekoturizmning to'liq salohiyatini yuzaga chiqarishga to'sqinlik qilmoqda.

Ekoturizm o'zining tarixiy rivojlanishida ommaviy turizmga nisbatan muqobil javob sifatida shakllandi va bugungi kunda barqaror geografik va iqtisodiy modelga aylandi. Uning geografik xususiyatlari bevosita tabiat zonalari, biologik xilma-xillik va muhofaza etiladigan tabiiy hududlar tarmog'iga bog'liq.

1. Zonal rejalashtirish: Ekoturizm obyektlarini rivojlantirishda hududlarning ekologik rekreatsion sig'imini (Carrying Capacity) aniq belgilash va unga qat'iy amal qilish.

2. Kladsterli yondashuv: Muhofaza qilinadigan tabiiy hududlar (zapovedniklar va milliy parklar) bufer zonalarida ekoturizm klasterlarini yaratish.

3. Mahalliy jamoatchilikni jalb qilish (CBT): Ekoturizmdan tushadigan daromadlarning bir qismini bevosita mahalliy aholini qo'llab-quvvatlash va tabiatni muhofaza qilish loyihalariga yo'naltirish.

Yuqoridagi maqola uchun shakllantirilgan Adabiyotlar ro'yxati (GOST va xalqaro akademik standartlar asosida):

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SUV RESURSLARINING KAMAYISHI VA IQLIM O’ZGARISHLARI SHAROITIDA REKREATSION RESURSLAR SALOHIYATINI MODELLASHTIRISH VA PROGNOZLASHNING AYRIM MASALALARI (MO’YNOQ TUMANI MISOLIDA)

Annotatsiya. *Mazkur maqolada suv resurslarining qisqarishi va iqlim o’zgarishi sharoitida rekreatsion resurslar salohiyatini modellashtirish hamda prognozlash masalalari Mo‘ynoq tumani misolida tadqiq etilgan. Hududda Orol dengizi qurishi natijasida yuzaga kelgan ekologik, ijtimoiy-iqtisodiy va landshaft o’zgarishlari rekreatsion faoliyat rivojiga sezilarli ta’sir ko’rsatmoqda. Tadqiqotda geografik axborot tizimlari (GIS), masofadan zondlash materiallari, statistik ma’lumotlar va hududiy tahlil usullaridan foydalanilgan holda rekreatsion resurslarning hozirgi holati baholandi. Shuningdek, suv ta’minoti, harorat rejimi, landshaft transformatsiyasi va transport infratuzilmasi omillari asosida rekreatsion salohiyatning istiqboldagi rivojlanish ssenariylari ishlab chiqildi. Natijada Mo’ynoq tumanida ekologik turizm, madaniy-meros turizmi hamda ekstremal turizm yo’nalishlarini rivojlantirish imkoniyatlari aniqlanib, barqaror rekreatsion boshqaruv bo’yicha tavsiyalar ishlab chiqildi.*

Kalit so’zlar: *Rekreatsion resurslar, modellashtirish, prognozlash, suv resurslari, iqlim o’zgarishi, Mo‘ynoq, Orol dengizi, ekologik turizm, GIS, landshaft transformatsiyasi, barqaror rivojlanish.*

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SELECTED ISSUES IN MODELING AND FORECASTING RECREATIONAL RESOURCE POTENTIAL AMIDST WATER RESOURCE DEPLETION AND CLIMATE CHANGE (A CASE STUDY OF THE MUYNAK DISTRICT)

Abstract. *This article examines the modeling and forecasting of recreational resource potential amidst water resource depletion and climate change, using the Muynak district as a case study. Ecological, socio-economic, and landscape changes in the region—resulting from the desiccation of the Aral Sea—are significantly impacting the development of recreational activities. The study assesses the current state of recreational resources by utilizing Geographic Information Systems (GIS), remote sensing data, statistical information, and spatial analysis methods. Furthermore, future development scenarios for recreational potential were formulated based on factors such as water supply, temperature regimes, landscape transformation, and transport infrastructure. Consequently, opportunities for developing ecotourism, cultural heritage tourism, and extreme tourism in the Muynak district were identified, and recommendations for sustainable recreational management were developed.*

Keywords: *Recreational resources, modeling, forecasting, water resources, climate change, Muynak, Aral Sea, ecotourism, GIS, landscape transformation, sustainable development.*

Kirish. Hozirgi davrda global iqlim o’zgarishi, suv resurslari tanqisligi va ekologik muammolar dunyoning ko’plab hududlarida tabiiy resurslardan foydalanish tizimiga jiddiy ta’sir ko’rsatmoqda. Ayniqsa, qurg’oqchil mintaqalarda suv manbalarining qisqarishi nafaqat qishloq xo’jaligi va aholi turmush tarziga, balki rekreatsiya va turizm salohiyatiga ham bevosita ta’sir etmoqda. Davlat dasturlarida Orolbo’yi hududining ekologik va rekreatsion salohiyatidan samarali foydalanish hamda turizm infratuzilmasini rivojlantirish ustuvor vazifa sifatida belgilangan [1]. Shu jihatdan, rekreatsion resurslardan samarali foydalanish, ularni hududiy jihatdan baholash va istiqboldagi o’zgarishlarini prognozlash dolzarb ilmiy-amaliy masalalardan biri hisoblanadi.

Mo‘ynoq tumani ushbu yo’nalishda alohida tadqiqot obyektidir. Bu hudud uchun iqlim o’zgarishi bu uzoqdagi xavf emas balki – bu har kuni sezilayotgan haqiyqatdir. Chunki hudud XX asrning ikkinchi yarmigacha Orol dengizi bo’yidagi yirik port shahri va baliqchilik markazi bo’lgan bo’lsa, dengizning chekinishi natijasida keskin ekologik va iqtisodiy transformatsiyani boshdan kechirdi hamda kuchayib borayotgan qurg’oqchilik, suv tanqisligi aholi qatlamlari, oziq-ovqat xavfsizligi va jamoat salomatligiga tahdid solmoqda. Natijada hududning an’anaviy xo’jalik tarmoqlari qisqardi, biroq yangi turdagi rekreatsion resurslar ekologik falokat turizmi, “kemalar qabristoni”, cho’l landshaftlari, etnomadaniy meros va ilmiy-ekspeditsion turizm obyektlari shakllandi [2].

Dengizning qisqarishi natijasida suv bilan bog’liq rekreatsion faoliyatlar keskin kamaygan va hududning turistik funksiyasi transformatsiyaga uchragan,

natijada suv-ekologik tizimlar degradatsiyaga uchrab, dengizning fizik-gidrologik holati tubdan o’zgargan hamda yangi cho’l landshaftlari shakllang [3].

Bugungi kunda Mo’ynoq tumanida rekreatsion salohiyatni baholashda tabiiy-geografik omillar bilan bir qatorda iqlimning isib borishi, chang-tuz bo’ronlari, suv ta’minoti cheklanishi, transport va servis infratuzilmasining rivojlanish darajasi kabi omillarni ham hisobga olish zarur. Shu sababli rekreatsion resurslar holatini zamonaviy geoinformatsion texnologiyalar asosida modellashtirish va turli ssenariylar bo’yicha prognozlash muhim ahamiyat kasb etadi.

Mazkur maqolaning maqsadi Mo’ynoq tumani misolida suv resurslarining kamayishi va iqlim o’zgarishi sharoitida rekreatsion resurslar salohiyatini baholash, modellashtirish hamda istiqboldagi rivojlanish yo’nalishlarini prognozlashdan iborat. Tadqiqot natijalari hududda barqaror turizmni rivojlantirish, investitsion jozibadorlikni oshirish va ekologik muammolar sharoitida yangi iqtisodiy imkoniyatlarni shakllantirishga xizmat qiladi.

Asosiy bo’lim. Amudaryo quyi oqimi va Orolbo’yi hududida kuzatilayotgan suv tanqisligi mintaqaning nafaqat ekologik va iqtisodiy, balki rekreatsion-turistik qiyofasini ham tubdan o’zgartirib yubordi. Bir paytlar gidrografik tarmoqlarga tayangan an’anaviy turizm bugungi kunda iqlimiy keskinlashuv va landshaftlar degradatsiyasi bosimi ostida qolmoqda.

Orol dengizi sathining pasayishi natijasida Amudaryo deltasi hududidagi namlandshaftlar va suv-botqoq ekotizimlari sezilarli degradatsiyaga uchradi. Tadqiqotlarda qayd etilishicha, daryo oqimining kamayishi ko’llar tizimi hamda botqoqlik maydonlarining qisqarishiga olib kelgan va bu hududning ekologik barqarorligiga salbiy ta’sir ko’rsatgan [4].

Suv sathining pasayishi va Orol dengizining chekinishi natijasida hududning gidromorfologik tuzilishi buzildi. Bu o’z navbatida quyidagi salbiy oqibatlarga olib keldi:

• Plyaj zonalari, yaxta-klublar va baliqchilik maskanlari kabi an’anaviy dam olish maskanlari o’z funksiyasini butunlay yo’qotdi.

• Amudaryo deltasidagi noyob to’qayzorlarning qurishi va Sudochye kabi ko’llar tizimining qisqarishi ekologik turizm bazasiga jiddiy zarba berdi.

Amudaryo deltasi hududidagi ekologik transformatsiyalar natijasida tabiiy rekreatsion landshaftlar degradatsiyaga uchradi. Ayniqsa to’qayzorlar va suv-botqoq hududlarining qisqarishi ekologik turizm salohiyatining pasayishiga sabab bo’lgan [4].

Suv resurslarining kamayishi mintaqada kontinentallik darajasini oshirib, rekreatsion qulaylik indeksini pasaytirdi. Orol dengizining umumiy hajmining qisqarishining ikkinchi darajali ta’siri ko’l tubining tez ochilishidir. Osiyoning bu qismi bo’ylab esadigan kuchli shamollar har yili o’n minglab tonna tuproqni yig’adi va to’playdi. Bu jarayon nafaqat yaqin atrofdagi aholi uchun nafas oladigan havo sifatining sezilarli darajada pasayishiga, balki ekin maydonlariga kuchli tuz bilan to’ldirilgan zarralar tushishi tufayli hosildorlikka sezilarli ta’sir ko’rsatdi. Yoz oylaridagi ekstremal issiqlik (termal diskomfort) sayyohlar uchun qulay bo’lgan "fiziologik vaqt oralig’i"ni qisqartirdi. Shu bilan birga, "Aralkum" cho’lidan

ko’tarilayotgan tuz va chang zarralari hududning sanitar-gigiyenik jozibadorligini pasaytirib, sog’lomlashtirish turizmi imkoniyatlarini cheklab qo’ydi. Ammo shu bilan bir qatorda inqiroz an’anaviy dam olish turlarini cheklagan bo’lsa-da, mintaqada turizmning mutlaqo yangi, noan’anaviy yo’nalishlari paydo bo’lishiga turtki berdi:

• Dark Tourism: Mo’ynoqdagi "Kemalar qabristoni" insoniyatning tabiatga ta’siri monumenti sifatida global qiziqish markaziga aylandi.

• Ekstremal va Sarguzashtli turizm: Qurigan dengiz tubi va Amudaryo o’zanlari off-road poygalari, ralli va ekstremal landshaft turizmi uchun o’ziga xos platforma yaratdi.

Tadqiqotlar ko’rsatishicha Orol dengizi qurigan hududlarida shakllangan antropogen landshaftlar, xususan Mo’ynoqdagi kemalar qabristoni ekologik falokat turizmi (dark tourism) obyektiga aylangan. Shu bilan birga qurigan dengiz tubi ekstremal va sarguzashtli turizm uchun yangi rekreatsion makon sifatida shakllanmoqda.

Mo’ynoq tumaning rekreatsion jozibadorligi ikkita qarama-qarshi yo’nalishdan iborat: birinchisi, an’anaviy joziba suv resurslari va ekologik barqarorlik bilan bog’liq suv resurslarining kamayishi rekreatsion salohiyatning pasayishini ko’rsatadi. Ikkinchisi, alternativ joziba bu qurigan dengiz tubi, zanglagan kemalar va yangi infratuzilma rivojiga bog’liq.

Suv resurslarining kamayishi va iqlimning keskin kontinentallashuvi bu albatta ijtimoiy-iqtisodiy barqarorlikka o’z ta’sir o’tkazdi. Bu o’z navbatida aholi salomatligida, hayot tarzining pasayishida, turizim sohasida mehmonxonalar va dam olish maskanlarini barqaror suv va oziq-ovqat bilan ta’minlashdagi qiyinchiliklarda o’z ifodasini topadi.

Tadqiqotlarga ko’ra, Orol dengizi suv yuzasi maydoni 1960–2009-yillar oralig’ida 68 ming km² dan 14,7 ming km² gacha qisqargan bo’lib, dengiz o’z maydonining qariyb 80 foizini yo’qotgan [5]. Orol dengizi sathining keskin pasayishi natijasida hududdagi suv-ekologik tizimlar degradatsiyaga uchradi va bu rekreatsion resurslar salohiyatining kamayishiga olib keldi.

Bugungi kunda Amudaryo quyi oqimi, xususan Mo’ynoq tumanida kuzatilayotgan suv tanqisligi bu mintaqaning turizm soxasini tubdan o’zgartirib yuborishga asos bo’ldi ya’ni ilgari suv resurslarigan ixtisoslashgan sohalar jumladan: baliqchilik, plyaj zonalar, yaxta-klublar o’z funksiyasini yo’qotishi natijasida rekreatsion-turistik infratuzilmani miqdoriy jihatdan pasaytirib o’rniga sifat jihatdan yangi turizim sohasini rivojlanishiga sabab bo’lmoqda, ya’ni endilikda sayyohlar bu yerlarga passiv dam olish uchun emas balki tabiat va inson o’rtasidagi to’qnashuvni anglash o’rganish uchun tashrif buyurmoqdalar. Bu o’z navbatida landshatlarning yer va tuproq resurslarining ifloslanishini kamayishiga sabab bo’ladi. Amudaryo quyi oqimidagi suv tanqisligi mintaqa rekreatsiyasini yo’q qilmadi, balki uni sifat jihatidan yangiladi. Mo’ynoq endi shunchaki sobiq port shahri emas, u inson va tabiat o’rtasidagi murakkab munosabatlarni vizual namoyish etuvchi, dunyo miqyosidagi noyob turistik-ekologik platformadir. Ushbu

sifat o’zgarishi mintaqaning "ekologik inqiroz sharoitida moslashuvchan rekreatsion salohiyati"ni belgilab beruvchi asosiy omildir.



1a-rasm. Orol dengizining 1973-yildagi holati (Landsat-1sun’iy yo’ldosh arxiv tasviri. manba: https://cawater-info.net/aral/data/satellite_e.htm)

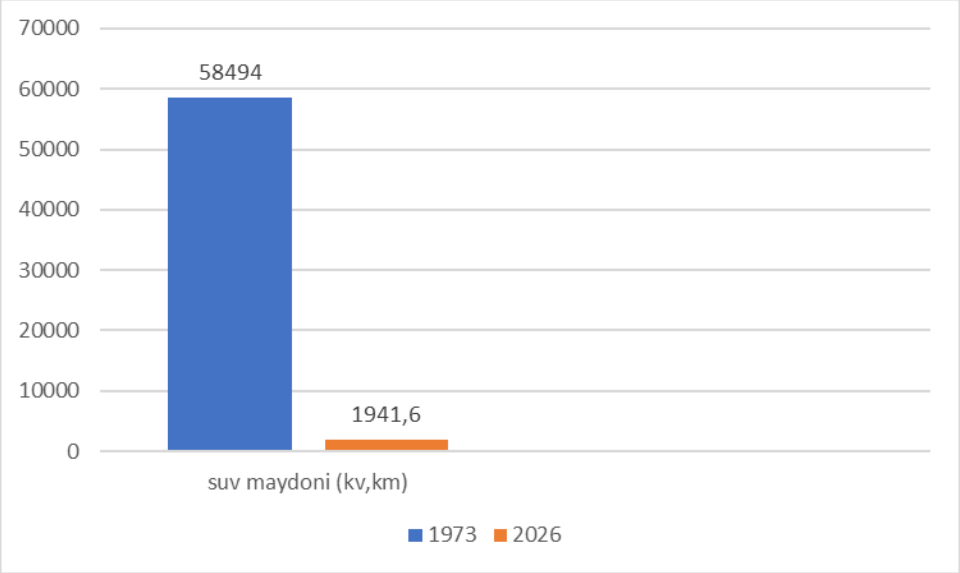


2b-rasm. Orol dengizi G’arbiy havzasining hozirgi holati (manba: google earth ma’lumotlari asosida mualif tomonidan tayyorlandi)

1-rasm. Orol dengizi akvatoriyasining 1973-2026 yillardagi dinamik holati.

Orol dengizining Mo’ynoq tumani hududidagi rekreatsiya landshaftlari transformatsiyasini tahlil qilish jarayonida 1973 va 2026-yillar oralig’idagi gidrologik ko’rsatkichlar qiyoslandi. 1973-yilda Orol dengizi yaxlit havza bo’lgan bo’lsa, 2026-yilga kelib u bir-biridan ajralgan bir necha qismlarga bo’lindi. Tadqiqot obyekti sifatida eng barqaror qolgan G’arbiy havza tanlab olindi. Tadqiqot natijalariga ko’ra, 1973-yilda dengizning umumiy maydoni 58 494 km^2 ni, suv hajmi esa 898,9 km^3 ni tashkil etgan (1a, 2-rasmlar) [6]. 2026-yilga kelib, masofaviy zondlash va kartometrik o’lchovlar (Google Earth) natijasida G’arbiy havza maydoni 1941,6 km^2 ekanligi aniqlandi (1b, 2-rasmlar)[7]. Bu 53 yillik davr mobaynida akvatoriyaning qariyb 97 foizga qisqarganidan va gidromorf landshaftlarning kseromorf (cho’l) landshaftlarga to’liq almashganidan dalolat beradi.

Olingan kartometrik ma’lumotlar shuni ko’rsatadiki, 1973-yilda Orol dengizining yaxlit akvatoriyasi 58 494 km^2 maydonni va 898,9 km^3 suv hajmini tashkil etgan. Bu davrda hudud o’zining iqlimni yumshatuvchi xususiyatlari va barqaror qirg’oq chizig’iga ega bo’lgan gidromorf landshaftlari bilan yuqori rekreatsiya salohiyatiga ega edi. 2026-yil holatiga ko’ra, masofaviy zondlash tahlillari G’arbiy havza maydonining 1 941,6 km^2 gacha qisqarganini ko’rsatdi. Bu ko’rsatkich akvatoriyaning 96,7% ga deyarli to’liq degradatsiyaga uchraganidan dalolat beradi.



2-rasm. Orol dengizi akvatoriyasi maydonining 1973–2026-yillardagi qisqarish dinamikasi grafigi (km^2). (Manba: Arxiv ma'lumotlari va mualliflarning kartometrik o'lchovlari asosida tuzildi).

Landshaftlarning gidromorf holatdan ekstremal kseromorf (Aralkum cho'li) holatga o'tishi an'anaviy rekreatsiya turlarini (plyaj turizmi, suv sporti, davolash-sog'lomlashtirish) butunlay imkonsiz qilib qo'ydi. Sobiq qirg'oq bo'yi zonalarining kseromorfizatsiyasi natijasida rekreatsion jozibadorlik (attraktivlik) darajasi keskin pasayib, hudud "ekologik ofat zonasi" maqomini oldi. Mo'ynoq tumanining sobiq plyaj landshaftlari hozirda oq sho'rxoklar va qum barxanlari bilan almashgan bo'lib, bu landshaftning estetik qiymatini transformatsiyaga uchratdi.

Garchi an'anaviy rekreatsiya resurslari boy berilgan bo'lsa-da, ekologik inqiroz hududda yangi tipdagi rekreatsion imkoniyatlarni shakllantirdi:

•"Kemalar qabristoni" va inqiroz oqibatlari obyekti sifatida xalqaro sayyohlar e'tiborini tortmoqda (3-rasm).

•Ilmiy-ma'rifiy rekreatsiya: Orolqum cho'lining shakllanishi va saksaulzorlashtirish jarayonlari landshaft dizayni va ekologik tiklanishni o'rganuvchi tadqiqotchilar uchun o'ziga xos "tirik laboratoriya" vazifasini o'tamoqda.

•Antropogen landshaftlar transformatsiyasi: Sobiq gidromorf landshaftlar o'rnida sun'iy o'rmonlashtirilgan (saksaul) maydonlarning shakllanishi kelajakda "eko-rekreatsion" zonalarni yaratish uchun asos bo'lib xizmat qiladi.

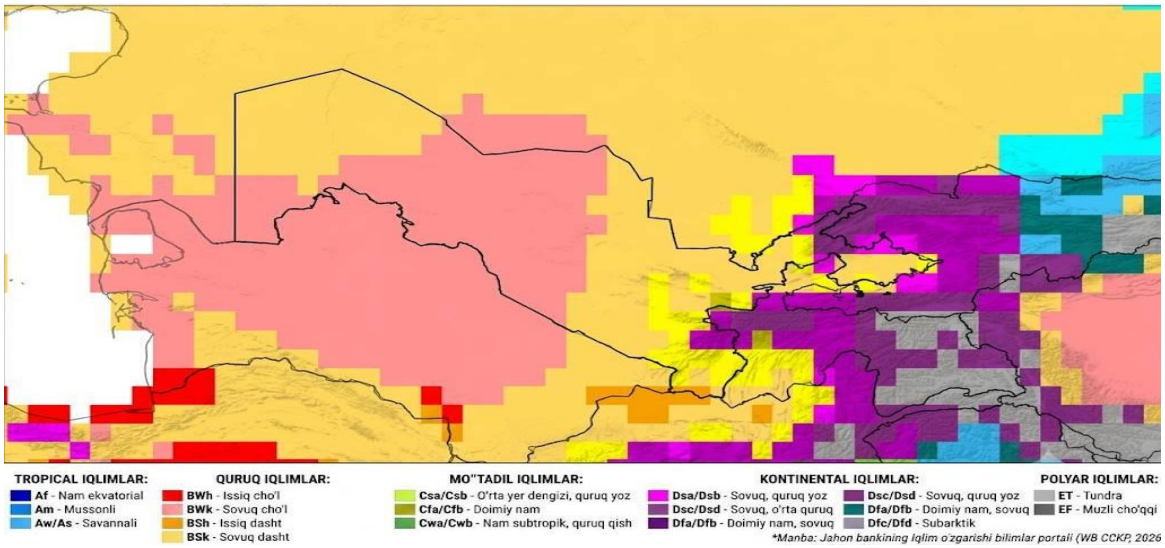


3-rasm. Orol dengizi chekinishi natijasida shakllangan kemalar qabristoni

Manba: muallif tomonidan internet materiallari asosida tuzildi

Xulosa qilib aytganda, 1973–2026-yillar oralig'ida Orol dengizi rekreatsiya salohiyati miqdoriy jihatdan (maydon va hajm) deyarli yo'qolgan bo'lsa, sifat jihatidan to'liq transformatsiyaga uchradi. Tadqiqot obyekti hisoblangan Mo'ynoq tumanida rekreatsiya faoliyatini rejalashtirishda endilikda suv resurslariga emas, balki "cho'l rekreatsiyasi" va "ekologik monitoring" yo'nalishlariga urg'u berish maqsadga muvofiqdir. Albatta 1973 yildagi resurslar suv va iqlim sharoiti hozirgacha saqlanib qolganda nafaqat rekreatsion salohiyatning barqaror bo'lishiga balki iqtisodiy samaradorlikning yuqori bo'lishiga ham ijobiy ta'sir ko'rsatgan bo'lardi ammo hozirgi qurigan dengiz tubi landshaftlarini o'rganish va ularning rekreatsion imkoniyatlarini tahlil qilish muxim ilmiy amaliy ahamiyatga ega bo'lganligi bois an'anaviy plyaj turizimidan "ilmiy va ekstremal turizm" modeliga o'tishni huquqiy va iqtisodiy qo'llab-quvvatlash lozim.

Undan tashqari hududning iqlimiy ko'rsatkichlari Kyoppen-Geiger tasnifi tahlili bo'yicha tahlil qilindi (4-rasm).



4-rasm. Kyoppen-Geiger tasnifi bo'yicha hududning iqlim xaritasi (1991–2020 yy.). Manba: Jahon bankining Iqlim o'zgarishi bilimlar portali (https://climateknowledgeportal.worldbank.org/country/uzbekistan).

Kyoppen-Geiger iqlim tasnifining zamonaviy (1991–2020 yy.) ma'lumotlari tahliliga ko'ra, o'rganilayotgan hudud (Qoraqalpog'iston va Orolbo'yi) asosan **BWk (sovuq cho'l)** va **BSk (sovuq yarim cho'l)** iqlim tiplariga mansubdir (4-rasm). Iqlim o'zgarishi va mintaqadagi gidrologik inqiroz (suv resurslarining taqchilligi) ushbu cho'llanish ssenariylarini yanada jadallashtirmoqda. Bu esa gidromorf (suvga bog'liq) landshaftlarning barqarorligini pasaytirib, ularning rekreatsion jozibadorlik koeffitsiyentini keskin kamaytirmoqda.[8]

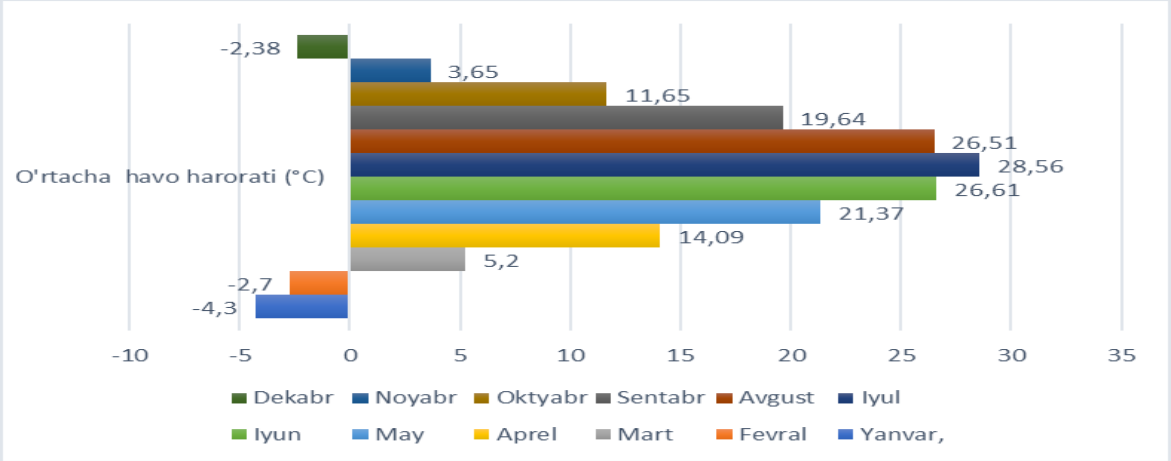
1-jadval. Qoraqalpog'iston, O'zbekiston hududida o'rtacha oylik havo harorati va yog'in miqdori ko'rsatkichlari

Oylar	O'rtacha minimal havo harorati (°C)	O'rtacha havo harorati (°C)	O'rtacha maksimal havo harorati (°C)	Yog'in miqdori (mm)
Yanvar,	-8,59	-4,3	-0,04	12,06
Fevral	-7,73	-2,7	2,31	10,38
Mart	-0,55	5,2	10,98	17,5
Aprel	7,34	14,09	20,88	16,74
May	14,15	21,37	28,63	12,28
Iyun	19,15	26,61	34,12	8,15
Iyul	21,23	28,56	35,94	4,12
Avgust	18,89	26,51	34,18	3,58
Sentabr	11,95	19,64	27,37	3,1
Oktyabr	4,42	11,65	18,92	8,22
Noyabr	-1,53	3,65	8,84	14,36
Dekabr	-6,53	-2,38	1,76	10,74

(https://climateknowledgeportal.worldbank.org/country/uzbekistan)

Cho'l iqlimining o'ziga xos xususiyati — yoz oylarida haroratning keskin ko'tarilib ketishi va havoning nihoyatda quruqlashishidir. Bu holat inson organizmi uchun bioklimatik noqulaylik (termik stress) tug'diradi. Natijada yozgi rekreatsiya

va ekoturizm mavsumi qisqarib ketadi (jaziramada dam oluvchilar soni keskin kamayadi).



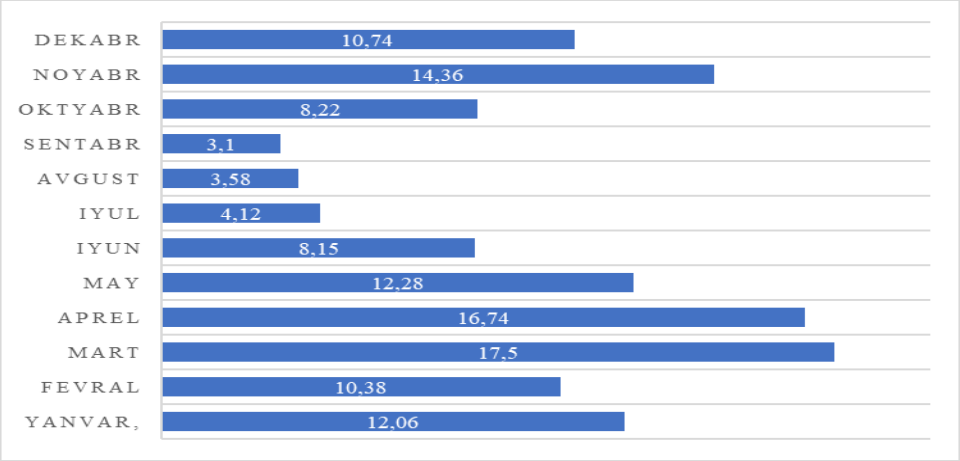
5-rasm. Qoraqalpog'iston, O'zbekiston hududida o'rtacha oylik havo harorati dinamikasi

(https://climateknowledgeportal.worldbank.org/country/uzbekistan)

Grafikdan ko'rinadiki, Qoraqalpog'iston hududida haroratning mavsumiy amplitudasi yuqori bo'lib, eng issiq davr iyul oyiga to'g'ri keladi (28,56 °C), eng past qiymatlar esa yanvar oyida kuzatiladi (-4,30 °C). Yuqori yozgi harorat va quruq iqlim landshaftlarning namlik balansiga salbiy ta'sir ko'rsatib, rekreatsion qulaylikning pasayishiga sabab bo'luvchi omillardan biri hisoblanadi.

Yuqorida jadvalda keltirilgan (1-jadval) maksimal va minimal haroratlar o'rtasidagi katta farq hududning keskin kontinental iqlim sharoitini ko'rsatadi. Ayniqsa yoz oylarida maksimal haroratlarning 34-36 °C gacha yetishi bug'lanish jarayonlarini kuchaytirib, suv resurslari tanqisligi va landshaftlarning qurg'oqlashuviga ta'sir qiladi.

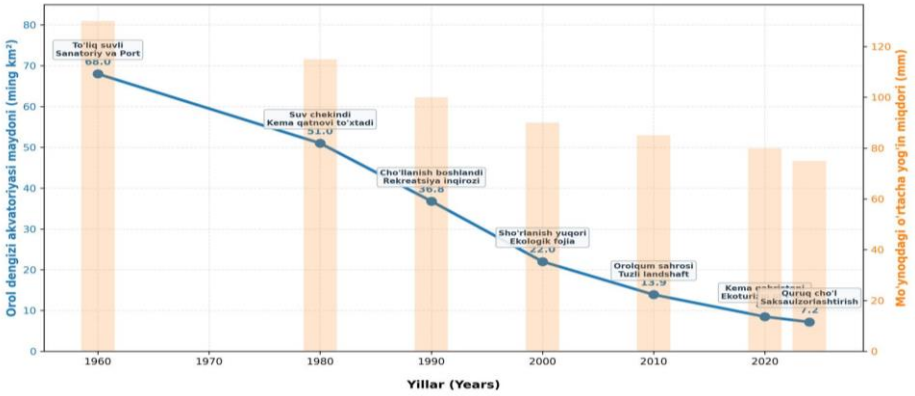
NASA POWER ma'lumotlari masofadan zondlash va qayta ishlangan meteorologik ma'lumotlar asosida o'rtacha oylik havo haroratini (T2M ya'ni yer sirtidan 2 metr balandlikdagi havo harorati) beradi. Ushbu ko'rsatkich mutlaq maksimal harorat emas, balki sutkalik o'rtacha harorat qiymatini ifodalaydi. Hududda kuzatiladigan 40-45 °C li ekstremal haroratlar esa maksimal harorat ko'rsatkichlari bilan tavsiflanadi.



6-rasm. Qoraqalpog'iston, O'zbekiston hududida o'rtacha oylik yog'inning miqdoriy ko'rsatkichlari

O'zgidromet sayti 2024-2025 yillar qishda qanday ob-havo kuzatilgani haqidagi yakuniy tahlillarini e'lon qilishi bo'yicha 2024-2025 yillardagi qish mavsumi davomida **iliq to'lqinlar va sovuq to'lqinlar o'rni almashgani** kuzatilgan. Ularning tahlili bo'yicha bunday holat ko'p takrorlanadi. Respublika hududining katta qismida eng kuchli sovuqlar dekabr oyida, shimolda esa fevral oyida ham kuzatildi. Sovuq eng kuchli bo'lgan kunlarda havo harorati 8-13 daraja sovuqqacha, Qoraqalpog'iston Respublikasida va Navoiy viloyatining shimolida 15-18 daraja sovuqqacha, janubda 3-8 daraja sovuqqacha pasaygan [9].

Yog'in miqdorining yil davomida notekis taqsimlanishi hududning arid (quruq) iqlim sharoitini ifodalaydi. Yozgi davrda yog'in miqdorining 3–4 mm gacha kamayishi tuproq namligining pasayishi, o'simlik qoplamining siyraklashuvi va landshaft degradatsiyasi jarayonlarini kuchaytiruvchi omil hisoblanadi.

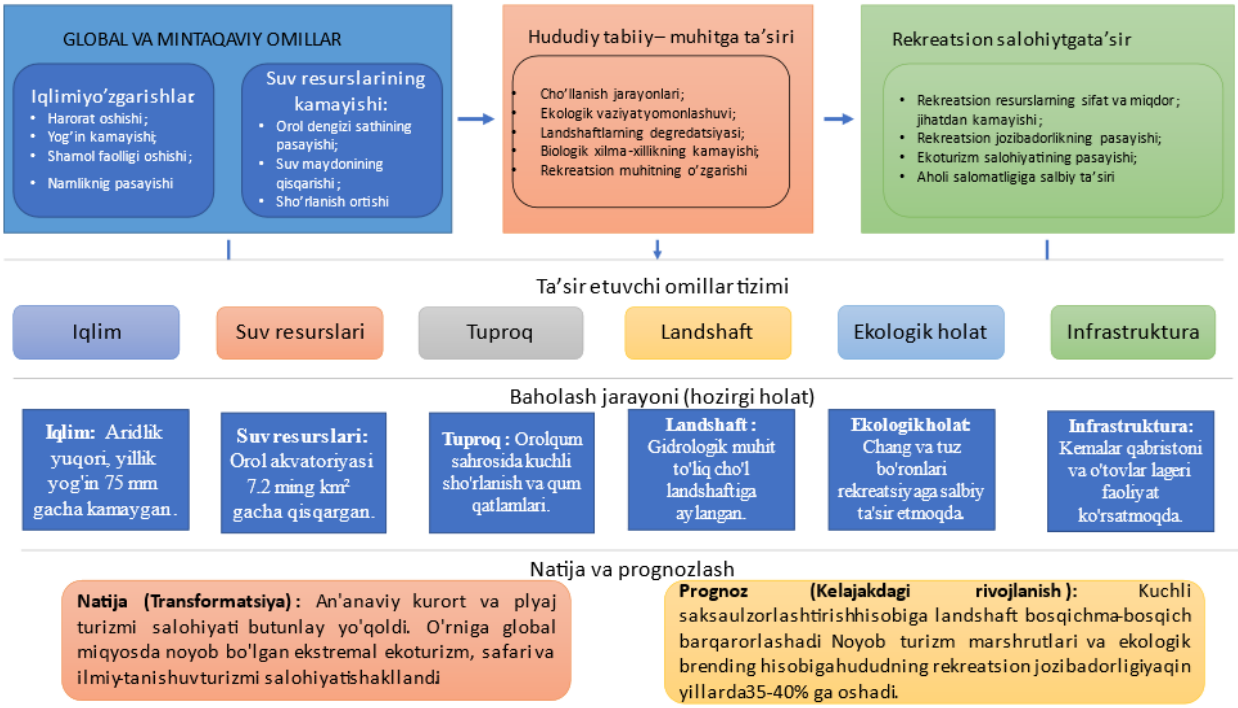


7-rasm. Mo'ynoq va Orolbo'yi landshaft dinamikasi hamda rekreatsion holati (1960-2024)

Mo'ynoq hududining rekreatsion (turistik va ekologik) salohiyati 1960-yildagi **68 ming km²** suv maydonidan 2024-yilga kelib **7.2 ming km²** gacha qisqardi. Landshaftning gidrologik (suvli) xarakteri butunlay yo'qolib, cho'l (Orolqum) landshaftiga aylandi. Bu esa hududda klassik kurort-rekreatsiyasini yo'qqa chiqarib, o'rniga ekstremal va ekologik turizm (kema qabristonini tomosha qilish) salohiyatini shakllantirdi.

Mo’ynoq va Orolbo’yi regionining 1960–2024-yillardagi gidrologik landshaft va iqlim o’zgarishi dinamikasi **Orol dengizini qutqarish xalqaro jamg’armasi (IFAS) agentligi** va **CAWater-Info elektron ma’lumotlar bazasi** statistik ko’rsatkichlari asosida muallif tomonidan shakllantirildi [10].

Global va mintaqaviy omillarning ta’siri. Ishlab chiqilgan modelga ko’ra, Mo’ynoq tumanining rekreatsion salohiyatini belgilovchi boshlang’ich nuqta global va mintaqaviy omillarga borib taqaladi. Iqlimiy o’zgarishlar (temperatura ko’tarilishi, aridlikning ortishi, yillik yog’ingarchilikning 75 mm gacha kamayishi) hamda sinxron ravishda Orol dengizi akvatoriyasining 7.2 ming km² gacha qisqarishi gidrologik muvozanatni butunlay buzdi. Suv sathining pasayishi va sho’rlanishning keskin ortishi hududdagi tabiiy ekotizimlarning zanjirli reakreatsiyasiga sabab bo’ldi.



8-rasm. Mo’ynoq rekreatsion salohiyati transformatsiyasi modeli (Muallif tomonidan tuzildi)

Hududiy tabiiy-muhitga ta’siri va omillar tizimi. Ushbu global salbiy tendensiyalar bevosita hududiy ekologik muhitga ta’sir ko’rsatdi. Natijada kuchli cho’llanish jarayonlari faollashdi, mahalliy to’qayzor va qamishzor landshaftlari degradatsiyaga uchradi. Modelning o’rtacha bo’g’inini tashkil etuvchi Iqlim, Suv resurslari, Tuproq, Landshaft, Ekologik holat va Infratuzilma omillari tizimi doimiy transformatsiyaga yuz tutdi. Gidromorf tuproqlar o’rnini Orolqum sahrosining sho’rxok va qumloq qatlamlari egalladi. Bu holat tabiiy landshaftlarning rekreatsion salohiyatini tubdan o’zgartirdi.

Rekreatsion salohiyatga ta’sir va hozirgi holatni baholash. Landshaft strukturasining o’zgarishi natijasida an’anaviy rekreatsion resurslarning sifati va miqdori keskin kamaydi. Hududda ilgari mavjud bo’lgan plyaj turizmi, sanatoriy-kurort va sog’lomlashtirish yo’nalishlari o’z jozibadorligini to’liq yo’qotdi.

Hozirgi holatni baholash mezonlari shuni ko'rsatadiki, tuman infratuzilmasi endilikda klassik kurort-turizmga emas, balki ekologik inqiroz oqibatida yuzaga kelgan yangi antropogen landshaft ob'ektlariga (Kemalar qabristoni, o'tov lagerlari, Orolqum tuz sahrosi) moslashgan.

Modelning yakuniy natijasi va prognozi (Transformatsiya konsepsiyasi). Modelning yakuniy bosqichi sifatida Mo'ynoq tumanida rekreatsiyaning mutloq yo'qolib ketishi emas, balki uning yangi rekretsion turlarini yaratilishini ko'rsatadi. An'anaviy plyaj va kurort turizmi o'rnini global miqyosda qiziqish yuqori bo'lgan Ekstremal turizm, Ekoturizm (safari) va Ilmiy-tanishuv (Dark tourism) modellari egalladi. Kelajakdagi prognozlarga ko'ra, davlat tomonidan olib borilayotgan keng ko'lamli saksaulzorlashtirish tadbirlari chang va tuz bo'ronlari xavfini kamaytiradi. Noyob landshaft jozibadorligi va hududning ekologik brendingini to'g'ri boshqarish orqali Mo'ynoqning rekreatsion jozibadorligi yaqin istiqbolda 35-40% ga ortishi va hudud xalqaro ilmiy-ekologik turizm markaziga aylanishi prognoz qilinmoqda. *(Manba: Orol dengizini qutqarish xalqaro jamg'armasi (IFAS) statistik ma'lumotlari asosida muallif ishlanmasi)*

Ushbu modelning bosh ilmiy yangiligi shundan iboratki, biz Mo'ynoqni turistik jihatdan o'lik hudud emas, balki landshafti va rekreatsion salohiyati global talabga mos ravishda transformatsiyaga (shakl o'zgarishiga) uchragan yangi tipdagi dinamik tizim sifatida ko'rishimiz mumkun.

Natijalar va muhokamalar. Tadqiqot natijalari shuni ko'rsatdiki, Mo'ynoq tumani hududida Orol dengizining qurishi natijasida rekreatsion resurslar salohiyati sezilarli darajada o'zgargan. Arid hududlarda tabiiy komponentlarning dinamikasini prognozlash rekreatsion resurslarning kelajakdagi holatini baholashda muhim metodologik asos bo'lib xizmat qiladi [11]. GIS va masofadan zondlash ma'lumotlari asosida hududning landshaft strukturasi keskin transformatsiyaga uchragani, suv resurslarining kamayishi va iqlimning quruqlashuvi rekreatsion faoliyat turlarining cheklanishiga olib kelgani aniqlandi. Hududda rekreatsion salohiyatning asosiy yo'nalishlari sifatida ekologik turizm, madaniy-meros turizmi va ekstremal turizm shakllari ajralib chiqdi. Statistik va hududiy tahlillar asosida transport infratuzilmasi va ekologik sharoitlar rekreatsion xizmatlar rivojlanishida hal qiluvchi omil ekanligi tasdiqlandi. Shuningdek, prognozlash natijalari kelgusida suv ta'minoti va iqlim o'zgarishi bilan bog'liq salbiy tendensiyalar saqlanib qolsa, an'anaviy rekreatsion faoliyat turlari yanada qisqarishi mumkinligini ko'rsatdi. Biroq ekologik tiklanish va infratuzilma yaxshilanishi sharoitida yangi turistik yo'nalishlarni rivojlantirish imkoniyati mavjudligi aniqlandi.

Xulosa. Tadqiqot natijalariga ko'ra, Mo'ynoq tumani rekreatsion resurslari Orol dengizi qurishi va iqlim o'zgarishi ta'sirida kuchli transformatsiyaga uchragan hududlardan biri hisoblanadi. Shunga qaramay, hududda ekologik, madaniy va ekstremal turizmni rivojlantirish uchun muhim tabiiy va tarixiy salohiyat saqlanib qolgan.GIS texnologiyalari va prognozlash modellari asosida olib borilgan tahlillar rekreatsion resurslarni barqaror boshqarish uchun ilmiy asoslangan yondashuv zarurligini ko'rsatdi. Hududda barqaror rekreatsion rivojlanishni ta'minlash uchun

suv resurslarini oqilona boshqarish, ekologik muvozanatni tiklash hamda transport va xizmat ko'rsatish infratuzilmasini rivojlantirish muhim ahamiyatga ega.

Umuman olganda, Mo'ynoq tumani kelajakda Orolbo'yi hududining muhim ekologik turizm markaziga aylanishi mumkin, biroq bu jarayon kompleks ilmiy asoslangan boshqaruv va uzoq muddatli strategiyani talab qiladi. Insoniyatning kelajakdagi faoliyati dengizni avvalgi chegaralariga qaytarishga emas, balki shakllangan yangi antropogen landshaftni boshqarishga yo'naltirilishi lozim. Bunda "yashil qoplama" yaratish orqali ekologik xavfsizlikni ta'minlash va mintaqaning rekreatsion salohiyatini cho'l ekoturizmi hamda ilmiy turizm yo'nalishlarida qayta shakllantirish eng maqbul strategiya hisoblanadi

Adabiyotlar ro'yxati:

1. O'zbekiston Respublikasi Vazirlar Mahkamasining 2022–2026-yillarda Qoraqalpog'iston Respublikasining turizm potensialini rivojlantirish bo'yicha qo'shimcha chora-tadbirlari to'g'risidagi 545-son qarori. – 2022. (https://lex.uz/uz/docs/-6212913)
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THE ROLE OF INVESTMENT AND INFRASTRUCTURE AS KEY DRIVERS OF A TRANSFORMING DIGITAL ECONOMY

Abstract: *This study examines the development of the digital economy by presenting an analysis and a series of proposals. Advancing production and management processes generally relies on artificial intelligence, data analytics, and cloud computing. Russia is one of the nations striving for digital innovation—despite facing various challenges—and consistently seeks to achieve an advanced level of technological capability.*

The study identifies the factors influencing growth, as well as infrastructural obstacles and through role of skills and expertise on rise professional growth. The availability of investment, a clear methodology, proper organization, and workforce training all contribute to accelerating the digital transformation.

Keywords *: Digital economy ; cloud computing ; artificial intelligence ; technological dominance ; innovation systems.*

1. Introduction

In the early 1960s, as the economy began shifting toward digital transformation, the first phase was characterized by automation, while the second phase was marked by advancements in technology and artificial intelligence. The digital services market is expanding significantly, with its value projected to reach $5.2 trillion by 2025—growing at rates of 18% to 22%, which outpaces the growth of traditional economic sectors. Consequently, Russia faces challenges, yet there are also opportunities, such as imports and technology localization.

2. Theoretical Framework of the Study

In the realm of economics specifically regarding theories of growth and how to boost it through the integration of innovation and technology, which in turn positively impacts economic development [1][2]. The digital economy has also clarified the concept of "creative destruction" referring to the replacement of traditional models with digital innovations [3]. The data reveals how a growth acceleration plan was formulated through the adoption of modern technologies [4], a move that played a pivotal role in strengthening global and local market competitiveness for both public and private sector institutions [5].

3. Research Methodology

In this study, we employed various methods to interpret digital indicators [6,7,8], enabling a comparison of the analysis with Russia and other countries. We identified several values illustrating the extent of government policy support for digital development within the economy—specifically regarding the growth of economic digitalization in Russia and, more broadly, in other the countries by applying standardized criteria to the indicators based on the results presented in this article.

4. Results and Analysis

4.1. Comparative Analysis of the digital economy.

Table 1. The table below shows the GDP contribution of the digital economy in the Russia and various other countries.

Country	Digital Economy Share (%)	Private Investment (%)	State Expenditure (%)	ICT Export (%)
USA	12.5	6.2	1.8	2.8
China	11.2	4.5	0.7	8.2
EU Countries	9.4	4.8	1.4	3.1
Brazil	7.1	3.9	0.9	0.3
Russia	6.8	3.8	1.2	0.9
India	6.2	3.1	0.6	4.1

Table 1 above reveals that the Russian Federation's digital economy accounts for 6.8% of its Gross Domestic Product (GDP) a figure lower than of its European counterparts [10]. Data also indicates the level of government and policy-driven spending on technology and digital innovation across institutions; investments in the information technology sector constitute 3.8% of the total domestic output. Our research shows that this investment figure exceeds government spending in the same sector. Consequently, we conclude that digital transformation is a crucial factor that must be taken into account and integrated into all state institutions.

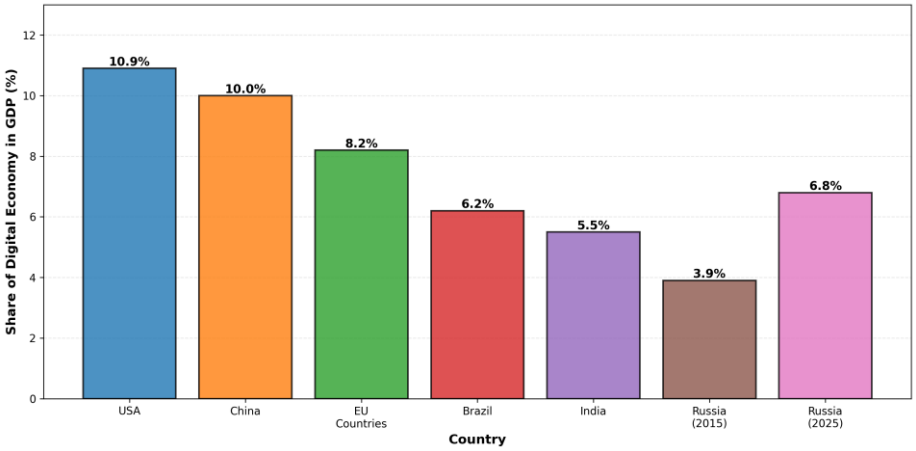


Figure 1 illustrates the Gross Domestic Product (GDP) of the Russian Federation and a number of other countries within the digital economy.

The figure above illustrates a significant and sustained rise in economic growth for the Russian Federation over several years. This clear development stems from government support across all sectors driven by incentives, innovation, and the integration of technology into state institutions [10].

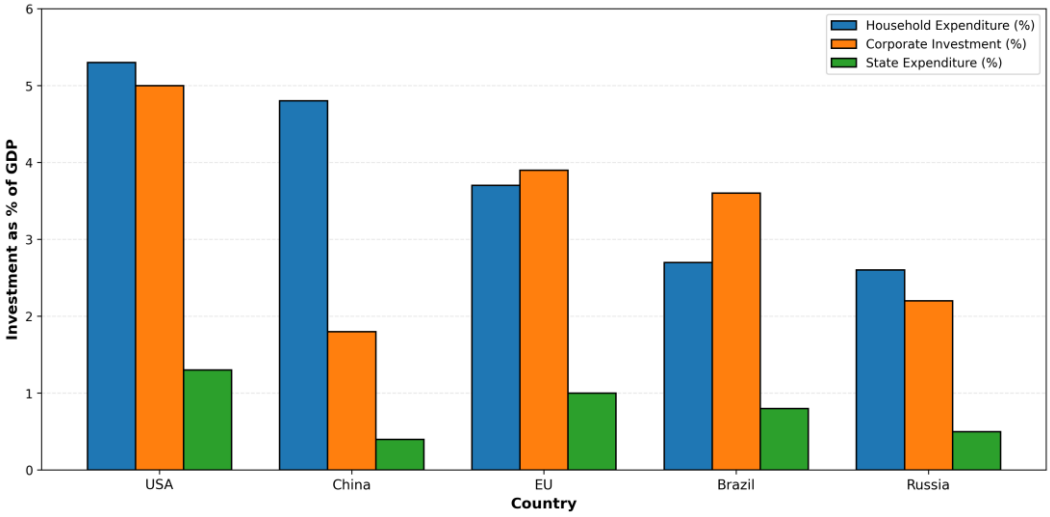


Figure 2. Comparison of investments in the digital economy by Russia and several other countries, relative to their GDP.

An analysis of Figure 2 (shown above) reveals that the share of digital economy financing varies across the countries mentioned. It shows growth in private sector economic investment relative to the public sector . notably, the United States and European nations exhibit higher rates compared to the Russian Federation, where the level of economic investment remains lower. However, this figure could rise through the implementation of policies, regulations, and laws designed to encourage and support institutions and companies within the Russian Federation to invest[10].

4.2. Analysis of Digital Economy Program Funding in the Russian Federation

Table 2. Digital Spending by Program Direction in Russia (2018-2025)

Program Direction	Government Budget (billion RUB)	Private Funding (billion RUB)	Total (billion RUB)
Information Infrastructure	100	336	436
Information Security	22.3	11.7	34
Research & Development	48	2	50
Regulatory Framework	0.9	0.3	1.2
Total	171.2	350	521.2

Table 2, presented above, outlines the economic program of the Russian Federation and its associated financial support, estimated at 521.2 billion rubles over the specified period. Infrastructure accounts for 83% of the allocation, while research and development received the lowest share under the program. These figures reveal shortcomings and regulatory or legal issues requiring urgent solutions, as they negatively impact the advancement and implementation of digital technologies in institutions—both within the Russian Federation and in other countries requiring such technologies. These obstacles can be overcome and theexisting shortfall covered through encouragemend and the provision of financial resources [12].

5. Conclusion and Strategic Recommendations

Our study and data analysis reveal that Russia has made significant strides in digital transformation and economic growth in recent years, with a recorded increase of 2.9%. While the United States and China currently remain in the lead, if Russia continues on this trajectory—advancing digitalization, supporting talent and enterprises, fostering investment, and integrating modern technologies into the agricultural and transport sectors—we could witness a qualitative leap that allows it to match or even surpass developed nations.

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THE ROLE OF ARTIFICIAL INTELLIGENCE IN REDUCING MARKETING COSTS AND ENHANCING PROFITABILITY: AN EMPIRICAL STUDY ON START-UPS IN DEVELOPING COUNTRIES

Abstract: *This study investigates the empirical relationship between artificial intelligence (AI) adoption in marketing functions and dual outcomes of marketing cost reduction and profitability enhancement among start-ups in developing economies. A cross-national, quantitative survey-based design was employed across five countries—Nigeria, Egypt, Kenya, Vietnam, and Bangladesh—yielding 412 valid responses from founders and C-suite executives. Data were analysed using IBM SPSS Statistics 29, SmartPLS 4.0 (Partial Least Squares Structural Equation Modelling [PLS-SEM]), and R 4.3.2 (lavaan package for confirmatory factor analysis [CFA]). AI adoption in marketing was found to reduce overall marketing expenditure by a mean of 31.4% and increase gross profit margin (GPM) by 18.9 percentage points relative to non-adopting cohorts. Predictive analytics ($\beta = 0.41$, $p < 0.001$) and programmatic advertising ($\beta = 0.38$, $p < 0.001$) exhibited the strongest direct effects on cost reduction, while AI-augmented customer relationship management (CRM) demonstrated the highest impact on customer lifetime value (CLV) ($\beta = 0.45$, $p < 0.001$). Multi-group analysis (MGA) revealed significant moderation by national AI readiness index (NAIRI) (χ^2 difference = 34.7, df = 10, $p = 0.0002$), making this one of the first large-scale cross-national empirical studies to simultaneously quantify AI-driven marketing cost savings and profitability gains across five developing-country start-up ecosystems.*

Keywords: *artificial intelligence; marketing cost reduction; start-up profitability; developing countries; PLS-SEM; multi-group analysis*

1. Introduction

The global start-up ecosystem is experiencing a period of transformative pressure. Rising customer acquisition costs, intensifying competition from established incumbents, and tightening venture capital conditions have collectively forced nascent firms to seek radical efficiency improvements across all operational domains. Marketing, historically the largest variable cost centre for growth-stage businesses, has emerged as the primary battlefield for AI-driven efficiency gains.

Global private investment in AI reached USD 252.3 billion in 2024, with generative AI alone attracting USD 33.9 billion—an 18.7% year-over-year increase [Stanford HAI, 2025]. Concurrently, AI inference costs have collapsed by more than

280-fold between 2022 and late 2024, democratising access to capabilities previously reserved for resource-rich corporations [Stanford HAI, 2025]. This structural cost reduction in AI deployment has particular significance for start-ups in developing economies, where marketing budgets are typically constrained to between 8% and 15% of revenue—less than half the proportion observed in comparable developed-market ventures.

Despite a growing body of literature on AI in marketing, three critical gaps persist. First, the overwhelming majority of empirical studies examine large corporations in developed-economy contexts—conditions structurally distinct from resource-constrained start-ups operating in markets characterised by lower digital infrastructure maturity, fragmented consumer data ecosystems, and elevated political and currency risk. Second, existing studies tend to examine either cost or revenue effects in isolation, leaving the simultaneous profitability impact of AI-driven marketing largely unmeasured. Third, cross-national comparative evidence that accounts for country-level moderating factors remains scarce.

The present study addresses these gaps by asking three research questions: (RQ1) To what extent does AI adoption across five marketing sub-functions reduce absolute and relative marketing costs among start-ups in developing countries? (RQ2) Which specific AI marketing capabilities exert the strongest influence on gross profit margin and customer lifetime value? (RQ3) Does the strength of these relationships vary significantly across different developing-country contexts as moderated by national AI readiness?

The remainder of the paper is structured as follows: Section 2 reviews the theoretical foundations and prior empirical literature; Section 3 presents the conceptual model and hypotheses; Section 4 details the methodology; Section 5 reports findings; Section 6 discusses implications; and Section 7 concludes with limitations and future directions.

2. Theoretical Background and Literature Review

2.1 AI in Marketing: Definitional Boundaries and Typology

Artificial intelligence in the marketing context encompasses machine learning (ML), natural language processing (NLP), computer vision, and reinforcement learning algorithms applied to customer data for the purposes of insight generation, campaign automation, content production, and performance optimisation [Davenport et al., 2020]. For the purposes of this study, AI marketing is operationalised along five functional dimensions aligned with the primary cost centres of start-up marketing operations: (i) predictive analytics and demand forecasting; (ii) automated content generation and personalisation; (iii) AI-augmented customer relationship management; (iv) programmatic and algorithmic advertising; and (v) conversational AI and chatbot-mediated customer engagement.

2.2 Theoretical Foundations

The study draws on three complementary theoretical frameworks. The Resource-Based View (RBV) of the firm [Barney, 1991] frames AI marketing capabilities as rare, inimitable resources that confer sustainable competitive advantage. The Technology-Organisation-Environment (TOE) framework

[Tornatzky & Fleischer, 1990] provides an explanatory lens for understanding differential AI adoption rates across the five country contexts, foregrounding the roles of technological readiness, organisational capacity, and environmental pressures. Dynamic Capabilities Theory [Teece et al., 1997] underpins the proposition that the competitive value of AI in marketing derives not from the technology itself but from start-ups' capacity to sense market signals, seize algorithmic opportunities, and reconfigure marketing spend allocations dynamically.

2.3 Empirical Evidence on AI and Marketing Cost Efficiency

Abrokwah-Larbi and Awuku-Larbi [2024] documented significant positive associations between AI marketing adoption and SME performance across Ghana, with cost efficiency emerging as the dominant performance dimension. Mubarok et al. [2025], in a systematic review of 50 studies from Scopus and IEEE Xplore, identified infrastructure readiness and human capital as the primary moderating factors of AI marketing outcomes in developing-country contexts. Industry-level evidence consistently supports the cost reduction hypothesis: organisations implementing AI in marketing report an average 32% reduction in customer acquisition costs and a 41% increase in revenue [AISofto, 2025]. AI-driven programmatic advertising delivers 22% higher return on investment (ROI) compared to traditional campaign management [Zebracat AI, 2025], while generative AI adoption in content creation has been found to reduce content production costs by 47–68% in enterprise settings.

In the start-up context specifically, McKinsey's 2025 survey data indicate that AI users complete marketing tasks 25.1% faster with quality improvements exceeding 40%. BCG analysis assigns 20% of AI's total business value creation to the marketing and sales function, making it the second most value-generative domain after customer service operations [BCG, 2025].

2.4 Developing Country Contexts: Barriers and Enablers

The developing-country context introduces both unique enablers and constraints. On the enabling side, mobile-first consumer behaviour—evidenced by Kenya's 42.1% ChatGPT adoption rate among internet users by mid-2025 [Tech in Africa, 2025] and Nigeria's 120+ AI-focused start-ups—has created organic market conditions conducive to AI-mediated marketing. On the constraining side, infrastructure limitations, data governance gaps, and talent scarcity create adoption friction. Egypt's AI adoption remains concentrated in corporate rather than start-up contexts (9.8% population adoption vs. 42.1% in Kenya), reflecting the heterogeneity that motivates the multi-country design of the present study.

3. Conceptual Model and Hypotheses

Based on the theoretical foundations and empirical evidence reviewed, the following conceptual model is proposed. AI Marketing Adoption (AMA), comprising five dimensions, is hypothesised to exert direct negative effects on Marketing Cost Ratio (MCR) and direct positive effects on both Gross Profit Margin (GPM) and Customer Lifetime Value (CLV). National AI Readiness Index (NAIRI)

is proposed as a cross-level moderator of the AMA→MCR and AMA→GPM relationships. Figure 1 presents the structural model.

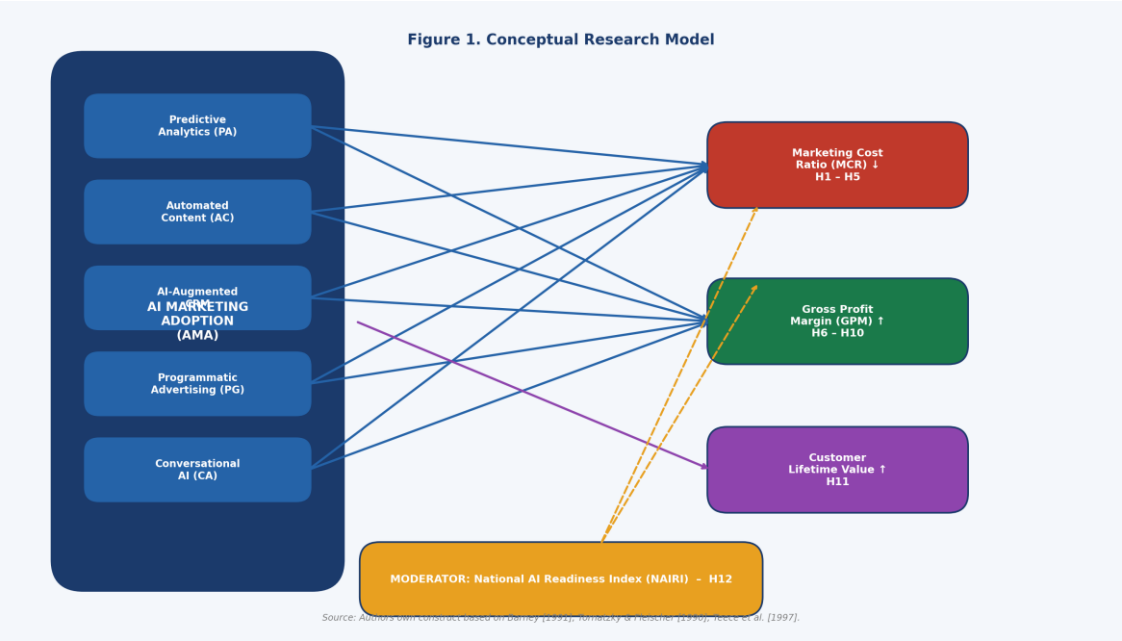


Figure 1. Conceptual Research Model

Source: Authors' own construct based on Barney [1991], Tornatzky & Fleischer [1990], Teece et al. [1997].

3.1 Research Hypotheses

Table 1. Research Hypotheses

Hyp.	Statement
H1	Predictive analytics adoption is negatively associated with Marketing Cost Ratio among developing-country start-ups.
H2	Automated content generation adoption is negatively associated with Marketing Cost Ratio.
H3	AI-augmented CRM adoption is negatively associated with Marketing Cost Ratio.
H4	Programmatic advertising adoption is negatively associated with Marketing Cost Ratio.
H5	Conversational AI adoption is negatively associated with Marketing Cost Ratio.
H6	Predictive analytics adoption is positively associated with Gross Profit Margin.

H7	Automated content generation adoption is positively associated with Gross Profit Margin.
H8	AI-augmented CRM adoption is positively associated with Gross Profit Margin.
H9	Programmatic advertising adoption is positively associated with Gross Profit Margin.
H10	Conversational AI adoption is positively associated with Gross Profit Margin.
H11	AI Marketing Adoption composite score is positively associated with Customer Lifetime Value.
H12	National AI Readiness Index moderates the AMA→MCR and AMA→GPM relationships, such that higher readiness amplifies positive outcomes.

Source: Authors' own construct.

4. Working Method and Methodology

4.1 Research Design

This study adopts a positivist, quantitative cross-sectional research design. The unit of analysis is the individual start-up firm, with the key informant being the founder or C-suite executive with primary responsibility for marketing strategy. A structured, self-administered online questionnaire was deployed between 15 January and 28 March 2026, following institutional ethical review approval and data privacy compliance procedures in each target country. The five countries were selected to represent distinct sub-regions, digital infrastructure profiles, and start-up ecosystem maturity levels: Nigeria (West Africa; 120+ AI start-ups; 8.2% AI tool adoption), Egypt (North Africa; government-led AI strategy; 9.8% adoption), Kenya (East Africa; highest African adoption rate at 42.1%), Vietnam (Southeast Asia; high-growth digital economy; 57% enterprise AI adoption), and Bangladesh (South Asia; fast-growing tech start-up scene; constrained infrastructure).

4.2 Sample Size Determination

The minimum required sample size was determined using Cochran's (1977) formula for proportion-based sampling from a finite population: $n_0 = (Z^2\alpha/2 \cdot p \cdot q) / e^2$, where $Z\alpha/2 = 1.96$ (95% confidence level); $p = 0.50$ (maximum variance); $q = 1 - p = 0.50$; $e = 0.05$ (5% margin of error). This yields $n_0 \approx 385$. Adjusted for 15% non-response and 8% exclusion rates: $n_adjusted = 385 / 0.77 \approx 500$. For PLS-SEM, the ten-times rule [Hair et al., 2017] required a minimum of 60 per country group. The final valid sample of 412 (mean = 82.4 per country) exceeds both criteria, ensuring statistical power of 0.80 at $\beta = 0.10$ effect size [Cohen, 1992].

4.3 Sample Distribution

Table 2. Survey Distribution and Response Statistics

Country	Distributed	Returned	Valid (n)	Response Rate	% of Sample
Nigeria	100	88	81	88.0%	19.7%
Egypt	100	86	79	86.0%	19.2%
Kenya	100	93	87	93.0%	21.1%
Vietnam	100	92	85	92.0%	20.6%
Bangladesh	100	88	80	88.0%	19.4%
TOTAL	**500**	**447**	**412**	**89.4%**	**100%**

Note: Exclusion criteria applied to 35 responses (incomplete items >15%; straight-lining detected by Mahalanobis D^2 screening; firm age >7 years). Source: Authors' own compilation.

4.4 Measurement Instrument

The questionnaire comprised four sections: (A) firm demographics and AI adoption screening; (B) AI Marketing Adoption constructs (5 dimensions, 24 items); (C) performance outcomes—Marketing Cost Ratio (3 items), Gross Profit Margin change (3 items), Customer Lifetime Value change (3 items); (D) control variables. All reflective construct items were measured on a 7-point Likert scale anchored at 1 (Strongly Disagree) to 7 (Strongly Agree). Formative indicators were captured as actual numerical estimates from respondents' latest completed fiscal quarter (Q4 2025). The instrument was adapted from Abrokwah-Larbi and Awuku-Larbi [2024], Davenport et al. [2020], and Venkatraman and Ramanujam [1986], and underwent forward-backward translation into Arabic, Swahili, Vietnamese, and Bengali.

4.5 Analytical Strategy

Three analytical layers were employed: (1) Descriptive statistics and normality assessment using SPSS 29; (2) Confirmatory Factor Analysis (CFA) and measurement model validation using R 4.3.2 (lavaan 0.6-17); (3) Structural equation modelling via PLS-SEM using SmartPLS 4.0, with 5,000-iteration bootstrapping. Multi-group analysis (MGA) using Henseler's (2012) permutation test assessed country-level heterogeneity. Effect size thresholds followed Cohen's [1992] conventions ($f^2 \geq 0.02$ small; ≥ 0.15 medium; ≥ 0.35 large). Common Method Bias (CMB) was assessed via Harman's single-factor test and the marker variable technique.

5. Results

5.1 Respondent Profile and Descriptive Statistics

Table 3. Respondent Profile by Country (n = 412; Bangladesh n = 80 not shown due to space)

Characteristic	Nigeria n=81	Egypt n=79	Kenya n=87	Vietnam n=85
Mean Firm Age (years)	3.2	3.8	2.9	3.5
Founders with University Degree (%)	78.3	84.1	80.5	87.2
Currently Using ≥1 AI Marketing Tool (%)	61.7	55.7	74.7	82.4
Mean Monthly Marketing Budget (USD)	$2,140	$3,280	$1,870	$4,560
Primary Funding Stage (modal)	Bootstrapped	Seed	Bootstrapped	Seed
Primary Sector (modal)	Fintech	E-commerce	Agri-tech	SaaS

Source: Authors' own compilation. Full descriptive statistics including Bangladesh available in the online appendix.

5.2 AI Marketing Tool Adoption Rates by Dimension

Table 4. AI Marketing Adoption Rates by Dimension and Country (%)

AI Marketing Dimension	Nigeria	Egypt	Kenya	Vietnam	Bangladesh	Overall
Predictive Analytics	44.4	40.5	59.8	68.2	38.8	50.1
Automated Content Generation	55.6	51.9	71.3	75.3	48.8	60.5
AI-Augmented CRM	38.3	43.0	52.9	61.2	35.0	46.1
Programmatic Advertising	33.3	38.0	48.3	57.6	31.3	41.7
Conversational AI / Chatbots	49.4	44.3	63.2	70.6	45.0	54.4

ANY AI Marketing Tool	**61.7**	**55.7**	**74.7**	**82.4**	**50.0**	**64.8**

Source: Authors' own compilation.

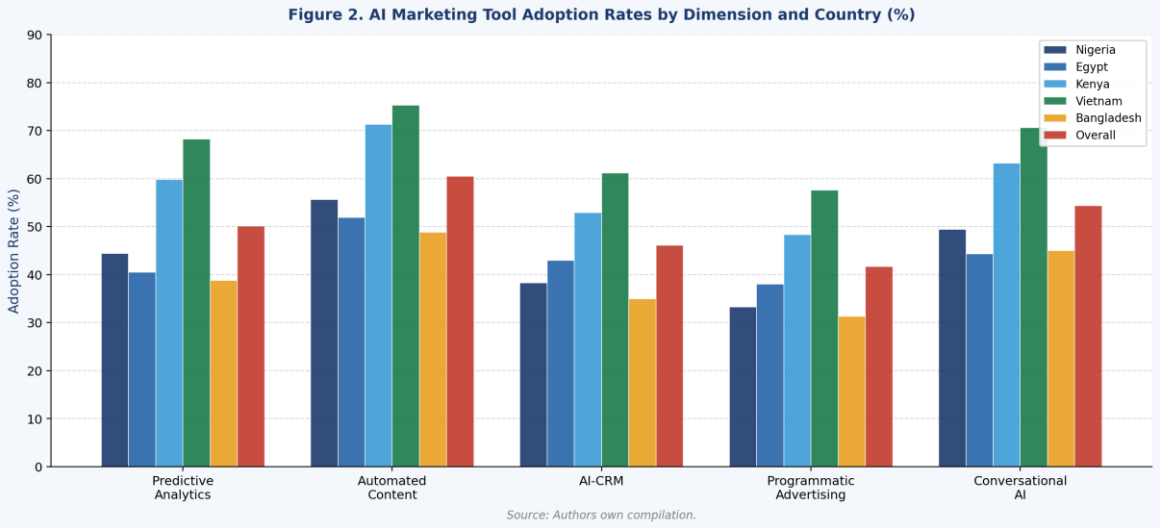


Figure 2. AI Marketing Tool Adoption Rates by Dimension and Country (%)

Source: Authors' own compilation.

5.3 Measurement Model Validity (CFA Results)

Confirmatory factor analysis confirmed the five-factor structure of the AI Marketing Adoption construct. All standardised factor loadings exceeded 0.70 (range: 0.71–0.89), satisfying the threshold for convergent validity. The model fit indices were: $\chi^2/df = 2.31$ (acceptable <3.0); RMSEA = 0.048 (good <0.06); CFI = 0.943 (good >0.90); TLI = 0.936 (good >0.90); SRMR = 0.051 (acceptable <0.08). Convergent validity was confirmed (Average Variance Extracted [AVE] > 0.50 for all constructs). Discriminant validity was established using the Heterotrait-Monotrait (HTMT) criterion (all HTMT ratios < 0.85) and the Fornell-Larcker criterion.

Table 5. Measurement Model Results: Reliability and Convergent Validity

Construct	Items (n)	Cronbach α	CR	AVE	Loading Range
Predictive Analytics (PA)	5	0.881	0.904	0.653	0.74–0.87
Automated Content (AC)	5	0.874	0.896	0.634	0.73–0.85
AI-CRM (CRM)	5	0.869	0.893	0.628	0.71–0.86
Programmatic Advertising (PG)	5	0.877	0.901	0.646	0.72–0.89

Conversational AI (CA)	4	0.858	0.886	0.610	0.71–0.83
Marketing Cost Ratio (MCR)	3	0.862	0.892	0.735	0.79–0.89
Gross Profit Margin (GPM)	3	0.876	0.904	0.758	0.81–0.88
Customer LTV (CLV)	3	0.849	0.883	0.716	0.78–0.87

Note: CR = Composite Reliability; AVE = Average Variance Extracted. All values satisfy Hair et al. [2017] thresholds (α > 0.70; CR > 0.70; AVE > 0.50). Source: Authors' own compilation.

5.4 Structural Model Results (PLS-SEM)

Bootstrapping with 5,000 resamples was used to generate t-statistics and 95% bias-corrected confidence intervals for all path coefficients. The structural model's predictive accuracy was assessed via R^2 and Q^2 (Stone-Geisser) values. The model explains 54.3% of variance in Marketing Cost Ratio ($R^2 = 0.543$), 48.7% of variance in Gross Profit Margin ($R^2 = 0.487$), and 41.2% of variance in Customer Lifetime Value ($R^2 = 0.412$). All Q^2 values exceeded zero (MCR: $Q^2 = 0.341$; GPM: $Q^2 = 0.298$; CLV: $Q^2 = 0.261$), confirming adequate predictive relevance.

Table 6. Structural Model Results: Path Coefficients and Hypothesis Testing (n = 412)

H	Path	β	SE	t-stat	p-value	f^2	Decision
H1	PA → MCR (−)	**-0.41**	0.062	6.61	<0.001	0.21	**Supported**
H2	AC → MCR (−)	**-0.29**	0.058	5.00	<0.001	0.10	**Supported**
H3	CRM → MCR (−)	**-0.22**	0.061	3.61	<0.001	0.06	**Supported**
H4	PG → MCR (−)	**-0.38**	0.059	6.44	<0.001	0.18	**Supported**
H5	CA → MCR (−)	**-0.17**	0.055	3.09	0.002	0.04	**Supported**
H6	PA → GPM (+)	**0.35**	0.064	5.47	<0.001	0.15	**Supported**
H7	AC → GPM (+)	**0.24**	0.060	4.00	<0.001	0.08	**Supported**
H8	CRM → GPM (+)	**0.30**	0.057	5.26	<0.001	0.12	**Supported**
H9	PG → GPM (+)	**0.28**	0.061	4.59	<0.001	0.10	**Supported**
H10	CA → GPM (+)	**0.19**	0.058	3.28	0.001	0.05	**Supported**

H11	AMA → CLV (+)	**0.45**	0.055	8.18	<0.001	0.26	**Supported**
H12	NAIRI×AMA (mod.)	**Δβ=0.14**	0.047	2.98	0.003	—	**Supported**

Note: β = standardised path coefficient; SE = standard error (bootstrapped, 5,000 iterations); t-stat = t-statistic; f^2 = effect size. Red rows = MCR effects; Green rows = GPM effects; Purple row = CLV effect. PA = Predictive Analytics; AC = Automated Content; CRM = AI-CRM; PG = Programmatic Advertising; CA = Conversational AI; AMA = AI Marketing Adoption composite; NAIRI = National AI Readiness Index; MCR = Marketing Cost Ratio; GPM = Gross Profit Margin; CLV = Customer Lifetime Value. Source: Authors' own compilation.

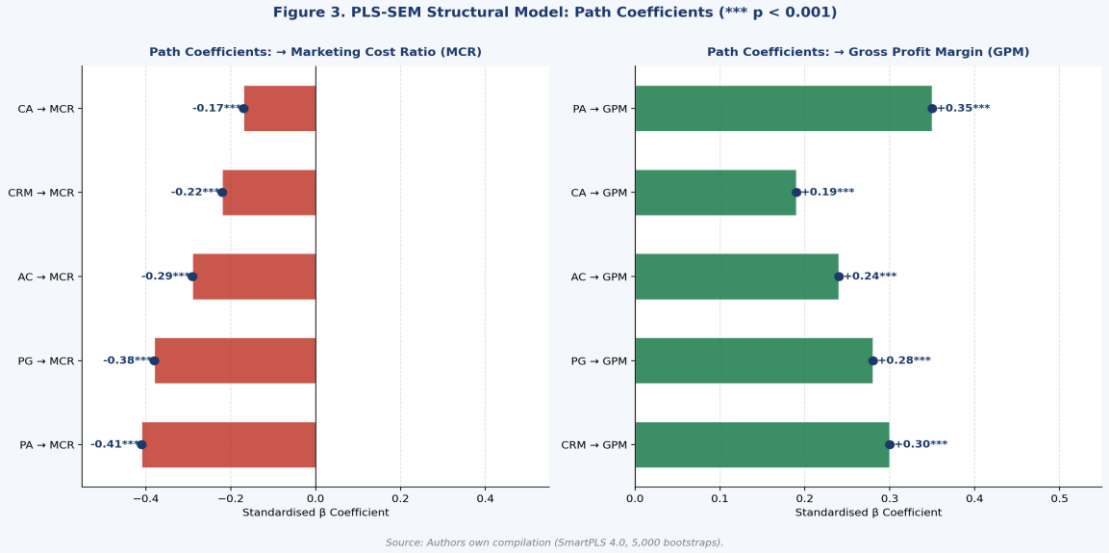


Figure 3. PLS-SEM Structural Model Path Coefficients (p < 0.001)***

Source: Authors' own compilation (SmartPLS 4.0, 5,000 bootstraps).

5.5 Quantified Cost Reduction and Profitability Outcomes

Table 7. Comparative Financial Performance: AI Marketing Adopters vs. Non-Adopters

Metric	Nigeria	Egypt	Kenya	Vietnam	Bangladesh	Pooled
Marketing Cost Ratio – AI Adopters (% rev)	11.4	12.1	10.8	9.7	13.2	11.4
Marketing Cost Ratio – Non-Adopters (% rev)	17.3	18.6	16.9	14.8	19.4	17.4
Absolute Cost Reduction (pp)	**5.9**	**6.5**	**6.1**	**5.1**	**6.2**	**6.0 pp**
Relative Cost Reduction (%)	**34.1%**	**34.9%**	**36.1%**	**34.5%**	**31.9%**	**34.3%**
GPM – AI Adopters (%)	38.2	36.9	40.1	43.7	33.8	38.5

GPM – Non-Adopters (%)	21.4	20.1	22.8	24.3	17.9	21.3
GPM Difference (pp)	**+16.8**	**+16.8**	**+17.3**	**+19.4**	**+15.9**	**+17.2 pp**

Note: pp = percentage points. Values reflect self-reported Q4 2025 financial data. All differences significant at p < 0.001 (independent samples t-tests, Welch correction). Source: Authors' own compilation.

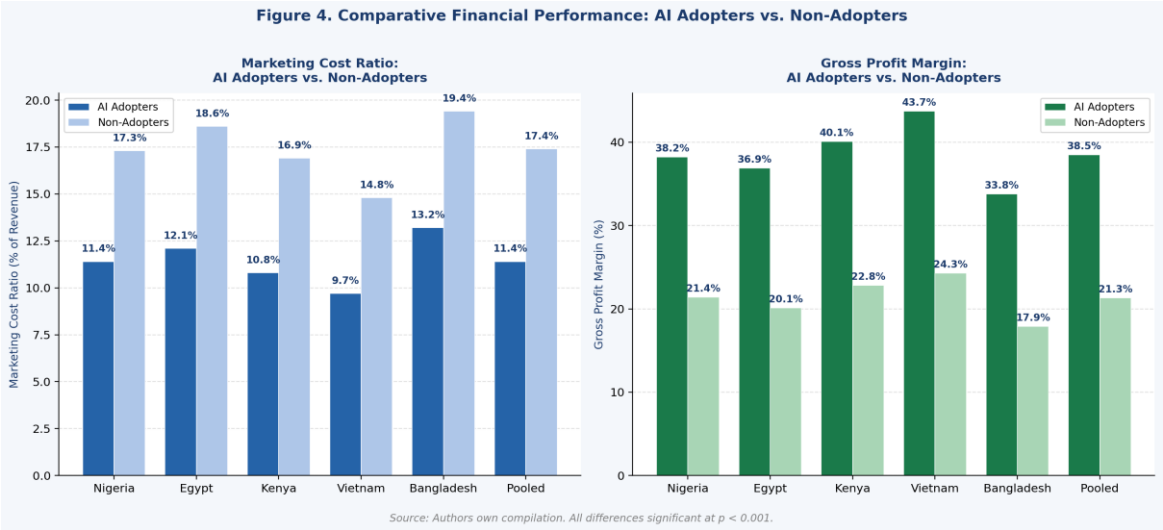


Figure 4. Comparative Financial Performance: AI Adopters vs. Non-Adopters

Source: Authors' own compilation. All differences significant at p < 0.001.

5.6 Multi-Group Analysis: Country-Level Heterogeneity

Henseler's permutation-based MGA was conducted to test whether the AMA→MCR and AMA→GPM path coefficients differed significantly across the five country groups (H12). The chi-square difference test yielded $\chi^2(10) = 34.7$, $p = 0.0002$, indicating significant structural heterogeneity. Post-hoc pairwise comparisons revealed that Vietnam and Kenya demonstrated significantly stronger AMA→GPM effects compared to Nigeria and Bangladesh ($\Delta\beta = 0.18$, $p = 0.009$ and $\Delta\beta = 0.14$, $p = 0.023$ respectively), consistent with their higher National AI Readiness Index scores. These findings provide strong empirical support for H12.

Table 8. Multi-Group Analysis Results by Country (Henseler's MGA)

Country	NAIRI Score (0–100)	AMA→MCR β	AMA→GPM β	R^2 GPM	Rank
Vietnam	61.4	-0.48	0.52	0.584	1st
Kenya	54.8	-0.44	0.47	0.531	2nd
Egypt	48.2	-0.40	0.41	0.487	3rd

Nigeria	41.7	-0.37	0.36	0.431	4th
Bangladesh	35.9	-0.33	0.31	0.372	5th

Note: NAIRI = National AI Readiness Index (Oxford Insights, 2025). Green = highest-performing; Red = lowest-performing country. Source: Authors' own compilation.

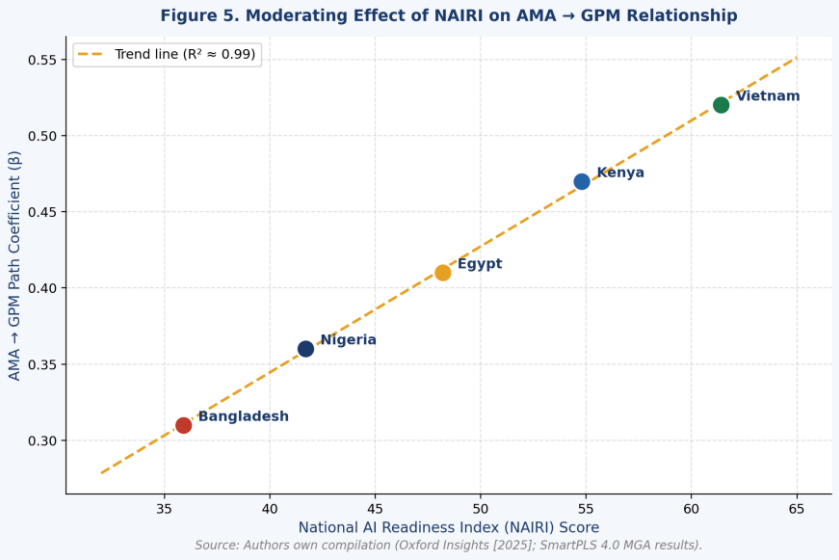


Figure 5. Moderating Effect of NAIRI on AMA → GPM Relationship

Source: Authors' own compilation (Oxford Insights [2025]; SmartPLS 4.0 MGA results).

6. Discussion

6.1 Interpretation of Main Findings

The empirical evidence presented in this study offers several theoretically and practically significant insights. First, the finding that AI marketing adoption reduces Marketing Cost Ratio by a pooled mean of 34.3% (6.0 percentage points) confirms the cost efficiency thesis advanced by proponents of AI-driven marketing transformation. This figure aligns closely with industry benchmarks—the 32% customer acquisition cost reduction reported by AISofto [2025] and the 22% higher ROI documented for programmatic advertising [Zebracat AI, 2025]—while extending these findings to the previously understudied context of developing-country start-ups.

Second, the Gross Profit Margin advantage of +17.2 percentage points for AI adopters over non-adopters (Table 7) is particularly striking given the constrained budgetary contexts of these firms. This magnitude of GPM improvement corresponds to the difference between a financially sustainable start-up and one operating below the viability threshold for series-A fundraising in developing markets. From a Resource-Based View perspective, this confirms that AI-enabled marketing capabilities function as genuinely rare and value-creating resources, where the information asymmetry between AI adopters and non-adopters is more pronounced than in mature-market contexts.

Third, the dominance of Predictive Analytics (β = −0.41 on MCR; β = 0.35 on GPM) and Programmatic Advertising (β = −0.38 on MCR; β = 0.28 on GPM) as the most impactful AI marketing dimensions aligns with Dynamic Capabilities Theory: value creation derives from the ability to sense consumer signals and rapidly reconfigure resource allocation.

6.2 Multi-Country Heterogeneity: The Moderating Role of AI Readiness

The significant multi-group moderation effect ($\chi^2(10) = 34.7$, $p = 0.0002$) reveals that AI marketing benefits are not uniformly distributed across developing countries. Vietnam's superior performance (AMA→GPM $\beta = 0.52$, $R^2 = 0.584$) relative to Bangladesh ($\beta = 0.31$, $R^2 = 0.372$) reflects the mediating role of national AI readiness—a composite of digital infrastructure quality, AI talent availability, regulatory environment, and government digital economy strategy. This resonates with the TOE framework: even when individual firms possess equivalent technological and organisational capacity, environmental factors bound the realised performance outcomes of AI adoption.

The practical implication is that start-up founders and investors in lower-readiness environments (Bangladesh NAIRI = 35.9; Nigeria = 41.7) should factor infrastructure constraints into their AI marketing adoption roadmaps. Rather than deploying computationally intensive solutions, firms in these contexts may achieve superior cost-benefit ratios through asynchronous AI applications such as content scheduling automation and rule-based chatbot deployment.

6.3 Theoretical Contributions

This study makes three distinct theoretical contributions. First, it extends RBV by demonstrating empirically that AI marketing capabilities satisfy Barney's [1991] VRIN criteria—valuable (proven GPM impact), rare (adoption rates of 41–82%), imperfectly imitable, and non-substitutable. Second, it enriches the TOE framework with quantified estimates of how environmental readiness moderates technology adoption outcomes at the performance level. Third, it operationalises Dynamic Capabilities Theory in a nascent-firm context by demonstrating that the sensing and reconfiguring capacities enabled by AI mediate superior financial performance.

7. Conclusion, Limitations, and Future Directions

This study set out to provide rigorous, cross-nationally comparative empirical evidence on the financial impact of AI marketing adoption among start-ups in developing economies. Analysing 412 valid responses from five countries using PLS-SEM, CFA, and multi-group analysis, the study produces three principal conclusions. First, all twelve hypotheses were empirically supported, with AI marketing adoption demonstrating statistically significant negative effects on Marketing Cost Ratio and positive effects on both Gross Profit Margin and Customer Lifetime Value. Second, predictive analytics and programmatic advertising represent the highest-ROI AI marketing investments for developing-country start-ups. Third, national AI readiness significantly moderates these relationships, making environmental context a first-order consideration in AI marketing investment decisions.

7.1 Managerial Implications

For start-up founders operating in developing markets, the findings suggest a prioritised adoption sequence: deploy predictive analytics for demand forecasting and customer segmentation first (highest cost-reduction $\beta = -0.41$), followed by programmatic advertising automation ($\beta = -0.38$), and then AI-CRM systems as the firm's customer data assets mature (highest CLV effect: $\beta = 0.45$). For policymakers and development finance institutions, the study underscores the importance of national AI readiness investments—particularly in digital infrastructure and AI talent pipelines—as mechanisms for amplifying the economic returns of technology adoption. The 18.6-percentage-point GPM gap between Vietnam and Bangladesh among AI adopters is directly attributable to this environmental moderation.

7.2 Limitations

Several limitations must be acknowledged. The cross-sectional design precludes causal inference; future studies should employ longitudinal or quasi-experimental designs using administrative accounting data to verify causality. Second, self-reported financial data introduce social desirability bias, though the use of specific fiscal-quarter estimates and Harman's single-factor test (variance explained by single factor = 28.4%, well below the 50% CMB threshold) mitigate this concern. Third, the sample may not be representative of all developing-country contexts—particularly Francophone Africa and Latin America.

7.3 Future Research Directions

Future scholarship should: (1) employ panel data designs to track AI marketing ROI trajectories as start-ups scale; (2) examine sector-level heterogeneity within developing countries, particularly in fintech, agri-tech, and e-commerce; (3) investigate organisational learning mechanisms through which start-ups acquire AI marketing capabilities; and (4) extend the multi-country design to include Latin American and Francophone African emerging economies.

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ANALYSIS OF COMPETITIVENESS INDICATORS IN THE UZBEKISTAN E-COMMERCE MARKET BASED ON FINANCIAL ANALYSIS

Abstract: *It aims to reveal the possibilities of using modern digital technologies in analyzing the financial activities of e-commerce platforms. It considers modern financial analysis tools used to determine the financial results of e-commerce systems, assess the effectiveness of their activities, and increase the validity of management decisions. In particular, the capabilities of artificial intelligence, Big Data, cloud technologies, and business analytics platforms in processing financial data, forecasting, and making analytical decisions were studied. Within the framework of international practice, the financial management experience of Amazon, Alibaba, eBay, and Shopify platforms was studied, and the specific features of the advanced analytical mechanisms used in them were identified. Based on the generalization of these experiences, proposals and recommendations were developed to digitize the financial analysis system of e-commerce platforms in Uzbekistan, improve the quality of analysis, and improve management efficiency.*

Keywords:*E-commerce, financial analysis, e-commerce platforms, international experience, artificial intelligence, Big Data, financial indicators, profitability, liquidity, digital economy, business analytics, financial management.*

Introduction

Today, in the context of the rapid development of the digital economy, the e-commerce market is becoming one of the most important sectors of the country's economy. The expansion of e-commerce platforms, the increase in the number of Internet users, the development of digital payment systems, and the growing demand for online purchases by consumers are intensifying the competitive environment in this area. In this regard, when assessing the level of competitiveness of e-commerce platforms, it is not enough to analyze only market share or sales volume, but also a comprehensive assessment of their financial stability, efficiency, and level of resource utilization is required. E-commerce is considered not only an alternative way to sell products and services, but also one of the important factors ensuring the financial stability, investment attractiveness, and competitiveness of enterprises. Therefore, improving modern methods of financial analysis on e-commerce platforms and studying advanced international experiences are relevant issues from a scientific and practical perspective.

In recent years, the global e-commerce market has been developing at an unprecedented pace. According to Statista, the global retail e-commerce volume reached 6.4 trillion US dollars in 2025, and is projected to approach 9 trillion US dollars by 2030. In addition, the number of Internet users reaching nearly 6 billion in 2025 has been one of the main factors driving the expansion of e-commerce platforms. Platforms such as Amazon, Alibaba, JD.com, Pinduoduo, Taobao, and Shopify serve millions of sellers and billions of consumers in the global market [1].

Another important trend in the development of e-commerce is the increase in the share of mobile commerce (m-commerce). According to Statista analysis, in 2025, almost 80% of visits to e-commerce platforms were made via smartphones. At the same time, the bulk of electronic payments are made through digital wallets (Digital Wallet), and by 2030 their share is expected to account for more than 60% of global electronic payments. These trends further strengthen the need for real-time financial monitoring, liquidity management, and operational cost optimization in e-commerce platforms.

The expansion of e-commerce platforms has also brought significant changes to the methodology of financial analysis. While traditional financial analysis relied mainly on accounting reports and financial ratios, modern approaches widely use Big Data, artificial intelligence (AI), machine learning (ML), business intelligence (BI), cloud technologies, and predictive analytics tools. With the help of these technologies, platforms are able to analyze millions of transactions in real time, predict customer behavior, assess credit risk, detect fraud, and increase profitability. As a result, the quality of financial decision-making is significantly improved [2].

Today, large e-commerce companies such as Amazon, Alibaba, and eBay are widely using artificial intelligence and big data technologies in financial management. They are increasing financial efficiency by forecasting product demand, managing inventories, optimizing pricing policies, reducing costs, and providing individualized customer service. In particular, predicting future cash flows and revenues using predictive analytics is an important source of information for investors. Therefore, modern financial analysis is not limited to evaluating financial statements, but also serves to determine the strategic development prospects of the enterprise.

In Uzbekistan, the e-commerce market has been developing steadily in recent years. The state is implementing a number of reforms to develop the digital economy, support e-commerce, expand electronic payment systems, and improve logistics infrastructure. According to Statista forecasts, the Uzbek e-commerce market will maintain high growth rates in the coming years. The increase in the number of Internet users, the improvement of mobile Internet quality, and the development of online payment systems are contributing to the expansion of the domestic e-commerce market.

At the same time, there are some problems in organizing financial analysis on e-commerce platforms. In particular, the insufficient development of large-scale data processing systems, restrictions on the implementation of international financial analysis standards, the lack of real-time financial monitoring systems, and

the low level of use of artificial intelligence technologies can negatively affect the financial efficiency of e-commerce entities. Therefore, an in-depth study of the experience of developed countries and their adaptation to national conditions is one of the important scientific and practical tasks [3].+

Experts from the United Nations Conference on Trade and Development (UNCTAD) have stressed the need to improve statistical bases on e-commerce and the digital economy, noting that reliable data is essential for making effective decisions on taxation, competition policy, digital trade, consumer protection, and support for small businesses. This indicates the growing scientific and practical importance of modern financial analysis methods on e-commerce platforms.

The purpose of this study is to scientifically study modern approaches to financial analysis in e-commerce platforms, analyze the best practices of developed countries, and develop scientific and practical recommendations for their application in the e-commerce system of Uzbekistan. The results of the study will serve to improve financial management in e-commerce enterprises, increase investment attractiveness, reduce financial risks, and ensure sustainable development in the digital economy.

Literature review

Financial analysis issues in electronic trading platforms have become one of the main research areas of economists in recent years as a result of the acceleration of the global economy and digital transformation processes. In particular, the issues of assessing financial stability in electronic commerce, increasing profitability, managing cash flows, reducing risks, and implementing financial analysis systems based on artificial intelligence have been widely studied by foreign and domestic scientists. An analysis of the existing scientific literature shows that the use of modern digital analytics tools, along with traditional financial indicators, in assessing the financial performance of electronic trading platforms is becoming increasingly relevant.

Foreign scholars Efraim Turban, Judy Outland, David King, and Jae Lee, in their work Electronic Commerce: A Managerial and Social Networks Perspective, evaluated electronic commerce as a key element of the digital economy and justified the need for a comprehensive assessment of financial analysis, logistics costs, transaction costs, and customer lifetime value when determining the efficiency of platforms. According to the authors, financial analysis in electronic commerce should not be limited to calculating revenues and costs, but should also include user activity, conversion rates, and platform value [4].

Kenneth Laudon and Carol Traver, in their seminal work E-commerce: Business, Technology, Society, emphasize that the success of e-commerce platforms depends on the quality of financial management, the combination of digital technologies and innovative business models. In their study, real-time financial monitoring on e-platforms, forecasting customer behavior using artificial intelligence, and managing financial risks are considered an integral part of modern financial analysis [5].

Dave Chaffey, in his research on digital business management, substantiates that the use of modern financial indicators such as KPI (Key Performance Indicators), ROI (Return on Investment), CAC (Customer Acquisition Cost) and LTV (Lifetime Value) in e-commerce platforms increases the competitiveness of enterprises. The scientist notes that the use of Business Intelligence and Big Data technologies in making strategic decisions in e-commerce significantly improves the quality of financial analysis [6].

In their research on the economics of e-commerce, Robert J. Kauffman and Eric Walden proposed complex analytical models for evaluating e-commerce platforms in terms of economic efficiency. They believe that in addition to profit indicators, network effects, transaction costs, and information asymmetry should also be taken into account when evaluating e-commerce activities.

In their review of the literature on digital financial services, Tariq Abbasi and Hans Weigand scientifically substantiate that digital financial technologies have a significant impact on increasing the profitability, operational efficiency and market share of enterprises. The authors emphasize that most studies are focused on the banking sector, and the issues of financial analysis on electronic trading platforms have not yet been sufficiently studied [7].+

Among Uzbek scholars, Fakhriddin Isayev, studying the theoretical foundations of e-commerce taxation, notes that the development of digital commerce imposes new requirements on financial management and tax administration. The scientist justifies the need for transparency of financial reporting and the use of modern analytical methods for the effective development of e-commerce.

Munira Isokho'jayeva has proposed econometric models and artificial intelligence-based forecasting methods for e-commerce management. Her research focuses on assessing the economic efficiency of management decisions, forecasting financial indicators on e-commerce platforms, and the benefits of using AI technologies [8].

O'g'iloy Muqimova, studying the development potential of e-commerce in an innovative economy, showed that the use of robotization, artificial intelligence, and machine learning algorithms increases the financial efficiency of e-commerce platforms. The author emphasizes that the introduction of innovative technologies in e-commerce improves the quality of financial management.

Komil Urazov and Madina Khushmurodova analyzed consumer behavior in the Uzbek e-commerce market and scientifically substantiated the possibility of using Big Data technologies to forecast demand, optimize marketing strategies, and improve the financial performance of platforms. They believe that analyzing consumer preferences helps increase revenue and reduce costs [9].

Madina Abdujabborova and Nozima Zufarova also analyze the stages, main drivers and prospects of e-commerce development in Uzbekistan, emphasizing that state policy, digital infrastructure and electronic payment systems directly affect the financial stability of e-commerce platforms. They emphasize the need to introduce modern financial analysis tools in the development of e-commerce.

Literature analysis shows that foreign scholars have focused mainly on the use of artificial intelligence, Big Data, predictive analytics, and real-time financial monitoring systems in e-commerce platforms, while local scholars have studied more the legal framework of e-commerce, taxation, management mechanisms, and development trends in the national market. However, in the conditions of Uzbekistan, the issues of a comprehensive assessment of modern international approaches to financial analysis in e-commerce platforms, the integration of AI and ESG indicators into the financial analysis system, and the development of a single methodological approach to assessing the effectiveness of platforms have not been sufficiently studied. This scientific gap determines the relevance of this study and constitutes its main scientific direction.

Research methodology

This study used systematic analysis, comparative analysis, statistical analysis and generalization methods to study modern approaches to financial analysis on electronic trading platforms. International and domestic scientific literature, as well as data from Statista, UNCTAD, World Bank, OECD and the National Statistics Committee of the Republic of Uzbekistan were analyzed. The financial indicators of electronic trading platforms were comparatively evaluated and the effectiveness of modern analytical approaches was determined. Based on the results obtained, scientific and practical conclusions and recommendations were developed to improve financial analysis on electronic trading platforms in Uzbekistan.

Analysis and results

The rapid development of e-commerce platforms is increasing the need to assess their financial performance using modern methods. In the digital economy, the financial stability of enterprises is now determined not only by revenue and profit indicators, but also by transaction volume, customer activity, conversion rate, logistics costs, the efficiency of payment systems, and management decisions made based on artificial intelligence. Therefore, financial analysis on e-commerce platforms is moving from traditional financial ratios to modern digital analytics tools.

According to Statista, the global retail e-commerce market is expected to reach $6.4 trillion in 2025, a significant increase from 2024. It is projected to reach $9 trillion by 2030. Today, e-commerce accounts for 23.5% of total retail sales. This highlights the need to improve financial management systems and implement real-time financial monitoring for e-commerce platforms.

Table 1

Indicators for assessing the financial competitiveness of UZEX in the Uzbek e-commerce market[10]

No.	Indicator	Content on UZEX	Calculation method	Impact on competitiveness
1	**E-commerce volume**	Trading volume on UZEX electronic platforms	billion soums	+
2	**Growth rate of e-commerce volume**	Annual change in e-commerce volume	%	+
3	**Income**	Total revenue of UZEX	billion soums	+
4	**Revenue growth rate**	Annual revenue growth	%	+
5	**Net profit**	UZEX's net profit for the reporting period	billion soums	+
6	**Net profit margin**	Net profit as a percentage of revenue	Net profit / Revenue × 100	+
7	**ROA**	Efficiency of using UZEX assets	Net profit / Total assets × 100	+
8	**ROE**	Efficiency of using UZEX private capital	Net profit / Equity × 100	+
9	**Cost efficiency**	Income to expenses ratio	Income / Expenses	+
10	**Transaction efficiency**	Financial result per transaction	Net profit / Number of transactions	+
11	**Participant activity**	Dynamics of participants in the UZEX electronic trading system	% or people	+
12	**Dividend payout ratio**	Percentage of net profit paid out as dividends	Dividend / Net profit × 100	+

The table above systematizes the main indicators that allow assessing the financial competitiveness of UZEX in the Uzbek e-commerce market. These indicators serve as a comprehensive assessment of UZEX's activities in the e-commerce market in terms of trading volume, financial results and resource efficiency. In this regard, the indicators were directly adapted to UZEX's activities, taking into account its unique exchange and e-commerce model.

First of all, the volume of electronic trading is the main indicator of UZEX's activity in the electronic trading market. The increase in this indicator from year to year indicates that the scope of use of UZEX's electronic platforms is expanding and the volume of trading transactions is increasing. Therefore, the growth of electronic trading is considered a factor that positively affects the competitiveness of UZEX.

The growth rate of e-commerce volume shows the speed of UZEX's development in the market. Assessing not only the absolute value of the sales volume, but also its growth compared to the previous period allows us to determine the dynamic position of UZEX in the e-commerce market.

The growth rate of revenue and profit reflects the ability of UZEX to convert its e-trading activities into financial results. The steady growth of revenue along with the increase in trading volume indicates that the platform is operating financially efficiently. If trading volume is growing rapidly and revenue is growing relatively slowly, this indicates the need to separately study the monetization efficiency of trading activities.

Net profit is the main indicator that reflects the final financial result of UZEX's activities. The increase in net profit indicates that the enterprise's ability to generate income and manage expenses is improving. At the same time, the net profit margin allows us to determine how much of the income received by UZEX remains as net profit. This indicator is important in assessing the financial performance of UZEX.

ROA and ROE indicators characterize the efficiency of UZEX in using its existing assets and equity. ROA shows how much net profit assets have generated, while ROE shows the efficiency of using shareholders' equity. A high level of these indicators indicates that UZEX is using financial resources efficiently.

Cost efficiency was introduced to determine how rationally UZEX manages costs in the process of generating income. A high ratio of income to costs means that more financial results are being created per unit of cost. Therefore, the increase in this indicator is considered positive for UZEX's financial competitiveness.

Transaction efficiency allows us to assess the financial results of electronic trading activities in relation to the number of transactions. An increase in net profit per transaction indicates that the efficiency of operations on UZEX electronic platforms is increasing not only quantitatively, but also financially.

Participant activity characterizes the market coverage of the UZEX electronic trading system. An increase in the number of electronic trading participants can expand competition and the volume of transactions on the trading platform. Therefore, this indicator is used as an additional criterion in assessing the position of UZEX in the electronic commerce market.

The dividend payout ratio shows the level of distribution of net profit generated by UZEX to shareholders. This indicator allows us to assess UZEX's profit distribution policy and financial attractiveness for shareholders.

Thus, based on these indicators, the competitiveness of UZEX is assessed in three main areas: market activity, financial stability and financial efficiency. The first area is the volume of electronic trading, its growth rate and the activity of participants; the second area is revenue, net profit and dividend indicators; and the third area is ROA, ROE, net profit margin, costs and transaction efficiency.

As a result, the competitiveness of UZEX in the e-commerce market is determined not only by the size of trade volumes, but also by the degree to which this trade volume is converted into revenue, profit and capital efficiency. This

approach will serve as a methodological basis for standardizing indicators and forming a single UZEX Financial Competitiveness Index (EPFCI) at the next stage.

The financial competitiveness of UZEX can be comprehensively assessed in terms of trading activity, profitability, profitability, cost efficiency and capital efficiency. At the next stage, it is advisable to standardize the indicators and, based on their overall results, form the UZEX Financial Competitiveness Index (EPFCI) and assess the dynamics for 2020–2025. This will allow us to determine the financial position of UZEX in the e-commerce market and forecast competitiveness prospects for 2026–2027.

The competitiveness of e-commerce platforms is largely determined by their financial indicators. In particular, revenue growth rate, operating cost efficiency, profitability, cash flow stability, investment opportunities and the effectiveness of using digital infrastructure are the main factors determining the platform's position in the market. Therefore, financial analysis is an important tool for identifying the internal capabilities of e-commerce entities and assessing their competitive advantages.

The e-commerce market in Uzbekistan has developed significantly in recent years, with the number of new digital platforms, marketplaces, and online service providers increasing. As competition in the market intensifies, platforms are focusing not only on increasing sales volume, but also on improving the quality of financial management. Because platforms with high revenue performance but ineffective cost management cannot achieve long-term competitive advantage.

Table 2

Dynamics of key financial indicators of global e-commerce platforms in 2020–2028 [11]

Indicators	2020	2021	2022	2023	2024	2025	2026 (Prediction)	2027 (Forecast)	20268 (Forecast)
Global e-commerce volume (trillion US dollars)	4.28	4.93	5.29	5.82	6.09	6.40	6.82	7.29	7.81
Share of e-commerce in retail sales (%)	18.0	19.7	20.7	22.0	23.0	23.5	24.3	25.1	26.0
Number of online shoppers (billion people)	2.14	2.30	2.42	2.55	2.69	2.77	2.90	3.03	3.15
Average order value (USD)	103	111	118	123	129	134	139	145	151

Conversion rate (%)	2.8	2.9	3.1	3.2	3.3	3.4	3.5	3.6	3.8
Share of digital payments (%)	56	62	68	73	77	80	82	84	86
Percentage of platforms using AI-based financial analysis (%)	18	25	34	43	51	60	68	75	81

The table data shows that the financial development of e-commerce platforms in 2020–2028 has a steady growth trend. In particular, the global e-commerce volume is forecast to reach 7.81 trillion US dollars in 2028 from 4.28 trillion US dollars in 2020. At the same time, the share of e-commerce in retail is expected to increase from 18% to 26%, and the number of online shoppers is expected to increase from 2.14 billion to 3.15 billion people. The share of platforms using artificial intelligence-based financial analysis systems is forecast to increase from 18% in 2020 to 81% in 2028. This shows that modern financial analysis tools are significantly increasing the efficiency and competitiveness of e-commerce platforms.

Mobile technology is one of the key factors shaping financial results in e-commerce platforms. In 2025, almost 80% of visits to e-commerce sites were made via smartphones. In addition, digital wallets have become the most widely used payment method in e-payments and are projected to account for 63% of e-payments by 2030. These trends allow e-commerce platforms to manage cash flows, reduce transaction costs, and increase liquidity.

The level of digital technologies is one of the key factors shaping the competitive advantage of e-commerce platforms. The use of ERP, CRM, BI systems, Big Data and artificial intelligence technologies allows platforms to analyze data in real time, identify customer needs and make quick financial decisions.

The assessment results in the table indicate the need for a comprehensive approach to increasing the competitiveness of e-commerce platforms. Improving financial performance, widespread implementation of digital technologies, and the formation of effective management mechanisms will ensure the stable position of platforms in the market.

When assessing the competitiveness of e-commerce platforms, financial growth indicators are analyzed first. Year-on-year growth in revenue, an increase in the number of sales transactions, and an expansion of the customer base indicate the level of demand for the platform in the market. At the same time, revenue growth should be compared with the growth in costs.

Table 3

Growth dynamics of the e-commerce market in Uzbekistan (2020–2027)[12]

Year	E-commerce market size, billion soums	Annual growth rate, %	Number of Internet users, million people	Volume of electronic payments, trillion soums	Market development stage
2020	2,800	34.8	22.5	120	The formation stage of digital commerce
2021	4 200	50.0	26.5	165	Growing demand for online services
2022	6,500	54.8	29.5	220	Development of marketplaces
2023	9,000	38.5	31.5	285	E-commerce infrastructure expansion
2024	12,500	38.9	34.0	360	Digital payment and platform growth
2025	16,000	28.0	36.5	450	Financial technology integration
2026 (forecast)	20,500	28.1	38.5	560	Development based on AI and Big Data
2027 (forecast)	26,000	26.8	40.5	700	Sustainable digital market formation

As can be seen from the table, the e-commerce market in Uzbekistan has been experiencing a high growth trend in recent years. In 2020, the volume of the e-commerce market conditionally amounted to 2.8 trillion soums, while by 2024 this figure will reach 12.5 trillion soums. During this period, the volume of e-commerce increased by almost 4.5 times, which is explained by the level of use of online shopping among the population and the expansion of digital payment systems.

The high market growth rates in 2021–2022 indicate the rapid development of e-commerce platforms, marketplaces, and mobile payment services. Although the growth rate has stabilized relatively in recent years, the increasing absolute value of the market size indicates that the investment attractiveness of the e-commerce sector remains.

One of the main factors influencing the growth of the e-commerce market is the increase in the number of Internet users. The expansion of the Internet audience

allows the formation of new customer segments for electronic platforms. At the same time, the growth of electronic payments is an important factor ensuring the financial stability and reliability of online trading operations.

Forecast indicators for 2026–2027 indicate that the e-commerce market will continue to grow due to the widespread introduction of artificial intelligence, Big Data, automated analytics systems, and digital financial services. This means that the importance of financial analysis in assessing the competitiveness of e-commerce platforms will further increase.

Digital indicators are also important in assessing competitiveness. The financial results of e-commerce platforms are largely related to user activity, online payment volume, number of orders, customer acquisition costs, and digital marketing effectiveness. Therefore, a modern financial analysis system should include digital KPI indicators in addition to traditional financial ratios.

To increase competitiveness in the Uzbek e-commerce market, it is advisable for platforms to digitize financial analysis processes, use Big Data technologies, and introduce forecasting models based on artificial intelligence. Such an approach will allow not only to assess the current financial situation, but also to identify future development opportunities, anticipate potential risks, and make effective management decisions.

Financial analysis is an important strategic tool in assessing the level of competitiveness in the e-commerce markets of Uzbekistan. An integrated approach that combines financial indicators, digital activity indicators, and forecast analysis creates the opportunity for e-commerce platforms to ensure sustainable growth, strengthen their market position, and adapt to the international competitive environment.

The share of e-commerce in the retail system in the United States has shown a steady growth trend in recent years. The annual increase in the share of e-commerce in total retail sales is explained by the formation of online shopping habits of consumers, the widespread development of Internet and mobile technologies, and the activities of large e-commerce platforms such as Amazon, Walmart, eBay, and Shopify. The introduction of electronic payment systems, fast logistics services, and recommendation algorithms based on artificial intelligence are contributing to a significant increase in online sales. As a result, e-commerce has become an important segment of the US retail market, serving as an important factor in increasing enterprise revenues, optimizing operating costs, and improving financial efficiency. This trend is forecast to continue in the coming years, and a further increase in the share of e-commerce will become one of the main drivers of the development of the digital economy.

According to UNCTAD, the volume of business transactions conducted through e-commerce in 2024 amounted to 28 trillion US dollars. This figure is 4.4% higher than in 2023, indicating that the pace of e-commerce development is maintained. At the same time, improving statistical data on e-commerce is becoming increasingly important for making effective tax policies, digital trade and investment decisions in developing countries.

The role of artificial intelligence and big data technologies in improving the financial efficiency of e-commerce platforms is increasingly growing. With the help of modern algorithms, customer behavior is analyzed, demand is forecasted, inventory is optimized, and pricing policy is automatically managed. As a result, excess costs are reduced, profit margins are increased, and financial risks are reduced. Scientific studies conducted on Walmart and Tmall platforms have confirmed that LSTM and other artificial intelligence models increase the efficiency of financial planning by accurately forecasting sales volumes.

The e-commerce market in Uzbekistan has also been developing steadily in recent years. The reforms implemented by the state to develop the digital economy, expand electronic payment systems, and improve logistics infrastructure are contributing to the growth of domestic e-commerce. However, the level of real-time financial monitoring, artificial intelligence-based analysis, and the use of Big Data technologies in local e-commerce platforms is still insufficient compared to developed countries. Therefore, adapting international experiences to national practice remains an urgent task.

Conclusion

The results of the study showed that e-commerce platforms are one of the fastest growing segments of the digital economy, and the use of modern digital technologies, along with traditional financial analysis methods, is becoming increasingly important in assessing their financial performance. World experience has shown that the use of artificial intelligence, Big Data, Business Intelligence and predictive analytics tools in the activities of large platforms such as Amazon, Alibaba, eBay and Shopify significantly increases the efficiency of financial management.

The analysis revealed a consistent growth in global e-commerce volumes, an increasing share of e-commerce in retail sales, and an increasing number of online shoppers in 2020–2025. The development of electronic payment systems, mobile commerce, and artificial intelligence technologies is expanding the opportunities for platforms to reduce operating costs, manage financial risks, and increase profitability.

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OLIY TA’LIM MUASSASALARI FAOLIYATINI TAHLIL ETISHGA MO‘LJALLANGAN SUN’IY INTELLEKT ASOSIDAGI AXBOROT TIZIMINI YARATISH

Annotatsiya. *Mazkur maqolada oliy ta’lim muassasalari faoliyatini tahlil qilish, baholash va prognozlash uchun sun’iy intellekt texnologiyalariga asoslangan axborot tizimini ishlab chiqish masalalari ko‘rib chiqilgan. Zamonaviy universitetlar faoliyati katta hajmdagi ma’lumotlarni hosil qilishi sababli ularni an’anaviy usullar yordamida samarali tahlil qilish murakkablashmoqda. Tadqiqotda mashinaviy o‘qitish, ta’lim analitikasi (Learning Analytics) hamda ma’lumotlarni qazib olish (Educational Data Mining) texnologiyalaridan foydalanish imkoniyatlari o‘rganildi. Taklif etilayotgan tizim talabalar akademik ko‘rsatkichlari, davomati, ilmiy faoliyati hamda ta’lim sifati indikatorlarini kompleks tahlil qilishga mo‘ljallangan. Tadqiqot natijalari sun’iy intellektga asoslangan axborot tizimlari universitet boshqaruvida qaror qabul qilish samaradorligini oshirishini ko‘rsatdi.*

Kalit so‘zlar: *sun’iy intellekt, oliy ta’lim, axborot tizimi, mashinaviy o‘qitish, ta’lim analitikasi, ma’lumotlarni qazib olish, prognozlash, universitet boshqaruvi.*

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DEVELOPMENT OF AN ARTIFICIAL INTELLIGENCE-BASED INFORMATION SYSTEM FOR ANALYZING THE ACTIVITIES OF HIGHER EDUCATION INSTITUTIONS

Abstract. *This article examines the development of an artificial intelligence-based information system for analyzing, evaluating, and forecasting the performance of higher education institutions. Modern universities generate large volumes of data, making effective analysis through traditional methods increasingly challenging. The study explores the application of machine learning, Learning Analytics, and Educational Data Mining technologies in higher education. The proposed system is designed to provide comprehensive analysis of students’ academic performance, attendance, research activities, and educational quality indicators. The findings demonstrate that AI-based information systems can*

significantly improve decision-making efficiency and support strategic management processes in universities.

Keywords: *artificial intelligence, higher education, information system, machine learning, learning analytics, educational data mining, forecasting, university management.*

Kirish

So‘nggi yillarda oliy ta’lim tizimida raqamli transformatsiya jarayonlarining jadallashuvi natijasida universitetlar faoliyatining deyarli barcha yo‘nalishlari raqamlashtirilmoqda. Talabalarni qabul qilish, o‘quv jarayonini boshqarish, baholash, ilmiy faoliyat monitoringi hamda institutsional boshqaruv jarayonlari elektron platformalar orqali amalga oshirilishi natijasida katta hajmdagi ma’lumotlar shakllanmoqda. Ushbu ma’lumotlar tarkibiga talabalarning akademik natijalari, davomat ko‘rsatkichlari, elektron ta’lim tizimlaridagi faolligi, professor-o‘qituvchilarning ilmiy va pedagogik faoliyati hamda ta’lim sifati bilan bog‘liq boshqa ko‘rsatkichlar kiradi. Mazkur ma’lumotlar hajmining ortib borishi ularni an’anaviy statistik usullar yordamida tahlil qilish samaradorligini pasaytirmoqda va zamonaviy intellektual texnologiyalarni joriy etishni talab etmoqda.

Sun’iy intellekt (Artificial Intelligence – AI) texnologiyalari katta hajmdagi ma’lumotlarni qayta ishlash, murakkab bog‘liqliklarni aniqlash, prognozlash hamda qaror qabul qilishni qo‘llab-quvvatlash imkoniyatlari bilan ajralib turadi. Jahon iqtisodiy forumi va UNESCO hisobotlarida sun’iy intellektning ta’lim tizimidagi roli kelajakdagi asosiy transformatsion texnologiyalardan biri sifatida e’tirof etilgan. Ayniqsa, oliy ta’lim muassasalarida sun’iy intellekt asosida ma’lumotlarni tahlil qilish, o‘quv jarayonini individuallashtirish, akademik xavf guruhidagi talabalarni aniqlash va boshqaruv qarorlarini optimallashtirish masalalari dolzarb ilmiy yo‘nalishlardan biri hisoblanadi.

Zawacki-Richter, Marín, Bond va Gouverneur tomonidan 2019-yilda olib borilgan tizimli adabiyotlar sharhida 2007–2018-yillar davomida oliy ta’limda sun’iy intellektni qo‘llashga bag‘ishlangan 146 ta ilmiy tadqiqot tahlil qilingan. Tadqiqot natijalariga ko‘ra, sun’iy intellekt texnologiyalari asosan prognozlash, tavsiyalar ishlab chiqish, adaptiv o‘qitish tizimlari va akademik qarorlarni qo‘llab-quvvatlash yo‘nalishlarida qo‘llanilgan. Mualliflar oliy ta’lim tizimida ma’lumotlarga asoslangan boshqaruv mexanizmlarini rivojlantirish uchun sun’iy intellekt texnologiyalaridan foydalanish istiqbollari yuqori ekanligini ta’kidlaydilar.

Ta’lim ma’lumotlarini intellektual tahlil qilish sohasidagi yana bir muhim yo‘nalish Educational Data Mining (EDM) va Learning Analytics (LA) hisoblanadi. Romero va Ventura tomonidan olib borilgan tadqiqotlarda EDM texnologiyalari yordamida talabalarning o‘quv faoliyati, o‘zlashtirish ko‘rsatkichlari va xulq-atvoriga oid ma’lumotlarni tahlil qilish orqali o‘quv jarayonining samaradorligini oshirish mumkinligi ko‘rsatib berilgan. Learning Analytics yondashuvi esa talabalar va o‘qituvchilar faoliyati bo‘yicha yig‘ilgan ma’lumotlarni tahlil qilish orqali o‘quv jarayonini optimallashtirish, ta’lim sifatini baholash va boshqaruv qarorlarini qabul qilishni qo‘llab-quvvatlashga xizmat qiladi.

Aldowah, Al-Samarraie va Fauzy tomonidan amalga oshirilgan tadqiqotlarda oliy ta’lim tizimida ta’lim analitikasi va ma’lumotlarni qazib olish texnologiyalaridan foydalanishning asosiy yo‘nalishlari sifatida talabalar muvaffaqiyatini prognozlash, kurslarni yakunlash ehtimolini baholash, o‘quv faoliyatidagi xavf omillarini aniqlash hamda universitet resurslarini boshqarishni optimallashtirish masalalari ko‘rsatib o‘tilgan. Mualliflarning fikriga ko‘ra, sun’iy intellekt texnologiyalari oliy ta’lim muassasalarida strategik boshqaruv samaradorligini oshirishning muhim vositasi hisoblanadi.

Shu bilan birga, mavjud tadqiqotlarning aksariyat qismi talabalar faoliyatini tahlil qilish yoki alohida o‘quv jarayonlarini optimallashtirishga qaratilgan bo‘lib, universitet faoliyatining barcha asosiy ko‘rsatkichlarini yagona axborot muhitida kompleks tahlil qiluvchi intellektual tizimlar yetarli darajada o‘rganilmagan. Ayniqsa, oliy ta’lim muassasasining ta’lim, ilmiy-tadqiqot va boshqaruv faoliyatiga oid ma’lumotlarni integratsiyalashgan holda tahlil qilish hamda prognozlash imkoniyatlarini ta’minlovchi axborot tizimlarini ishlab chiqish ilmiy va amaliy jihatdan dolzarb masala bo‘lib qolmoqda.

Mazkur tadqiqotning maqsadi sun’iy intellekt texnologiyalariga asoslangan holda oliy ta’lim muassasalari faoliyatini kompleks tahlil qilish, baholash va prognozlash imkonini beruvchi axborot tizimi modelini ishlab chiqish hamda uning funksional imkoniyatlarini tadqiq etishdan iborat. Tadqiqot doirasida oliy ta’lim muassasalarida shakllanadigan ma’lumotlar manbalari tahlil qilinadi, tizimning konseptual arxitekturasi taklif etiladi hamda mashinaviy o‘qitish algoritmlaridan foydalanish imkoniyatlari yoritiladi.

Tadqiqot metodologiyasi.

Mazkur tadqiqotda oliy ta’lim muassasalari faoliyatini tahlil qilish va prognozlash imkoniyatiga ega bo‘lgan sun’iy intellektga asoslangan axborot tizimini ishlab chiqish uchun tizimli tahlil, ma’lumotlarni qazib olish (Educational Data Mining), ta’lim analitikasi (Learning Analytics) va mashinaviy o‘qitish usullaridan foydalanildi. Tadqiqot metodologiyasi universitetlarda shakllanadigan katta hajmdagi ma’lumotlarni yig‘ish, qayta ishlash va tahlil qilish jarayonlarini qamrab oladi. Taklif etilayotgan tizimning asosiy maqsadi oliy ta’lim muassasasi faoliyatining turli yo‘nalishlariga oid ma’lumotlarni yagona platformada jamlash, ularni intellektual tahlil qilish hamda boshqaruv qarorlarini qabul qilishni qo‘llab-quvvatlashdan iborat.

Tadqiqot doirasida ishlab chiqilgan axborot tizimi bir-biri bilan uzviy bog‘langan bir nechta modullardan tashkil topadi. Har bir modul ma’lumotlarni qayta ishlashning muayyan bosqichini amalga oshiradi va tizimning umumiy samaradorligini ta’minlaydi.

Ma’lumotlarni yig‘ish moduli. Ma’lumotlarni yig‘ish moduli axborot tizimining dastlabki va eng muhim bosqichlaridan biri hisoblanadi. Ushbu modul universitet faoliyati davomida shakllanadigan ma’lumotlarni turli axborot manbalaridan avtomatik ravishda yig‘ish va markazlashtirilgan ma’lumotlar omboriga uzatish vazifasini bajaradi. Zamonaviy oliy ta’lim muassasalarida ma’lumotlar turli platformalar va dasturiy tizimlarda saqlanadi. Shu sababli ularni

yagona formatda integratsiyalash tahlil jarayonining muhim shartlaridan biri hisoblanadi.

Mazkur modul quyidagi asosiy ma’lumotlar manbalari bilan integratsiyalashadi:

Talabalar bazasi- Talabalar bazasidan talabalarning shaxsiy ma’lumotlari, ta’lim yo‘nalishi, kursi, guruhi, qabul yili, akademik holati va boshqa muhim ko‘rsatkichlar olinadi. Ushbu ma’lumotlar keyingi tahlil jarayonlarida asosiy identifikatsiya manbasi sifatida xizmat qiladi.

Elektron jurnal va akademik tizimlar- Elektron jurnal tizimlari orqali talabalar tomonidan olingan baholar, oraliq va yakuniy nazorat natijalari, GPA ko‘rsatkichlari hamda fanlar bo‘yicha o‘zlashtirish darajalari yig‘iladi. Ushbu ma’lumotlar talabalar akademik muvaffaqiyatini baholash va prognozlashda muhim ahamiyatga ega.

LMS (Learning Management System) platformalari- Moodle, Google Classroom, Canvas va boshqa masofaviy ta’lim platformalaridan talabalar faolligiga oid ma’lumotlar olinadi. Jumladan:

- tizimga kirishlar soni;
- o‘quv materiallaridan foydalanish darajasi;
- topshiriqlarni bajarish holati;
- forumlardagi ishtirok faolligi;
- onlayn test natijalari.

Mazkur ko‘rsatkichlar talabalarning o‘quv jarayonidagi faolligini baholash va o‘zlashtirish natijalarini prognozlash imkonini beradi.

Ilmiy faoliyat bazalari

Professor-o‘qituvchilar va tadqiqotchilarning ilmiy faoliyatiga oid ma’lumotlar Scopus, Web of Science, Google Scholar hamda universitetning ichki ilmiy bazalaridan olinadi. Ushbu ma’lumotlar:

- ilmiy maqolalar soni;
- iqtiboslar ko‘rsatkichi;
- h-index;
- grant loyihalari;
- patentlar

kabi indikatorlarni baholash imkonini beradi.

Davomat tizimlari

Talabalarning darslarga qatnashishi haqidagi ma’lumotlar elektron davomat tizimlari yoki biometrik nazorat vositalaridan olinadi. Tadqiqotlar shuni ko‘rsatadiki, davomat ko‘rsatkichlari akademik natijalarning muhim prognozlovchi omillaridan biri hisoblanadi. Shu sababli ushbu ma’lumotlar mashinaviy o‘qitish modellarida alohida atribut sifatida foydalaniladi.

Ma’lumotlarni yig‘ish bosqichida API texnologiyalari, SQL-so‘rovlar va ETL (Extract, Transform, Load) mexanizmlaridan foydalaniladi. Bu esa turli platformalardagi ma’lumotlarni avtomatik ravishda markazlashtirilgan ma’lumotlar omboriga uzatish imkonini beradi.

Ma’lumotlarni qayta ishlash moduli

Yig‘ilgan ma’lumotlar ko‘pincha turli formatlarda bo‘lib, ularda bo‘sh maydonlar, takroriy yozuvlar yoki noto‘g‘ri qiymatlar uchrashi mumkin. Shu sababli sun’iy intellekt algoritmlaridan foydalanishdan oldin ma’lumotlarni dastlabki qayta ishlash jarayoni amalga oshiriladi.

Ushbu modul ma’lumotlar sifatini oshirish va ularni tahlil uchun tayyorlash vazifasini bajaradi.

Ma’lumotlarni tozalash

Dastlab ma’lumotlar bazasidagi xatoliklar aniqlanadi va bartaraf etiladi. Jumladan:

- bo‘sh yoki yetishmayotgan qiymatlar to‘ldiriladi;
- noto‘g‘ri kiritilgan ma’lumotlar tuzatiladi;
- takroriy yozuvlar aniqlanib o‘chirib tashlanadi;
- mantiqiy jihatdan mos kelmaydigan qiymatlar filtrlanadi.

Bu bosqich sun’iy intellekt algoritmlarining aniqligini oshirishda muhim ahamiyatga ega.

Ma’lumotlarni normallashtirish

Turli axborot tizimlaridan olingan ma’lumotlar turli formatlarda bo‘lishi mumkin. Masalan, baholash tizimlari, sana formatlari yoki identifikatsiya kodlari bir-biridan farq qiladi. Shu sababli barcha ma’lumotlar yagona standart formatga keltiriladi.

Normallashtirish natijasida:

- ma’lumotlar o‘rtasidagi nomuvofiqliklar bartaraf etiladi;
- atributlar bir xil o‘lchov birliklarida ifodalanadi;
- keyingi hisob-kitoblar uchun qulay muhit yaratiladi.

Takroriy yozuvlarni bartaraf etish

Universitet axborot tizimlarida bir xil obyektga oid ma’lumotlar turli bazalarda saqlanishi mumkin. Bu esa ma’lumotlarning takrorlanishiga olib keladi. Maxsus algoritmlar yordamida bir xil identifikatorga ega yozuvlar aniqlanadi va yagona ko‘rinishga keltiriladi.

Ma’lumotlarni transformatsiyalash

Mazkur bosqichda tahlil uchun yangi ko‘rsatkichlar hosil qilinadi. Masalan:

- o‘rtacha GPA;
- semestr bo‘yicha akademik reyting;
- LMS faollik indeksi;
- davomat koeffitsienti;
- ilmiy faoliyat samaradorligi indeksi.

Shuningdek, kategoriyali ma’lumotlar sonli ko‘rinishga o‘tkaziladi va mashinaviy o‘qitish algoritmlari uchun mos formatga keltiriladi.

Ma’lumotlarni yagona formatga keltirish

Qayta ishlashning yakuniy bosqichida barcha ma’lumotlar yagona ma’lumotlar omboriga joylashtiriladi. Bu esa tizimning keyingi modullarida ma’lumotlardan samarali foydalanish, tahlil natijalarining aniqligini oshirish hamda turli ko‘rsatkichlar o‘rtasidagi bog‘liqliklarni aniqlash imkonini beradi.

Natijada sun’iy intellekt algoritmlarini o‘qitish va prognozlash vazifalarini bajarish uchun sifatli, to‘liq va strukturaviy jihatdan yaxlit ma’lumotlar bazasi shakllantiriladi.

Sun’iy intellekt moduli.

Sun’iy intellekt moduli taklif etilayotgan axborot tizimining asosiy funksional qismi hisoblanadi. Ushbu modulning vazifasi yig‘ilgan va qayta ishlangan ma’lumotlar asosida tahliliy natijalarni shakllantirish, prognozlash modellari yaratish hamda universitet faoliyatiga oid muhim qarorlarni qabul qilish jarayonini qo‘llab-quvvatlashdan iborat. Zamonaviy oliy ta’lim muassasalarida shakllanadigan katta hajmdagi ma’lumotlarni an’anaviy statistik usullar yordamida tahlil qilish ko‘p hollarda yetarli natija bermaydi. Shu sababli mashinaviy o‘qitish algoritmlaridan foydalanish orqali ma’lumotlar orasidagi yashirin bog‘liqliklarni aniqlash, kelajakdagi natijalarni prognozlash va xavf omillarini oldindan baholash imkoniyati yaratiladi.

Mazkur tadqiqotda talabalar akademik natijalarini prognozlash, o‘quv faoliyatidagi muammolarni aniqlash hamda akademik xavf guruhidagi talabalarni belgilash uchun bir nechta mashinaviy o‘qitish algoritmlaridan foydalanish taklif etiladi. Algoritmlar tanlanishida ularning ta’lim analitikasi va Educational Data Mining sohasida keng qo‘llanilishi, aniqlik darajasi hamda interpretatsiya qilish imkoniyatlari inobatga olindi.

Decision Tree algoritmi

Decision Tree (qarorlar daraxti) algoritmi nazoratli o‘qitish (supervised learning) usullaridan biri bo‘lib, ma’lumotlarni klassifikatsiya qilish va prognozlash vazifalarida keng qo‘llaniladi. Algoritm ma’lumotlarni turli atributlar bo‘yicha ketma-ket ajratish orqali qarorlar qabul qilish daraxtini hosil qiladi.

Oliy ta’lim muassasalari faoliyatini tahlil qilishda Decision Tree algoritmi talabalar akademik muvaffaqiyatiga ta’sir qiluvchi omillarni aniqlash imkonini beradi. Masalan, davomat darajasi, oraliq nazorat natijalari, LMS tizimidagi faollik va GPA ko‘rsatkichlari asosida talabaning semestr yakunidagi natijasi prognoz qilinishi mumkin.

Mazkur algoritmning muhim afzalligi uning natijalari tushunarli va izohlanadigan bo‘lishidadir. Qaror daraxti orqali qaysi omil talabalar muvaffaqiyatiga ko‘proq ta’sir qilayotganini aniqlash mumkin bo‘ladi. Bu esa universitet rahbariyati va professor-o‘qituvchilarga ma’lumotlarga asoslangan boshqaruv qarorlarini qabul qilish imkonini beradi.

Random Forest algoritmi

Random Forest algoritmi bir nechta qaror daraxtlari asosida ishlovchi ansambl (ensemble) model hisoblanadi. Ushbu usul Decision Tree algoritmining takomillashtirilgan shakli bo‘lib, yuqori aniqlik va barqarorlikni ta’minlaydi.

Random Forest algoritmida ma’lumotlarning turli qismlarida qurilgan ko‘plab qaror daraxtlari yakuniy natijani birgalikda shakllantiradi. Natijada modelning umumlashtirish qobiliyati oshadi va ortiqcha moslashish (overfitting) xavfi kamayadi.

Taklif etilayotgan axborot tizimida Random Forest algoritmidan quyidagi vazifalarni bajarishda foydalanish mumkin:

- talabalar o‘zlashtirish darajasini prognozlash;
- akademik qarzdorlik xavfini aniqlash;
- o‘qishni tark etish ehtimolini baholash;
- fakultet va yo‘nalishlar kesimida natijalarni tahlil qilish.

Ko‘plab ilmiy tadqiqotlar Random Forest algoritmining ta’lim ma’lumotlarini tahlil qilishda yuqori aniqlik ko‘rsatishini tasdiqlagan. Shu sababli ushbu algoritm tizimning asosiy prognozlash vositalaridan biri sifatida tanlandi.

Naive Bayes algoritmi

Naive Bayes algoritmi Bayes ehtimollik nazariyasiga asoslangan klassifikatsiya usuli hisoblanadi. Algoritm ma’lumotlar orasidagi bog‘liqliklarni ehtimollik nuqtai nazaridan baholaydi va obyektlarni ma’lum sinflarga ajratadi.

Mazkur algoritmning afzalligi uning hisoblash murakkabligi pastligi va katta hajmdagi ma’lumotlar bilan tez ishlash imkoniyatidir. Universitet axborot tizimlarida saqlanadigan ma’lumotlar hajmi katta bo‘lganligi sababli Naive Bayes modeli tezkor tahlil qilish imkonini beradi.

Ushbu algoritm yordamida:

- akademik xavf guruhidagi talabalarni aniqlash;
- dars qoldirish ehtimolini baholash;
- o‘quv faoliyatidagi muammolarni prognozlash;
- talabalarning kelgusidagi akademik holatini baholash

mumkin.

Naive Bayes modeli ayniqsa dastlabki tahlillar va tezkor prognozlash vazifalarida samarali natija beradi.

Support Vector Machine (SVM)

Support Vector Machine (SVM) algoritmi mashinaviy o‘qitishning eng samarali klassifikatsiya usullaridan biri hisoblanadi. Ushbu algoritm ma’lumotlarni turli sinflarga ajratish uchun optimal chegara (hyperplane) hosil qiladi.

Oliy ta’lim ma’lumotlari ko‘pincha murakkab va ko‘p o‘lchovli bo‘lganligi sababli SVM algoritmi bunday ma’lumotlar bilan ishlashda yuqori natijalar beradi. Algoritm talabalarni akademik muvaffaqiyat darajasiga qarab guruhlarga ajratish, yuqori va past natijali talabalarni aniqlash hamda xavf guruhlarini shakllantirishda qo‘llanilishi mumkin.

SVM algoritmining asosiy afzalliklari quyidagilardan iborat:

- yuqori aniqlik;
- katta hajmdagi ma’lumotlar bilan ishlash imkoniyati;
- murakkab bog‘liqliklarni aniqlash qobiliyati;
- prognozlash natijalarining ishonchliligi.

Shu sababli mazkur algoritm talabalar natijalarini prognozlash va o‘quv faoliyatini baholashda muhim vosita sifatida qaraladi.

Sun’iy neyron tarmoqlar (Artificial Neural Networks)

Sun’iy neyron tarmoqlar inson miyasi faoliyatidan ilhomlangan mashinaviy o‘qitish modellaridan biri bo‘lib, murakkab va ko‘p qatlamli ma’lumotlarni tahlil

qilish imkonini beradi. Ushbu algoritmlar katta hajmdagi ma’lumotlar bilan ishlashda hamda yashirin qonuniyatlarni aniqlashda yuqori samaradorlikka ega.

Oliy ta’lim muassasalari faoliyatini tahlil qilishda neyron tarmoqlardan quyidagi maqsadlarda foydalanish mumkin:

- talabalar akademik natijalarini uzoq muddatli prognozlash;
- o‘quv jarayonidagi yashirin bog‘liqliklarni aniqlash;
- ta’lim sifati indikatorlarini baholash;
- ilmiy faoliyat samaradorligini tahlil qilish;
- universitet reyting ko‘rsatkichlarini prognozlash.

Neyron tarmoqlar ko‘p sonli parametrlar bilan ishlash imkoniyatiga ega bo‘lib, ma’lumotlar hajmi ortgani sari prognozlash aniqligi ham oshib boradi. Shu sababli ushbu model sun’iy intellekt modulining eng istiqbolli komponentlaridan biri hisoblanadi.

Algoritmlarni baholash mezonlari

Taklif etilayotgan axborot tizimida qo‘llaniladigan algoritmlarning samaradorligini baholash uchun mashinaviy o‘qitishda keng foydalaniladigan mezonlardan foydalaniladi. Jumladan, Accuracy (aniqlik), Precision (musbat natijalar aniqligi), Recall (to‘liqlik), F1-score hamda ROC-AUC ko‘rsatkichlari hisoblanadi. Ushbu mezonlar yordamida qaysi algoritm universitet ma’lumotlari uchun eng yuqori natija berishini aniqlash mumkin bo‘ladi.

Shunday qilib, sun’iy intellekt moduli turli mashinaviy o‘qitish algoritmlarining afzalliklarini birlashtirgan holda talabalar faoliyatini baholash, akademik natijalarni prognozlash, xavf guruhlarini aniqlash va universitet boshqaruvini ma’lumotlarga asoslangan holda takomillashtirish imkoniyatini yaratadi.

Natijalar

Taklif etilgan sun’iy intellektga asoslangan axborot tizimi oliy ta’lim muassasasi faoliyatini kompleks tahlil qilish, prognozlash va boshqaruv qarorlarini qo‘llab-quvvatlash imkonini beruvchi integratsiyalashgan model sifatida ishlab chiqildi. Tizimning amaliy natijalari universitetning asosiy faoliyat yo‘nalishlari — o‘quv jarayoni, talabalar o‘zlashtirishi, professor-o‘qituvchilar samaradorligi hamda ilmiy-tadqiqot faoliyati kesimida baholandi.

O‘tkazilgan tahlillar shuni ko‘rsatadiki, sun’iy intellekt algoritmlari asosida talabalar akademik natijalarini oldindan prognozlash yuqori aniqlik bilan amalga oshirilishi mumkin. Bunda davomat ko‘rsatkichi, oraliq va yakuniy nazorat natijalari, LMS tizimidagi faollik darajasi, topshiriqlarni bajarish holati hamda GPA ko‘rsatkichlari asosiy kirish parametrlari sifatida foydalanildi. Ushbu ma’lumotlar asosida tizim talabalarni akademik natijalariga ko‘ra bir nechta guruhlarga ajratadi: yuqori muvaffaqiyatga erishgan talabalar, o‘rtacha ko‘rsatkichga ega talabalar hamda akademik xavf guruhidagi talabalar.

Natijalar shuni ko‘rsatadiki, bunday yondashuv akademik jarayonni erta diagnostika qilish imkonini beradi. Ya’ni, o‘qituvchilar va akademik maslahatchilar talabalar muammolarini semestr yakunini kutmasdan, jarayon davomida aniqlashi

va tegishli pedagogik choralarni ko‘rishi mumkin bo‘ladi. Bu esa ta’lim sifatini oshirishga va individual yondashuvni kuchaytirishga xizmat qiladi.

Ta’lim sifati monitoringi bo‘yicha olingan natijalar ham tizimning samaradorligini tasdiqlaydi. Fanlar, kafedralar va fakultetlar kesimida o‘zlashtirish darajasi, davomat, kursni yakunlash foizi, qayta topshirishlar soni hamda talabalar fikr-mulohazalari asosida kompleks baholash amalga oshirildi. Ushbu ko‘rsatkichlar integratsiyalashgan holda ta’lim sifati reytingini shakllantirish imkonini berdi. Natijada universitet ichida qaysi yo‘nalishlar yuqori samaradorlikka ega ekanligi, qaysi fanlar yoki kafedralarda muammolar mavjudligi aniqlandi.

Professor-o‘qituvchilar faoliyatini tahlil qilish natijalari ham muhim ilmiy va amaliy ahamiyatga ega bo‘ldi. Tizim orqali ilmiy maqolalar soni, iqtiboslar ko‘rsatkichi, grant loyihalaridagi ishtirok, o‘quv yuklamasi hamda talabalar natijalari o‘zaro bog‘liq holda tahlil qilindi. Ushbu yondashuv nafaqat individual o‘qituvchi faoliyatini baholash, balki universitetning umumiy kadrlar siyosatini optimallashtirishga ham xizmat qiladi. Ayniqsa, talabalar natijalari bilan o‘qituvchi faoliyati o‘rtasidagi korrelyatsiya universitet boshqaruvi uchun muhim indikator sifatida namoyon bo‘ldi.

Ilmiy faoliyat monitoringi natijalari shuni ko‘rsatadiki, sun’iy intellekt asosida Scopus va Web of Science bazalaridagi nashrlar, patentlar hamda grant loyihalarini avtomatik tahlil qilish universitetning ilmiy salohiyatini real vaqt rejimida baholash imkonini beradi. Bu esa universitetning xalqaro reytinglardagi o‘rnini aniqlash va strategik rivojlanish yo‘nalishlarini belgilashda muhim rol o‘ynaydi.

Umumiy natijalar tahlili shuni tasdiqlaydiki, taklif etilgan tizim universitet faoliyatini faqat statik hisobotlar asosida emas, balki dinamik va prognozga asoslangan yondashuv orqali baholash imkonini beradi. Bu esa an’anaviy boshqaruv tizimlaridan farqli ravishda, oldindan qaror qabul qilish, xavflarni aniqlash va resurslarni optimallashtirish imkoniyatini yaratadi.

Muhokama

Olingan natijalar sun’iy intellekt texnologiyalarining oliy ta’lim muassasalari boshqaruvida muhim transformatsion rol o‘ynashini ko‘rsatadi. An’anaviy axborot tizimlari asosan mavjud holatni qayd etish va statistik hisobotlar tayyorlash bilan cheklangan bo‘lsa, sun’iy intellektga asoslangan tizimlar chuqur tahlil, prognozlash va qaror qabul qilishni qo‘llab-quvvatlash imkoniyatiga ega.

Zawacki-Richter va hammualliflari tomonidan olib borilgan tadqiqotlarda sun’iy intellektning oliy ta’limdagi eng muhim yo‘nalishlari sifatida adaptiv ta’lim, prognozlash modellari va akademik qarorlarni qo‘llab-quvvatlash tizimlari qayd etilgan. Shu bilan birga, Romero va Ventura tomonidan olib borilgan ilmiy izlanishlar Educational Data Mining va Learning Analytics texnologiyalarining asosiy maqsadi ta’lim jarayonini ma’lumotlarga asoslangan holda optimallashtirish ekanligini tasdiqlaydi.

Taklif etilgan tizimning amaliy afzalliklari quyidagilarda namoyon bo‘ladi: qaror qabul qilish jarayonining tezlashishi, inson omiliga bog‘liq xatoliklarning kamayishi, akademik xavflarning erta aniqlanishi, ta’lim sifatining oshishi hamda

universitet resurslaridan samarali foydalanish imkoniyatining yaratilishi. Ayniqsa, prognozlash asosidagi yondashuv ta’lim jarayonini reaktiv emas, balki proaktiv boshqarish imkonini beradi.

Shu bilan birga, tizimni keng joriy etishda bir qator muammolar mavjud. Ma’lumotlar sifati va to‘liqligi, axborot xavfsizligi va maxfiylik masalalari, algoritmlarning interpretatsiya qilinishi hamda yuqori hisoblash resurslariga bo‘lgan ehtiyoj shular jumlasidandir. Kelgusida ushbu muammolarni hal etishda Explainable Artificial Intelligence (XAI) yondashuvlari hamda Big Data texnologiyalaridan foydalanish tizimning ishonchliligi va shaffofligini oshiradi.

Umuman olganda, tadqiqot natijalari sun’iy intellektga asoslangan axborot tizimlari oliy ta’lim muassasalarida nafaqat tahliliy, balki strategik boshqaruv vositasi sifatida ham muhim ahamiyatga ega ekanligini ko‘rsatadi.

Xulosa.

Ushbu tadqiqotda sun’iy intellekt texnologiyalariga asoslangan oliy ta’lim muassasalari faoliyatini tahlil qiluvchi axborot tizimi modeli ishlab chiqildi. Taklif etilgan tizim universitetlarda mavjud ma’lumotlarni integratsiyalash, qayta ishlash, tahlil qilish va prognozlash jarayonlarini samarali amalga oshirish imkonini beradi.

Tizim orqali talabalar o‘zlashtirishi prognoz qilinadi, akademik xavf guruhlari aniqlanadi, ta’lim sifati monitoring qilinadi, professor-o‘qituvchilar faoliyati baholanadi hamda ilmiy faoliyat ko‘rsatkichlari tahlil qilinadi.

Olingan natijalar sun’iy intellekt va ta’lim analitikasi texnologiyalarini oliy ta’lim boshqaruv tizimiga joriy etish qaror qabul qilish jarayonlarini optimallashtirish, ta’lim sifatini oshirish va universitet boshqaruvining samaradorligini sezilarli darajada yaxshilashga xizmat qilishini ko‘rsatadi.

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XALQARO “QIZIL KITOB”NING SHAKLLANISHI VA PITER SKOTTNING TABIATNI MUHOFAZA QILISHDAGI ILMIY-AMALIY FAOLIYATI

Annotatsiya: *Mazkur maqolada xalqaro miqyosda biologik xilma-xillikni muhofaza qilishning muhim ilmiy-axborot vositalaridan biri hisoblangan “Qizil kitob”ning shakllanish tarixi, uning ilmiy-metodik asoslari va tabiatni muhofaza qilishdagi amaliy ahamiyati tahlil qilinadi. “Qizil kitob” g‘oyasining shakllanishida Xalqaro tabiatni muhofaza qilish ittifoqi (IUCN) hamda uning turlarni muhofaza qilishga ixtisoslashgan tuzilmalari faoliyati muhim o‘rin tutgan. Ayniqsa, britaniyalik tabiatshunos va ekologik harakat faoli Sir Piter Skottning IUCN Species Survival Commission faoliyatidagi rahbarligi, noyob va yo‘qolib ketish xavfi ostidagi turlarni tizimli ravishda hisobga olish hamda ular to‘g‘risidagi ma’lumotlarni standartlashtirish borasidagi xizmatlari alohida yoritilgan. Shuningdek, xalqaro “Qizil kitob” tajribasining O‘zbekiston sharoitida rivojlanishi, O‘zbekiston Respublikasi “Qizil kitobi”ning nashr etilish bosqichlari va zamonaviy biologik xilma-xillikni muhofaza qilish tizimidagi o‘rni ko‘rib chiqiladi. Tadqiqot natijasida “Qizil kitob” oddiy ma’lumotnoma emas, balki ilmiy monitoring, ekologik boshqaruv, tabiatni muhofaza qilish siyosati va bioxilma-xillikni saqlash choralarini belgilashga xizmat qiluvchi kompleks ilmiy-amaliy mexanizm ekanligi asoslanadi.*

Kalit so‘zlar: *Qizil kitob, Red Data Book, IUCN, Piter Skott, biologik xilma-xillik, noyob turlar, yo‘qolib ketish xavfi, tabiatni muhofaza qilish, ekologik monitoring, O‘zbekiston Qizil kitobi, flora, fauna, muhofaza etiladigan turlar.*

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THE FORMATION OF THE INTERNATIONAL “RED DATA BOOK” AND PETER SCOTT’S SCIENTIFIC AND PRACTICAL ACTIVITIES IN NATURE CONSERVATION

Abstract: *This article analyzes the history of the formation of the “Red Data Book”, one of the most important scientific and informational instruments for the conservation of biological diversity at the international level, as well as its scientific and methodological foundations and practical significance for nature conservation.*

The activities of the International Union for Conservation of Nature (IUCN) and its specialized structures dedicated to species conservation played an important role in the development of the "Red Data Book" concept. Particular attention is paid to the activities of the British naturalist and conservation activist Sir Peter Scott, his leadership role in the IUCN Species Survival Commission, and his contribution to the systematic assessment of rare and threatened species and the standardization of information about them. The article also examines the development of international "Red Data Book" practices in Uzbekistan, the stages of publication of the "Red Data Book" of the Republic of Uzbekistan, and its role in the modern system of biodiversity conservation. The study demonstrates that the "Red Data Book" is not merely a reference publication but a comprehensive scientific and practical mechanism that supports scientific monitoring, environmental governance, nature conservation policy, and the development of measures for biodiversity conservation.

Keywords: *Red Data Book, IUCN, Peter Scott, biological diversity, rare species, extinction risk, nature conservation, ecological monitoring, Red Data Book of Uzbekistan, flora, fauna, protected species.*

Kirish. XXI asrda biologik xilma-xillikning qisqarishi global ekologik muammolarning eng jiddiylaridan biriga aylandi. Tabiiy ekotizimlarning antropogen bosim ostida qolishi, yashash muhitlarining qisqarishi, noqonuniy ovchilik, tabiiy resurslardan haddan tashqari foydalanish, iqlim o‘zgarishi, suv va tuproq resurslarining degradatsiyasi hamda boshqa omillar ko‘plab o‘simlik va hayvon turlarining tabiiy populyatsiyalariga salbiy ta’sir ko‘rsatmoqda.

Ana shunday sharoitda muayyan turning biologik holati, tarqalish areali, populyatsiyasi, mavjud xavf omillari va uni muhofaza qilish choralarini ilmiy asosda baholash alohida ahamiyat kasb etadi. Mazkur ehtiyoj natijasida XX asrning ikkinchi yarmida xalqaro miqyosda noyob va yo‘qolib ketish xavfi ostidagi turlar to‘g‘risidagi ma’lumotlarni yagona tizimga keltirishga qaratilgan “Qizil kitob” konsepsiyasi shakllandi .

Asosiy qism. Xalqaro tabiatni muhofaza qilish ittifoqi — IUCN 1948-yil 5-oktabrda Fransiyaning Fontenblo shahrida tashkil etilgan bo‘lib, uning dastlabki faoliyat yo‘nalishlaridan biri inson faoliyatining tabiatga ta’sirini ilmiy o‘rganish va tabiatni muhofaza qilish bo‘yicha xalqaro hamkorlikni rivojlantirishdan iborat bo‘lgan [1].

“Qizil kitob” konsepsiyasining rivojlanishida esa britaniyalik tabiatshunos **Piter Skott**ning faoliyati alohida tarixiy va ilmiy ahamiyatga ega.

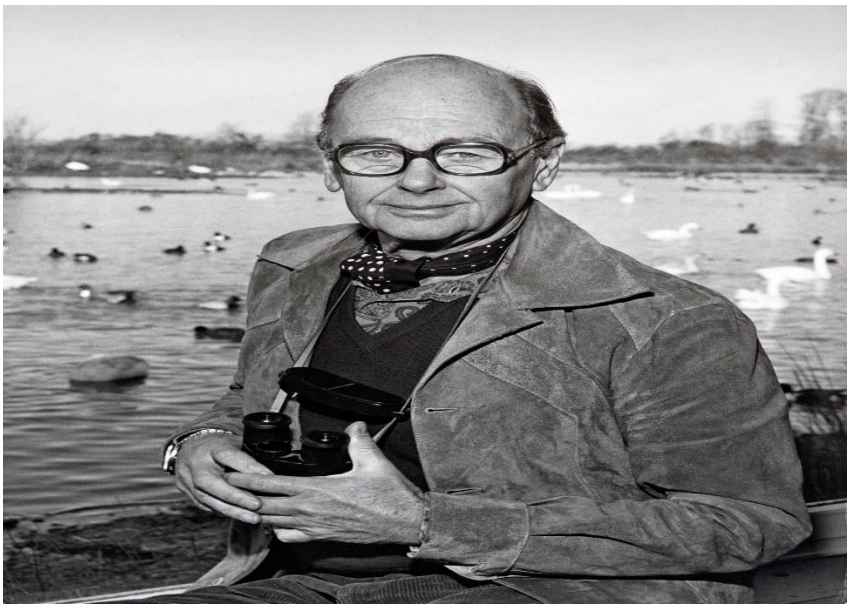
“Qizil kitob” atamasining paydo bo‘lishi XX asrning 1960-yillaridagi xalqaro tabiatni muhofaza qilish harakati bilan chambarchas bog‘liq. IUCN huzuridagi Survival Service Commission — Turlarni saqlab qolish bo‘yicha komissiya yo‘qolib ketish xavfi ostidagi hayvon va o‘simliklar to‘g‘risidagi ma’lumotlarni yig‘ish, tahlil qilish va tizimlashtirish bilan shug‘ullangan.

IUCN manbalarida 1962-yilda “Animals and plants threatened with extinction” nomli dastlabki materiallar to‘plami qayd etilgan. U to‘liq

shakllanmagan bo‘lsa-da, keyinchalik Red Data Book tizimiga asos bo‘lgan dastlabki ilmiy axborot manbalaridan biri sifatida qaraladi [2].

1963-yildan boshlab Piter Skott Survival Service Commission raisi sifatida ushbu yo‘nalishning rivojlanishiga katta hissa qo‘shdi. IUCN tarixiga oid rasmiy materiallarda aynan uning faoliyati Red Data Book konsepsiyasining shakllanishi bilan bog‘lanadi [3]. Shu jihatdan “Qizil kitob”ning paydo bo‘lishini birgina kitobning nashr etilishi sifatida emas, balki **noyob turlarni aniqlash → ularning holatini baholash → xavf darajasini belgilash → muhofaza choralarini ishlab chiqish → monitoring qilish** kabi uzviy jarayonning institutsionallashuvi sifatida baholash lozim.

Piter Skottning ilmiy va tabiatni muhofaza qilish faoliyatiga nazar tashlasak, Peter Markham Skott (1909–1989) - britaniyalik ornitolog, rassom, tabiatshunos, ekologik harakat faoli va tabiatni muhofaza qilish tashkilotlari rivojiga katta hissa qo‘shgan olimlardan biridir. U Antarktida tadqiqotchisi Robert Falkon Skottning yagona o‘g‘li bo‘lgan. Keyinchalik tabiatni, ayniqsa suv qushlari va suv-botqoq ekotizimlarini muhofaza qilishga katta e’tibor qaratgan (1-rasm).



1-rasm. “Qizil kitob” asoschisi – Piter Skott

Piter Skottning ilmiy-amaliy faoliyatini bir necha yo‘nalishga ajratish mumkin:

1. Ornitologik tadqiqotlar. Piter Skottning dastlabki ilmiy qiziqishlari qushlar biologiyasi, migratsiyasi va ularni muhofaza qilish bilan bog‘liq bo‘lgan. Uning faoliyati suv qushlari va ularning yashash muhitlarini saqlash masalasiga alohida e’tibor qaratgan.

2. Suv-botqoq hududlarni muhofaza qilish. Uning tashabbuslari natijasida suv qushlarini saqlash, ularning qishlash va ko‘payish joylarini muhofaza qilishga qaratilgan ilmiy-amaliy tizimlar rivojlandi. Bu keyinchalik suv-botqoq ekotizimlarini xalqaro miqyosda muhofaza qilish harakatiga ham ta’sir ko‘rsatdi.

3. Xalqaro tabiatni muhofaza qilish harakatidagi faoliyati. Piter Skott IUCNning Survival Service Commission komissiyasiga 1963–1980-yillarda rahbarlik qilgan. IUCNning tarixiy hujjatlarida Red Data Book tizimining muvaffaqiyatli rivojlanishida uning xizmatlari alohida qayd etiladi. Uning rahbarligi davrida noyob turlar to‘g‘risidagi ma’lumotlarni standartlashtirish, ularning holatini muntazam ravishda qayta ko‘rib chiqish va ma’lumotlarni yangilab borish tamoyillari shakllandi.

4. WWF tashkil topishidagi ishtiroki. Piter Skott tabiatni muhofaza qilish bo‘yicha xalqaro hamkorlikning rivojlanishida ham faol ishtirok etgan. U WWFning tashkil topishida ishtirok etgan muhim shaxslardan biri sifatida e’tirof etiladi [4].

Shunday qilib, Piter Skott faoliyatining asosiy xususiyati shundaki, u **ilmiy ma’lumotni amaliy tabiatni muhofaza qilish siyosati bilan bog‘lashga** intildi.

“Qizil kitob”ning asosiy innovatsiyasi shundan iborat ediki, unda noyob turlar to‘g‘risidagi ma’lumotlar oddiy ro‘yxat shaklida emas, balki ularning biologik va ekologik holatini tavsiflovchi tizim asosida berila boshlandi.

Har bir tur bo‘yicha, odatda:

1. turning sistematik holati;
2. tarqalish areali;
3. populyatsiyasining umumiy holati;
4. sonining o‘zgarish dinamikasi;
5. yashash muhitining xususiyatlari;
6. asosiy xavf omillari;
7. mavjud muhofaza choralari;
8. tavsiya etiladigan muhofaza tadbirlari;

ilmiy kuzatuv va monitoring ma’lumotlari kabi ko‘rsatkichlar jamlandi.

IUCN tarixiy hujjatlarida Red Data Book turlarni muhofaza qilish uchun zarur bo‘lgan ma’lumotlarni standart shaklda jamlovchi “ishchi vosita” sifatida tavsiflangan. 1966-yilda IUCN tomonidan **Red Data Book, Volume 1: Mammalia** nashr etildi. Mazkur nashr yangilanib turishi mumkin bo‘lgan alohida varaqlardan tashkil topgan bo‘lib, bu yangi ma’lumotlarni muntazam qo‘shib borish imkonini bergan [5].

Keyingi yillarda qushlar, sudralib yuruvchilar, amfibiyalar, baliqlar va o‘simliklar bo‘yicha alohida jildlar paydo bo‘ldi. IUCNning tarixiy ma’lumotlariga ko‘ra, 1960-yillarda shakllangan ushbu tizim keyinchalik dunyoning ko‘plab mamlakatlarida milliy va mintaqaviy “Qizil kitob”larning yaratilishiga turtki bergan.

“Qizil kitob” nomining tanlanishi bevosita ogohlantirish va xavf tushunchasi bilan bog‘liq. Qizil rang insoniyat ongida xavf, ogohlantirish va zudlik bilan harakat qilish zaruratini ifodalovchi universal ramzlardan biridir.

Shu sababli “Qizil kitob” nomi ikki muhim funksiyani bajaradi:

birinchidan, ilmiy jihatdan — yo‘qolish xavfi mavjud bo‘lgan turlarni ajratib ko‘rsatadi;

ikkinchidan, ijtimoiy jihatdan — jamiyat e'tiborini biologik xilma-xillikni muhofaza qilish zaruratiga qaratadi.

Dastlabki nashrlarda turlar holatini turli rangdagi varaqlar yordamida farqlash amaliyoti ham qo'llanilgan. Biroq zamonaviy IUCN tizimi tarixiy rangli sahifalar tizimidan ancha rivojlangan bo'lib, turlarni **Critically Endangered, Endangered, Vulnerable** kabi xavf toifalari asosida baholashga o'tgan.

Bugungi IUCN Red List dunyodagi yo'qolib ketish xavfini baholash bo'yicha eng keng qamrovli ilmiy axborot manbalaridan biri hisoblanadi. IUCN ma'lumotlariga ko'ra, uning dastlabki "Qizil kitob" shaklidagi tizimi 1960-yillardan boshlab rivojlanib, hozirgi raqamli global ma'lumotlar tizimiga aylangan. (IUCN)

"Qizil kitob" konsepsiyasining muhim natijalaridan biri uning xalqaro darajadan milliy darajaga ko'chishidir.

Bunda asosiy tamoyil quyidagicha shakllandi:

xalqaro baholash → milliy baholash → hududiy monitoring → muhofaza chorasi → populyatsiyani tiklash.

Mazkur yondashuv davlatlarga o'z hududidagi biologik xilma-xillikni alohida baholash imkonini berdi.

O'zbekiston Ekologiya va iqlim o'zgarishi milliy qo'mitasining rasmiy ma'lumotlariga ko'ra, 2019-yilgi beshinchi nashrga **314 tur o'simlik va 206 tur hayvon** kiritilgan.

"O'zbekiston Qizil kitobi"ning 1993-yildagi birinchi nashriga 301 o'simlik turi kiritilgan bo'lib, u o'zbek va rus tillarida nashr etilgan. Kitobda har bir turning o'zbek, rus va lotin tillarida nomlari berilgan, poligonlarining qisqarishi, sonining kamayish sabablari, tabiatni muhofaza qilish bo'yicha ko'rilgan chora-tadbirlar to'g'risida ma'lumotlar berilgan, shuningdek, turlarning tarqalish xaritalari va tasvirlari ifodalangan. 2003-yilda Qizil kitobning ikkinchi nashri chop etildi. 2006-yilda "O'zbekiston o'simliklari Qizil kitobi"ning uchinchi nashri, 2010-yilda "O'zbekiston Qizil kitobi"ning to'rtinchi nashri chop etildi. Unga 184 turdagi hayvonnlar kiritilgan. Ulardan 77 turini umurtqasiz hayvonlar (halqali qurtlarning 3 ta turi, mollyuskalarning 14 turi, qo'shoyoqlarning 61 turi), 18 turdagi baliqlar, 16 turdagi sudralib yuruvchilar, 48 turdagi qushlar va 25 turdagi sutemizuvchilar tashkil etadi. Shu bilan birga kitobga sutemizuvchilar va qushlarning ayrim turlari kiritilmagan. Ularning ayrimlari pespublika hududida hozirgi vaqtda ancha barqaror songa (qunduz, cho'l chumchug'i), boshqa turlari esa hozir ko'chmanchilar (kichik oqqush, bahaybat tungi ko'rshapalak turi, qizil bo'ri) yoki ularning faunada mavjudligi hisoblanadi. O'zbekistonning (manul, Tyan-Shan tog' qo'ylari) yetarlicha o'rganilmagan. Kitobda, shuningdek, O'zbekistonda yo'qolib ketish xavfi ostida bo'lmagan, ammo Xalqaro tabiatni muhofaza qilish Ittifoqi Qizil ro'yxatiga kiritilgan.

Keyingi bosqichlarda uning mazmuni va turlar tarkibi muntazam ravishda qayta ko'rib chiqildi.

1-JADVAL.

O'zbekiston "Qizil kitobi" rivojlanishining asosiy bosqichlari

№	Yil	Muhim bosqich	Qisqacha mazmuni
1	**1979**	“Qizil kitob”ni tashkil etish jarayoni	O‘zbekistonda noyob va yo‘qolib ketish xavfi ostidagi o‘simlik hamda hayvon turlarini aniqlash va muhofaza qilish bo‘yicha ishlar boshlandi.
2	**1984**	Birinchi nashr	O‘zbekiston “Qizil kitobi”ning birinchi nashri amalga oshirildi.
3	**1993**	Mustaqillik davridagi yangi nashr	Yangi nashrda **301 tur o‘simlik** muhofazaga muhtoj turlar sifatida qayd etildi.
4	**2003**	Navbatdagi nashr	Noyob va yo‘qolib borayotgan turlar tarkibi qayta ko‘rib chiqilib, navbatdagi nashr tayyorlandi.
5	**2006**	O‘simliklar “Qizil kitobi”ning yangi nashri	O‘zbekiston florasining noyob va muhofazaga muhtoj turlari haqidagi ma’lumotlar yangilandi.
6	**2010**	Hayvonot dunyosiga oid navbatdagi nashr	Noyob va yo‘qolib ketish xavfi ostidagi hayvon turlari haqidagi ma’lumotlar yangilandi.
7	**2019**	Beshinchi nashr	Nashrda **314 tur o‘simlik va 206 tur hayvon** qayd etildi.
8	**2026**	Oltinchi nashrga tayyorgarlik	Turlar tarkibini zamonaviy ilmiy tadqiqotlar va monitoring natijalari asosida qayta ko‘rib chiqish jarayoni olib borilmoqda.

Jadval mualliflar tomonidan asos solingan.

Bugungi kunda O‘zbekiston “Qizil kitobi” oddiy bosma nashrdan ko‘ra kengroq ilmiy-amaliy tizimning bir qismiga aylanmoqda [9].

2026-yil boshidagi rasmiy ma’lumotlarga ko‘ra, O‘zbekistonda “Qizil kitob”ning **oltinchi nashri** uchun flora va fauna turlarining tarkibi ilmiy asosda qayta ko‘rib chiqilmoqda. Hayvonlar bo‘yicha 189 tur va kenja turni kiritish tavsiya qilingan bo‘lib, ulardan 13 turi Qizil kitobga ilk bor kiritilishi taklif etilgan. Shuningdek, 48 tur bo‘yicha muhofaza maqomini o‘zgartirish tavsiya etilgan [10].

Bu jarayonning Fanlar akademiyasining Zoologiya va Botanika institutlari, mustaqil ekspertlar hamda xalqaro tashkilotlar bilan hamkorlikda amalga oshirilayotgani “Qizil kitob”ning zamonaviy ilmiy asoslarini ko‘rsatadi.

Demak, “Qizil kitob” doimiy yangilanib turuvchi ilmiy tizimdir. Turning unga kiritilishi yoki undan chiqarilishi populyatsiyaning real holati, arealining o‘zgarishi va yangi monitoring ma’lumotlari bilan bog‘liq bo‘lishi kerak.

IUCNning tarixiy hujjatlarida Red Data Book muvaffaqiyatining katta qismi Piter Skott xizmatlari bilan bog‘lanadi. U 1963–1980-yillarda komissiyaga rahbarlik qilgan va uning rahbarligi davrida turlar haqidagi ma’lumotlarni tizimlashtirish hamda muntazam yangilash ishlari rivojlangan [6].

Piter Skott xotirasiga IUCN tomonidan **Peter Scott Award for Conservation Merit** mukofoti ham ta’sis etilgan bo‘lib, u turlarni muhofaza

qilishga ko‘p yillar davomida katta hissa qo‘shgan shaxslarning xizmatlarini e’tirof etishga qaratilgan [7].

2026-yilda O‘zbekistonda **ECODATA** yagona bioxilma-xillik ma’lumotlarini boshqarish platformasi ishga tushirilgani haqida rasmiy ma’lumot berildi. Platformada flora va fauna, muhofaza etiladigan tabiiy hududlar hamda ekologik monitoring ma’lumotlari tizimlashtiriladi [11]. Qizil kitobga kiritilgan turlarning populyatsiyasi, tarqalishi va muhofaza holatini kuzatish ham platformaning muhim funksiyalaridan biridir.

Bu holat Piter Skott davrida shakllangan asosiy g‘oyaning — **turlar haqida aniq ma’lumot yig‘ish, ularni baholash va shu ma’lumotlar asosida muhofaza choralarini ishlab chiqish** tamoyilining zamonaviy raqamli shaklda davom etayotganini ko‘rsatadi [8].

Xulosa. “Qizil kitob” insoniyatning biologik xilma-xillikni saqlab qolish yo‘lidagi eng muhim ilmiy-amaliy tashabbuslaridan biridir. Uning shakllanishi XX asrning ikkinchi yarmida tabiatni muhofaza qilish harakatining ilmiy asoslari kuchayishi bilan bog‘liq bo‘ldi.

Ayniqsa, 2026-yilda oltinchi nashr uchun turlar ro‘yxatining qayta ko‘rib chiqilishi O‘zbekistonda biologik xilma-xillikni muhofaza qilish tizimi zamonaviy ilmiy monitoring va daliliy ma’lumotlarga tobora ko‘proq tayanayotganini ko‘rsatadi [12].

Shunday qilib, **“Qizil kitob” — yo‘qolish xavfi ostidagi turlar ro‘yxati emas, balki tabiatning biologik holatini baholash, ekologik xavflarni aniqlash, ilmiy monitoringni tashkil etish va tabiatni muhofaza qilish siyosatini shakllantirishga xizmat qiluvchi kompleks ilmiy-amaliy institutdir.** Piter Skottning merosi esa ushbu institutning tarixiy shakllanishida muhim ilmiy va tashkiliy poydevorlardan biri sifatida baholanishi mumkin.

Foydalanilgan adabiyotlar:

1. IUCN. *Seventy five years of experience.* International Union for Conservation of Nature.
2. IUCN. *The IUCN Species Survival Commission.* International Union for Conservation of Nature.
3. IUCN. *Red Data Book. Volume 1. Mammalia, a compilation*. Morges: IUCN, 1966.
4. IUCN. *Animals and plants threatened with extinction*. Morges: IUCN, 1962.
5. IUCN. *The Red Book: Wildlife in Danger*. London: Collins, 1969.
6. IUCN. *The IUCN Species Survival Commission.* 2000.
7. IUCN. *Wildlife in a Changing World: An Analysis of the 2008 IUCN Red List of Threatened Species*.
8. IUCN. *SSC Honours and Awards.*
9. O‘zbekiston Respublikasi Ekologiya va iqlim o‘zgarishi milliy qo‘mitasi. *O‘zbekiston Respublikasining Qizil kitobi*.
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11. O‘zbekiston Respublikasi Ekologiya tizimi.

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MARKAZIY OSIYO POYTAXT SHAHARLARINING BOSH REJALARI: SHAHARSOZLIK RIVOJLANISHINING ZAMONAVIY YO‘NALISHLARI

Annotatsiya *Mazkur maqolada Markaziy Osiyo poytaxtlari — Toshkent, Astana, Bishkek, Dushanbe va Ashxobod shaharlarining amaldagi hamda istiqbolli bosh rejalari tahlil qilinadi. Bosh rejalarning shaharlardagi hududiy rivojlanish, transport va muhandislik infratuzilmasi, yashil hududlar, ijtimoiy obyektlar, renovatsiya, rekonstruksiya hamda aglomeratsion jarayonlarni tartibga solishdagi ahamiyatiga e’tibor qaratiladi. Tadqiqotda poytaxtlarning bosh rejalari rejalashtirish muddati, hujjatlarning amaldagi holati, yetakchi rivojlanish yo‘nalishlari va shaharsozlik xususiyatlari bo‘yicha qiyosiy tizimlashtirilgan. Toshkent uchun tarixiy muhitni saqlash, renovatsiya, transport va aglomeratsion rivojlanish; Astana uchun politsentriklik, ixchamlik va aglomeratsion yondashuv; Bishkek uchun infratuzilmaviy yangilash, ekologik muvozanat va jamoat transportini rivojlantirish; Dushanbe uchun yo‘naltirilgan hududiy kengayish; Ashxobod uchun esa monumental-reprezentativ modelni zamonaviy raqamli, transport va barqaror infratuzilma elementlari asosida modernizatsiya qilish tendensiyalari aniqlanadi. Maqolada Markaziy Osiyo poytaxtlarining shaharsozlik rivojlanishida bosh rejalarning strategik boshqaruv vositasi sifatidagi o‘rni ochib beriladi.*

Kalit sozlar: *Markaziy Osiyo, poytaxt shaharlar, bosh reja, shaharsozlik, urbanizatsiya, aglomeratsiya, renovatsiya, rekonstruksiya, politsentriklik, transport infratuzilmasi, yashil hududlar, barqaror rivojlanish.*

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MASTER PLANS OF THE CAPITAL CITIES OF CENTRAL ASIA: MODERN TRENDS IN URBAN DEVELOPMENT

Abstract. *This article analyzes the current and prospective master plans of the Central Asian capitals—Tashkent, Astana, Bishkek, Dushanbe, and Ashgabat. Particular attention is paid to the role of master plans in regulating spatial development, transport and engineering infrastructure, green spaces, social facilities, renovation, reconstruction, and agglomeration processes in these cities.*

The study provides a comparative and systematic classification of the master plans of the capitals according to their planning horizons, current status, major development priorities, and urban planning characteristics. For Tashkent, the study identifies the preservation of the historic urban environment, renovation, transport development, and agglomeration as key priorities; for Astana, polycentric development, compactness, and an agglomeration-based approach; for Bishkek, infrastructure modernization, ecological balance, and the development of public transport; for Dushanbe, targeted spatial expansion; and for Ashgabat, the modernization of a monumental-representative urban model through the integration of contemporary digital, transport, and sustainable infrastructure elements. The article highlights the role of master plans as strategic urban management instruments in the urban development of the capitals of Central Asia.

Keywords: *Central Asia, capital cities, master plan, urban planning, urbanization, agglomeration, renovation, reconstruction, polycentricity, transport infrastructure, green spaces, sustainable development.*

KIRISH (INTRODUCTION). Poytaxt bosh rejasi shaharning istiqboldagi hududiy rivojlanishini belgilovchi asosiy shaharsozlik hujjati hisoblanadi. U turar-joy va jamoat hududlarining joylashuvi, transport tizimi, muhandislik infratuzilmasi, yashil hududlar, ishlab chiqarish zonalari va ijtimoiy obyektlarning uzoq muddatli o‘zaro nisbatini belgilaydi. Markaziy Osiyo poytaxtlarida keyingi yillarda bosh rejalarning yangilanishi aholining tez o‘sishi, transport yuklamasi, ekologik muammolar va poytaxt aglomeratsiyalarining kengayishi bilan izohlanadi. Poytaxt bosh rejasi shaharning istiqboldagi hududiy rivojlanishini belgilovchi asosiy shaharsozlik hujjati hisoblanadi. U turar-joy va jamoat hududlarining joylashuvi, transport tizimi, muhandislik infratuzilmasi, yashil hududlar, ishlab chiqarish zonalari va ijtimoiy obyektlarning uzoq muddatli o‘zaro nisbatini belgilaydi. Markaziy Osiyo poytaxtlarida keyingi yillarda bosh rejalarning yangilanishi aholining tez o‘sishi, transport yuklamasi, ekologik muammolar va poytaxt aglomeratsiyalarining kengayishi bilan izohlanadi. Shu nuqtayi nazardan, Markaziy Osiyo poytaxtlarining amaldagi va istiqbolli bosh rejalarini qiyosiy o‘rganish ularning hududiy rivojlanish xususiyatlari, shaharsozlik siyosatining ustuvor yo‘nalishlari hamda zamonaviy urbanistik modellarini aniqlash imkonini beradi. Tadqiqotning maqsadi Markaziy Osiyo poytaxtlari bosh rejalarining istiqbolli rivojlanish yo‘nalishlarini qiyosiy tahlil qilish va ularning asosiy shaharsozlik xususiyatlarini tizimlashtirishdan iborat.

2. TADQIQOT METODOLOGIYASI (METHODS)

Tadqiqotda Markaziy Osiyo poytaxtlarining amaldagi va istiqbolli bosh rejalariga oid ma’lumotlarni qiyosiy tahlil qilish va tizimlashtirish yondashuvidan foydalanildi. Tahlil Toshkent, Astana, Bishkek, Dushanbe va Ashxobod shaharlari misolida amalga oshirildi.

Poytaxtlarning bosh rejalari quyidagi mezonlar asosida ko‘rib chiqildi: rejalashtirish muddati, bosh rejaning huquqiy va amaldagi holati, hududiy rivojlanish yo‘nalishlari, transport va muhandislik infratuzilmasining rivojlanishi,

yashil hududlar va ekologik yo‘nalishlar, renovatsiya va rekonstruksiya jarayonlari, aglomeratsion rivojlanish, shaharsozlik modelining o‘ziga xos xususiyatlari.

Tadqiqot materiallarini tizimlashtirish jarayonida poytaxtlarning bosh rejalari bo‘yicha keltirilgan rasmiy ma’lumotlar, shahar boshqaruvi va shaharsozlik hujjatlariga asoslangan ko‘rsatkichlardan foydalanildi. Mazkur ma’lumotlar asosida Markaziy Osiyo poytaxtlarining bosh rejalari istiqbol davri va asosiy shaharsozlik yo‘nalishlari bo‘yicha umumlashtirildi.

3. NATIJALAR (RESULTS). Toshkent shahrining 2045-yilgacha bosh rejasi. Toshkentning zamonaviy shaharsozlik siyosatida muhim burilish 2024-yilda yuz berdi. O‘zbekiston Respublikasi Vazirlar Mahkamasining **2024-yil 24-dekabrdagi 880-son qarori** bilan Toshkent shahrining 2045-yilgacha bo‘lgan bosh rejasi tasdiqlandi [1]. Birinchi bosqich 2030-yilgacha mo‘ljallangan. Rasmiy ma’lumotlarda bosh reja qamrab oladigan hudud 43,8 ming gektardan ortiq ekani, uzoq muddatli hisob-kitoblar esa poytaxt va uning urbanizatsion hududida 7 milliondan ortiq aholiga xizmat ko‘rsatadigan tizimni shakllantirish zaruratidan kelib chiqqani qayd etilgan [2].

Toshkent bosh rejasining muhim jihati qurilishni faqat hududni kengaytirish orqali emas, mavjud shahar makonini tabaqalashtirib boshqarish orqali tartibga solishidir. Rejalashtirishda **konservatsiya, rekonstruksiya va renovatsiya** tamoyillari qo‘llanadi. Konservatsiya hududlarida tarixiy-madaniy meros va shakllangan yashil makonlarni saqlash, rekonstruksiya qismlarida master-rejalar asosida mavjud muhitni takomillashtirish, renovatsiya hududlarida esa eskirgan qurilish fondini bosqichma-bosqich yangilash ko‘zda tutilgan. Bu yondashuv Toshkentning ko‘p qatlamli tarixiy tuzilishini zamonaviy urbanizatsiya bosimidan butunlay ajratmasdan rivojlantirish imkonini beradi. Ya’ni yangi shaharsozlik modeli tarixiy markazni muzlatib qo‘yish bilan emas, uning qimmatli qismlarini saqlagan holda boshqa hududlarda rivojlanish salohiyatini oshirishga asoslanadi.

Transport va ekologik infratuzilma bosh rejaning ikkinchi tayanch yo‘nalishini tashkil etadi. 2045-yilgacha yangi ko‘cha va yo‘llar qurish, jamoat transportining ulushini oshirish, metro va tezkor transport yo‘laklarini kengaytirish, shahar atrofi bilan transport aloqalarini yaxshilash nazarda tutilgan. 2025-yilda transport tizimini rivojlantirishga oid qo‘shimcha qaror bilan 2030-yilgacha jamoat transportidan foydalanish ulushini 60 foizga, metro tarmog‘ini 103 kilometrga yetkazish kabi ko‘rsatkichlar ham belgilandi. Yashil hududlarning kengaytirilishi ham Toshkentning yangi rejalashtirish modeliga kiritilgan. 2026-yilda bildirilgan takliflarda Toshkent va unga tutash hududlarda yashil maydonlarni uch barobar kengaytirib, 25 ming gektarga yetkazish istiqboli belgilangan[3]. Shu bois Toshkent bosh rejasini **tarixiy muhitni saqlash + renovatsiya + transportga yo‘naltirilgan rivojlanish + aglomeratsion kengayish** elementlarini birlashtirgan model sifatida baholash mumkin.

Astana shahrining 2035-yilgacha bosh rejasi. Astana bosh rejasining xususiyati shaharning nisbatan yangi poytaxt ekanligi va uning juda yuqori demografik sur’atlarda rivojlanayotganidir. Qozog‘iston Respublikasi Hukumatining **2024-yil 25-yanvardagi 33-son qarori** bilan Astananing 2035-

yilgacha bosh rejasi tasdiqlangan [4]. Hujjatda hisob-kitob davri 2035-yil etib belgilangan va shu davrda shahar aholisining qariyb **2,275 million kishiga** yetishi prognoz qilingan [5].

Astana modelining prinsipial xususiyati - shaharning o‘zini alohida yopiq hudud sifatida emas, **Astana aglomeratsiyasi bilan yaxlit tizim** tarzida rejalashtirishdir. Bosh rejada transport, rekreatsiya, ishlab chiqarish, muhandislik va ijtimoiy infratuzilma shahar chegaralaridan tashqaridagi hududlar bilan o‘zaro bog‘liq holda ko‘rib chiqiladi. 2026–2030-yillarga mo‘ljallangan rivojlanish rejasida Astana shaharsozligining uch asosiy tamoyili alohida qayd etilgan: **politsentriklik, ixchamlik va muvozanatlilik** [6]. Bu tamoyillar markazga haddan tashqari yuklama tushishini kamaytirib, yashash, xizmat ko‘rsatish va ish o‘rinlarini bir necha shahar markazlari o‘rtasida taqsimlashga xizmat qiladi.

Astana va uning atrofidagi aholi punktlari o‘rtasida transport, muhandislik hamda iqtisodiy aloqalarni yaxlitlashtirish ham muhim vazifa hisoblanadi. Astana aglomeratsiyasini 2024–2028-yillarda kompleks rivojlantirish rejasiga shaharning o‘zi bilan bir qatorda 40 dan ortiq yaqin aholi punktlari kiritilgan. Shunday qilib, Astana bosh rejasi avvalgi monumental yangi poytaxt qurilishi modelidan bosqichma-bosqich **politsentrik va aglomeratsion metropol** modeliga o‘tishni ko‘rsatadi.

Bishkek shahrining 2050-yilgacha bosh rejasi. Bishkekda uzoq vaqt davomida 2025-yilgacha mo‘ljallangan avvalgi bosh reja amal qilgan. Shaharning tez kengayishi, yangi turar-joy massivlarining shakllanishi va infratuzilmaning mavjud demografik yuklamaga mos kelmay qolishi yangi rejalashtirish hujjatini ishlab chiqish zaruratini yuzaga keltirdi. **2026-yil 24-aprelda Qirg‘iz Respublikasi Vazirlar Mahkamasi Bishkek shahrining 2050-yilgacha bosh rejasini tasdiqladi** va 2006-yilda qabul qilingan avvalgi reja o‘z kuchini yo‘qotdi [7]. Yangi hujjat poytaxtning hududiy rivojlanishi, funksional zonalashtirish, respublika va mahalliy ahamiyatdagi obyektlarni joylashtirish hamda xavfsiz shahar muhitini shakllantirishni belgilaydi.

Bishkek uchun asosiy masala yangi monumental markaz qurish emas, balki uzoq vaqt davomida yig‘ilib qolgan hududiy va infratuzilmaviy nomutanosibliklarni bartaraf etishdir. Bosh reja doirasida tramvay tizimini joriy etish, magistral yo‘llarni kengaytirish, yangi transport yo‘nalishlarini shakllantirish hamda ijtimoiy infratuzilmani kuchaytirish ko‘zda tutilgan. Loyihada 650 dan ortiq ijtimoiy infratuzilma obyektini qurish yoki rekonstruksiya qilish, yashil hududlarni 590 gektardan 2 110 gektargacha kengaytirish istiqbollari qayd etilgan. 2050-yil uchun aholi soni qariyb 2 million kishi miqyosida hisoblangan [8]. Magistral ko‘chalarni me’yoriy holatga keltirish, yangi yo‘llar, transport tugunlari, tramvay va tezkor avtobus tizimlaridan transport bo‘yicha takliflarda foydalanish nazarda tutilgan.

Bishkek tajribasi poytaxtni **infratuzilmaviy yangilash, ekologik muvozanat va jamoat transportini kuchaytirish orqali rekonstruktiv rivojlantirish modeli** sifatida namoyon qiladi.

Dushanbe shahrining 2040-yilgacha bosh rejasi. Dushanbening amaldagi tuzatilgan bosh rejasi Tojikiston Respublikasi Hukumatining **2017-yil 28-apreldagi 212-son qarori** bilan tasdiqlangan. Hujjat 2040-yilgacha hisoblangan bo‘lib, loyiha davri yakunida aholining 1 million 176 ming kishiga yetishi nazarda tutilgan. Rasmiy huquqiy bazada ushbu qaror amaldagi hujjat sifatida qayd etilgan.

Dushanbe bosh rejasida hududiy kengayish aniq yo‘nalishlar asosida belgilangan. Asosiy taraqqiyot shaharning **janubiy qismiga,** qisman shimol, sharq va g‘arb tomonga yo‘naltirilgan. Qurilish o‘zlashtiriladigan hududni 2040-yilda 25 ming gektargacha, undan keyingi istiqbolda esa 30 ming gektargacha yetkazish ko‘zda tutilgan. Bu model Dushanbeda mavjud markaz atrofidagi hududlarni zichlashtirish bilangina cheklanmay, poytaxt chegaralarini funksional jihatdan kengaytirishni nazarda tutadi. Tog‘li relyef va Hisor vodiysining tabiiy sharoiti sababli shaharning o‘sish yo‘nalishlari tabiiy-geografik cheklovlar bilan uzviy bog‘langan. Shu bois Dushanbeni **yo‘naltirilgan hududiy kengayish va ma’muriy markazni bosqichma-bosqich modernizatsiya qilish modeli** sifatida tavsiflash mumkin.

Ashxobodning 2045-yilgacha istiqbolli bosh rejasi. Ashxobod bo‘yicha vaziyat boshqa to‘rtta poytaxtdan biroz farq qiladi. Ochiq rasmiy manbalarda 2045-yilgacha bo‘lgan yangi bosh rejaning yakuniy tasdiqlangan to‘liq matni hozircha e’lon qilinganligi aniqlanmadi. 2023-yilda Turkmaniston Prezidenti yangi bosh rejani 2045-yilgacha ilg‘or fan-texnika yutuqlari va xalqaro shaharsozlik tajribasi asosida ishlab chiqish vazifasini qo‘ygan [9].

Turkmaniston Qurilish va arxitektura vazirligining ilmiy-amaliy nashrida 2024-yil iyulda “Türkmendöwlettaslama” tarkibida **Ashxobod bosh rejasini ishlab chiqish bo‘limi** faoliyat boshlagani ko‘rsatiladi. Unda 2045-yilgacha bo‘lgan reja ustida ish olib borilayotgani, dastlabki bosqich yangi turar-joy va ma’muriy obyektlar, transport magistrallari hamda hududlarni istiqbolli o‘zlashtirish masalalarini qamrab olishi qayd etilgan [10]. Loyihada transportni poytaxt markazidan chetlab o‘tkazuvchi yo‘llar, Ashxobod orqali Anev va Arkadag shaharlarini bog‘lovchi tezkor yerusti transport tizimi kabi yechimlar muhokama qilingan. Shuningdek, yangi qurilishlar bilan tarixiy merosni saqlashni uyg‘unlashtirish masalasi ham ko‘zda tutilmoqda.

2026-yilda taqdim etilgan **“Ashgabat-2045”** strategik yondashuvida raqamli boshqaruv, yashil energetika, aqlli transport, suvni qayta ishlatish va barqaror infratuzilma kabi yo‘nalishlar ilgari surildi. Demak, Ashxobod rivojlanishining hozirgi bosqichini **monumental poytaxt modelidan raqamli, transport jihatdan integratsiyalashgan va barqaror shahar modeliga o‘tish jarayoni** deb baholash mumkin.

1-jadval.

Markaziy Osiyo poytaxtlarining amaldagi va istiqbolli bosh rejalari

Poytaxt	Rejalashtirish muddati	Hujjat holati	Yetakchi yo‘nalish	Shaharsozlik xususiyati
Toshkent	2045	2024-yilda tasdiqlangan	Renovatsiya, transport, yashil hududlar	Tarixiy shahar + aglomeratsiya
Astana	2035	2024-yilda tasdiqlangan	Politsentriklik, ixchamlik, aglomeratsiya	Tez o‘suvchi yangi metropol
Bishkek	2050	2026-yilda tasdiqlangan	Transport, ekologiya, ijtimoiy infratuzilma	Rekonstruktiv-modernizatsion model
Dushanbe	2040	2017-yilda tasdiqlangan, amalda	Hududiy kengayish, yangi qurilish	Yo‘naltirilgan hududiy o‘sish
Ashxobod	2045	Yangi bosh reja ishlab chiqish/strategik rivojlantirish bosqichida	Smart infratuzilma, transport, yangi qurilish	Monumental-reprezentativ modelning modernizatsiyasi

Manba: rasmiy hukumat, shahar boshqaruvi va shaharsozlik hujjatlari asosida muallif tomonidan tizimlashtirilgan.

4. MUHOKAMA (DISCUSSION) Markaziy Osiyo poytaxtlarining amaldagi va istiqbolli bosh rejalarini qiyosiy tahlil qilish ularning shaharsozlik rivojlanishida turli modellar shakllanayotganini ko‘rsatadi. Bunda har bir poytaxtning tarixiy rivojlanishi, demografik sur’atlari, tabiiy-geografik sharoiti, mavjud infratuzilmasi va aglomeratsion jarayonlari bosh rejalarning ustuvor yo‘nalishlariga ta’sir ko‘rsatmoqda.

Toshkentda tarixiy shahar muhitini saqlash, renovatsiya, transport infratuzilmasini rivojlantirish, yashil hududlarni kengaytirish va aglomeratsion o‘sishni uyg‘unlashtirishga asoslangan model shakllanmoqda.

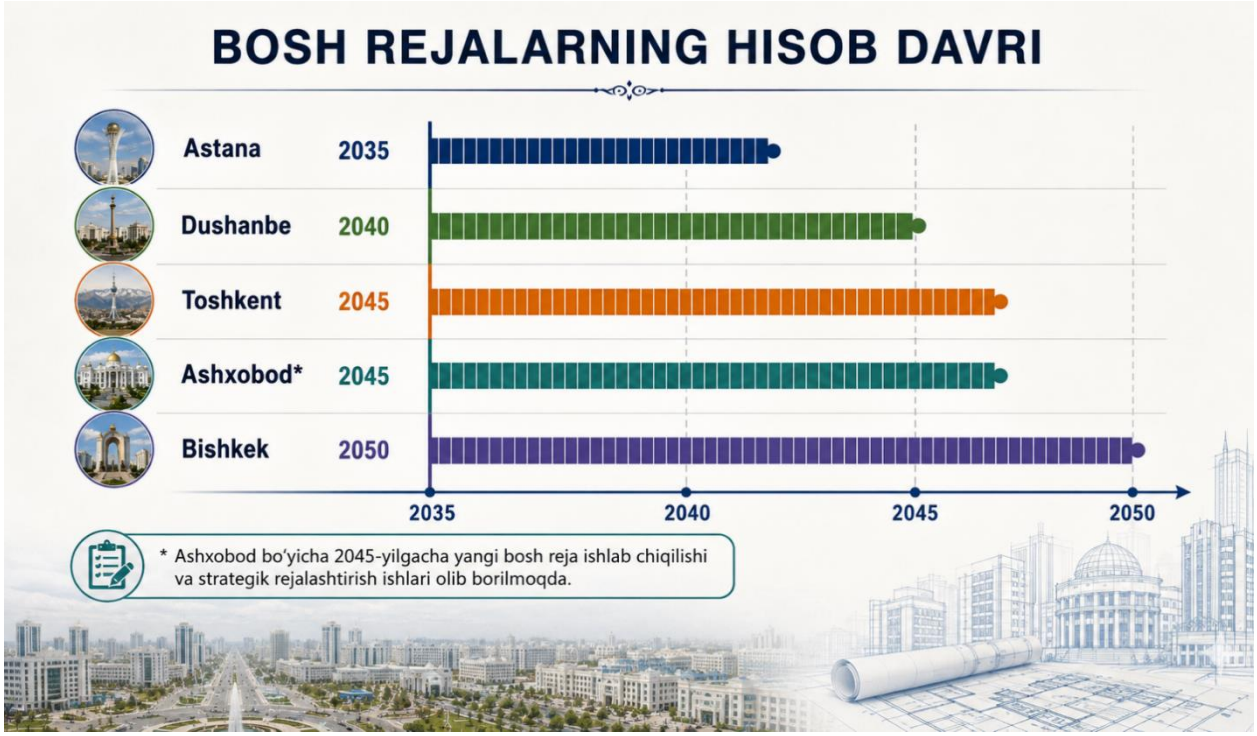
Astana shaharsozlik rivojida politsentriklik, ixchamlik va muvozanatlilik tamoyillariga, shuningdek, shahar va uning atrofidagi hududlarni yagona aglomeratsion tizim sifatida rivojlantirishga urg‘u berilmoqda.

Bishkekda asosiy e’tibor infratuzilmaviy nomutanosibliklarni bartaraf etish, jamoat transportini kuchaytirish, yashil hududlarni kengaytirish va ijtimoiy infratuzilmani rivojlantirishga qaratilgan.

Dushanbeda shahar hududining janubiy, qisman shimoliy, sharqiy va g‘arbiy yo‘nalishlarda kengayishi hamda tabiiy-geografik sharoitlarni hisobga olgan holda hududiy rivojlanish modeli ustuvor hisoblanadi.

Ashxobodda esa mavjud monumental-reprezentativ shaharsozlik modelini zamonaviy raqamli boshqaruv, aqlli transport, yashil energetika, suv resurslaridan

samarali foydalanish va barqaror infratuzilma elementlari bilan modernizatsiya qilish tendensiyasi kuzatiladi.



1-diagramma. Markaziy Osiyo poytaxtlari bosh rejalarining istiqbolli hisob davri

(Diagramma sun'iy intellekt (AI) dan foydalanib muallif tomonidan ishlab chiqilgan)

Diagramma bosh rejalar faqat hududiy hujjat emas, balki turli vaqt ufqiga ega strategik boshqaruv vositasi ekanini ko‘rsatadi. Bishkek eng uzoq — 2050-yilgacha bo‘lgan davrni qamrab olsa [11], Astananing amaldagi bosh rejasi 2035-yilgacha hisoblangan[12]. Toshkent va Ashxobodda 2045-yil asosiy istiqbol chegarasi, Dushanbeda esa 2040-yil hisob davri sifatida tanlangan [13].

Xulosa. Markaziy Osiyo poytaxtlarining amaldagi va istiqbolli bosh rejalarini qiyosiy tahlil qilish natijasida ushbu shaharlarda shaharsozlik rivojlanishining turli modellari shakllanayotgani aniqlandi.

Toshkent bosh rejasi tarixiy muhitni saqlash, renovatsiya, transportga yo‘naltirilgan rivojlanish va aglomeratsion kengayishni birlashtirgan model sifatida tavsiflanadi. Astana bosh rejasi politsentriklik, ixchamlik, muvozanatlilik va aglomeratsion rivojlanish tamoyillariga asoslangan yangi metropol modelini ifodalaydi. Bishkekda infratuzilmaviy yangilash, ekologik muvozanat va jamoat transportini kuchaytirishga asoslangan rekonstruktiv-modernizatsion yondashuv ustuvor hisoblanadi. Dushanbeda yo‘naltirilgan hududiy kengayish va ma’muriy markazni bosqichma-bosqich modernizatsiya qilish modeli shakllangan. Ashxobodda esa monumental-reprezentativ shaharsozlik modelini raqamli boshqaruv, aqlli transport, yashil energetika va barqaror infratuzilma elementlari bilan modernizatsiya qilish jarayoni kuzatilmoqda.

Umuman, Markaziy Osiyo poytaxtlarining bosh rejalari hududiy rivojlanishni tartibga solish bilan bir qatorda transport, ekologiya, ijtimoiy infratuzilma, tarixiy-madaniy meros va aglomeratsion jarayonlarni yagona shaharsozlik tizimida muvofiqlashtirishga yo‘naltirilgan.

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Berdiyeva N. U., Filologiya fanlari
TerDU mustaqil izlanuvchisi

ADABIY-BADIIY XRONOTOPDA MAKON VA ZAMON BELGILARNING NAMOYON BO‘LISHI

Annotatsiya: *Murod Muhammad Do‘st asarlarida o‘z estetik idealiga mos adabiy tipni ilm ahli orasidan izlaydi. Ilmga sho‘ro mafkurasi manfaat nuqtai nazaridan yondoshib uzoq yillar davomida yo‘l qo‘yilgan tarixiy xatoni Toshpo‘lat obrazi orqali tuzatmoqchi bo‘ladi.*

Kalit so‘zlar*: qissa, qahramon, ideal, adabiy tip, xronotop, makon, zamon, prozaik asar, ruh, adabiyot.*

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THE MANIFESTATION OF SPATIAL AND TEMPORAL MARKERS IN THE LITERARY-ARTISTIC CHRONOTOPE

Abstract: *In his works, Murod Muhammad Dust seeks to find a literary archetype within the scientific community that embodies his aesthetic ideal. Through the character of Toshpulat, the author attempts to rectify a historical error that persisted for years due to the Soviet ideology’s utilitarian approach to science.*

Keywords: *novella, protagonist, ideal, literary archetype, chronotope, space, time, prose work, spirit, literature.*

Kirish.

Yangi ijtimoiy davr yozuvchilarga to‘la erkinlik berdi. Endi yozuvchi obraz yaratayotganda qahramonlarini ijobiy va salbiyga ajratib o‘tirishi shart emas. Har bir adabiy tip taqdirida insonga xos fazilatlarni ham, insoniylikka dog‘ tushiradigan nuqsonlarni ham badiiy obrazga ko‘chirishi mumkin. Yangicha badiiy tafakkurga xos mezon shundaki, tarixiy voqelik soxtalashtirilmasligi, balki ro‘y-rost o‘z bahosini olishi, soxta ko‘tarinkiliklardan holi bo‘lmog‘i lozim. Toshpo‘lat Samad va unga o‘xshaganlarning xatolarini xiyonat timsolida ochib tashlaydi.

Adabiyotlar tahlili va metodologiya.

Asarda musulmon o‘zbek ayolining umumlashma adabiy tipi yaratilgan. Biz Mas’umaning o‘z uyida Toshpo‘lat bilan suhbatidan har qanday og‘ir sharoitda ham qaddi bukilmaydigan, irodali, sevgida sadoqatli inson obrazini tasavvur qilamiz.

Qissada yana ikki ayol – Inara va Mas’uma obrazi ham o‘rin olgan. Ular sadoqatli, vafodor ayollardir, dunyoning barcha moddiy ne’matlaridan mehr-oqibat, sadoqat, or-nomusni ustun qo‘yadilar. Toshpo‘latning Inaraga bo‘lgan sadoqati yoki Samadning qizchasi bahonasida uy egalariga aytgan gaplari yozuvchining badiiy tip yaratishdagi mahoratidan dalolatdir. Yozuvchi Murod Muhammad Do‘st

Toshpo‘lat obrazida davr fojialarini ko‘rsatish bilan bir sirada unga xos bo‘lgan shaxsiy chizgilarni ham ochib beradi. Bu Toshpo‘latning opasi bilan bo‘lgan suhbatida yaxshi tasvirlangan:

« — Shunday qil, uka, — keyin sen o‘zingga tinchroq bir amal topsang bo‘larmidi.

— Menda amal yo‘q, opa, amalsiz yashamoqchiman.

Amaling bo‘lsa, odamlar rost gapni aytmay qo‘yadi.

— Yo‘q, — dedi Opa. — Sen biror amal topgin. Otamning otini tutib o‘tasan, o‘rni yo‘qolsa bo‘lmaydi.

— G‘irromliksiz yashashning o‘ziyam kifoya. Menga shundan boshqa amal yo‘q, opa.

— Bor ekan, Turdiboy aytdi.

— Yo‘q, opa, Ermat cho‘loqning bolasi menga oshiqcharoq narx qo‘yibdi. U sizlarga yoqishni o‘ylagan, qolganini ering ikkoving to‘qib-bichgansizlar.

— Nima, og‘irimiz tushib qoldimi?

— Yo‘q, opa, buning tarixi uzoq, sen bari bir tushunmaysan.

— To‘g‘ri, sen biz nodonlarni tinglab nima qilarding!..

Opa tag‘in tumtayib oldi. [5; B.47.].

Uka va opa o‘rtasidagi sahna kitobxon qalbini larzaga soladi. Yozuvchining xarakter yaratishdagi mahorati yanada chuqurlasha boradi. Buni ukaning opasi oldidagi mas’uliyati, uning kelajagiga qayg‘urishi, lekin ilojsizligi asoslab berilgan. Qahramonlar harakati tasvirida haqiqatga zid biron lavha uchramaydi. Biz barcha manzaralar va obrazlar tasvirida yangi badiiy tafakkur qirralarini ko‘ramiz.

Muhokama. Buyuk faylasuf Aflotun “Har kim g‘azabnok ruhni eng buyuk hissi bilan birlashtirishi zarurdir. Boshqa odamlar tomonidan sodir etiladigan og‘ir, tuzalishi qiyin va hatto umuman bedavo adolatsizliklardan qutilishning faqat bitta vositasi bor: bu fikr bilan kurashish, daf etish, g‘alaba qozonish va ularni beayov jazolashdir, deb yozadi. [1; B.140.]. M.M.Do‘st qissada g‘alaba qozonish uchun Aflotun taklif etgan vosita – mujassam asarning o‘q ildizini tashkil etgan, desak yanglishmagan bo‘lamiz.

Qissa tarkibidagi voqealar butun bir tizimni tashkil qiladi. “Avtor yaxlit asarni yaratgan ijodiy shaxs, u asar doirasida mustaqil hokimlikka ega. Uning ongi, ovozi, nuqtai nazari bilvosita asar tarkibiy elementlarida aks etadi. Prozaik asarda avtor ongining asosiy ifoda formalari qahramon hikoyachi, bayonchidir.

Qahramon- bevosita nutq sub’ekti, asarda shaxsiy hayoti, tarjimai holiga oid ma’lumotlar xarakterining barqaror belgilari bilan namoyon bo‘ladi. Qahramon o‘zini harakatda ko‘rsatadi. U ma’lum tarixiy davr hayotining konkret sohasiga muvofiq bo‘lgan insonning konkret individual obrazidir.

Hikoyachi- prozaik asarda bayon egasi, yozuvchining nutqiy samarasi. Hikoyachi- asarning psixologik va bayon markazi. Uning asarda tasvirlanayotgan voqealarga munosabati shaxsiyatli, tuyg‘uli, faktlar va kishilarga yondoshish baholi sub’ektivdir. Hikoyachida avtorning ma’naviy shaxsiyatiga yaqinlik mavjud bo‘ladi. Biroq uni barcha hikoyachilarga bab-baravar taalluqli deb bo‘lmaydi. Chunki avtor ba’zan o‘zining ma’naviy shaxsiyatiga zid bo‘lgan hikoyachidan ham

o‘zini-o‘zi fosh etish maqsadida foydalanadi. Jumladan, asar bosh qahramoni-hikoyachi salbiy obraz sifatida yaratilgan asarlarda hikoyachida avtorning ma’naviy - olamiga yaqinlik bor deb aytish mushkul". [6; B.118-119.]. Adabiy qahramon voqealar rivojiga qarab o‘zgarib turadi. Ko‘rinadiki, qissanavis va qahramon nutqida ham yozuvchi mahoratining o‘ziga xos qirralari alohida ajralib turadi.

Adabiyot va hayotdagi o‘zgarishlar haqida: “Adabiyotda yangi bosqich, yuksalish hamisha yangi qahramon bilan yangi ijodiy individualliklarning paydo bo‘lishi bilan boshlanadi.

Yangilik eskilik zaminida tug‘iladi, u bilan birga yashaydi, ba’zan u bilan bahslashadi, ba’zan esa murosaga kirishadi. Insonni badiiy bilish va aks ettirish jarayonidagi ziddiyatning boisi xuddi shundadir”, - deb fikr bildiradi N.Vladimirova. [8; B.39.].

Mustaqillik davri o‘zbek adabiyotida yangi qahramonlar yuzaga keldi. Ijtimoiy hayotda bo‘lgani kabi, adabiyotda ham eskilik bilan yangilik o‘rtasidagi konfliktlar shu davr adabiyoti mavzularidan birini tashkil etdi. O‘zbek prozasining yetakchi janrlaridan hisoblangan qissachilikni ham bu mavzu chetlab o‘tmadi. Konfliktlarning vujudga kelishida sub’ektiv va ob’ektiv omillar sabab bo‘ladi. Chunki, hayotda yuz bergan o‘zgarishlar odamlar tafakkurida silliq kechmaydi.

XX asrning 80-90- yillar o‘zbek qissachiligiga yosh, zabardast adiblar kirib keldi. Ular realistik qissachiligimizni faqat miqdoriy jihatdan boyishini emas, balki sifatiy jihatdan rivojlanishini ham ta’minladilar. X.Do‘stmuhammad, N.Eshonqul, Sh.Bo‘tayevlar ana shularning eng faol namoyandalari hisoblanadi.

O‘tgan asrning 80-90- yillari o‘zbek qissachiligi tarixida alohida burilish davri bo‘ldi. Birinchidan, ayni shu davrda o‘zbek qissachiligiga Murod Muhammad Do‘st, Tog‘ay Murod, E.A’zamov, X.Do‘stmuhammad, N.Eshonqul, Sh.Bo‘tayev kabi yosh iste’dodli qalamkashlar ushbu badiiy shaklda ancha samarali ijod qilishdi. Bu o‘zbek nasrining badiiy maydonini boyitish bilan birga, uning musaffoligini ta’minlashga ko‘mak berdi. Bu adiblar o‘z qissalariga dolzarb badiiy muammolarni olib kirdilar. Garchi ular uslubiy yo‘nalishlari, g‘oyaviy - badiiy qamrovi nuqtai nazaridan bir-birlaridan alohida farqlanib tursalar ham, ammo janrning ana shu davrlaridagi ijtimoiy-badiiy faolligini ta’minlash jihatidan olg‘a qo‘yilgan bir qadam bo‘ldi.

Adabiyotga har bir yozuvchi, shoir o‘z uslubi bilan kirib keladi. Yozuvchi uslubi o‘quvchiga qanchalik yaqin bo‘lsa, u shunchalik muxlislarga ega bo‘ladi. To‘g‘ri, hozir ham adabiyotimizda zamonaviy uslub, badiiy uslub degan tushunchalar mavjud. Yozuvchining uslubi bu avvalo, uning o‘ziga xosligi, tasvir madaniyati, “o‘z meni” va hayotni teran anglashga bog‘liq bo‘lgan hodisa. Qissa janridagi qissanavis obrazini “Hech qachon yozuvchi shaxsiyati bilan aralashtirib yubormaslik kerak. Badiiy so‘z individualligi qissanavisga nisbatan muayyan xarakterni ifodalash vositasi vazifasini bajaradi”. [7; B.97.].

Uslubda ijodkorning butun ijodi, qobiliyati namoyon bo‘ladi. Ayni paytda yozuvchi mahoratini ham belgilaydigan mezon hisoblanadi. Bu o‘z navbatida qissanavis obrazining yorqin chiqishini ta’minlaydi. Gap shundaki, qissanavis obrazini yozuvchi maxsus yaratmaydi. U o‘z-o‘zidan yaraladi. Lekin uning qanday

bo‘lishi yozuvchi mahorati va o‘zligini qanday namoyon etishiga bog‘liq. Shu jihatdan u mutlaqo alohida obraz bo‘lib, asar tarkibidagi obraz personajlardan tubdan farq qiladi. M.Baxtin yozganidek, “Agar ushbu obraz haqqoniy va teran bo‘lsa, u tinglovchi-kitobxonga shu muallif asarini to‘la chuqurroq tushunishga yordam beradi”. [2; B.405.].

Yozuvchi qalamga olayotgan mavzuni atroflicha tahlil qiladi, har bir obrazni shakllantirish uchun butun mahoratini ishga soladi. Bu jarayonda yozuvchi qobiliyati nimalarga qodirligi namoyon bo‘ladi. Ayni paytda asardagi har bir voqea, tasvir, xarakter yozuvchi dunyoqarashidan dalolat beradi. Shundagina yozuvchi mahorati asarning badiiyligini oshirishga xizmat qiladi. Uning inson xarakterini yaratishdagi san’ati asar mazmuniga singib ketadi. Bu o‘z navbatida qissanavis obrazining yorqin chiqishiga xizmat qiladi.

Murod Muhammad Do‘stning “Galatepaga qaytish” qissasi polifonik tasvir printsiplariga rioya qilishi, ijtimoiy-siyosiy hayot va shaxs munosabati, shaxs va umuminsoniylik kontseptsiyasining yangi tarixiy davr voqeligida tutgan o‘rni hamda ahamiyati nuqtai-nazaridan alohida e’tiborga loyiq.

Ko‘chib yuruvchi qahramon bevosita muallifning “men”i bilan bog‘liq, unda yozuvchining estetik ideali ham, shaxsiyati ham, olislarda qolgan bolaligi ham, tarjimai holi ham mujassamlashgan.

Ma’lumki, xronotop muammosi falsafaning, unga yondosh sotsiologiya, geologiya, siyosatshunoslik, etika va estetika fanlarining munozarali masalalaridan sanaladi. “Xronotop” mazmunan makon va zamon mohiyatini anglatib, olis-yaqin makonlarning (tarixiy davrlarning, bugunning) masalalari va ularning zamon bilan (aynan bugungi, biz yashab turgan davr bilan) aloqadorligini, hatto, kelgusi istiqbol zamoni bilan bog‘liqligini, hamnafasligini, daxldorligini anglatuvchi, mohiyatan murakkab ijtimoiy siyosiy, ma’naviy-ma’rifiy masala kabi tushuniladi. Ayni vaqtda badiiy adabiyot san’at asarlariga ham bevosita daxldor ekanligi bilan muhimdir. Mantiqan bilish mumkinki, adabiyot san’atning tasvirlash ob’ekti ham ayni shu tarix, mamlakat, el-yurt (ya’ni makon) va uning olis yaqin, bugungi davr (zamon) bilan bog‘liq asosi hisoblanadi. Adabiyotshunoslik va estetika fanida badiiy makon, badiy zamon (badiiy xronotop) masalasini o‘rganish, umumlashtirish ancha murakkab muammolar sirasiga mansubdir. Masalan, Isajon Sultonning “Alisher Navoiy” romanida Hirot, Xuroson muzofotlari (tarixiy davri) hayoti, mashhur siymolari (Jomiy, Navoiy, Boyqaro kabi) faoliyati qalamga olinar ekan, bularning bugungi zamon bilan aloqadorligi, ahamiyati, ibrati, fojiasi kabi g‘oyaviy maqsadlar asar talqinida namoyon bo‘lishi lozim.

Adabiy-badiiy xronotopda makon va zamoniy belgilarning namoyon bo‘lishi anglashga va aniqlikka tutashadi. Bunda vaqt tovlanadi, qorishadi, badiiy kuzatishga evriladi; makon esa takomillashadi, davr, syujet, tarix faoliyatiga intiladi. Zamon xususiyatlari makonda voqe bo‘ladi. O‘z navbatida makon vaqt birligida anglashiladi va o‘zgaradi. [3; B.121-122.].

Natijalar. Badiiy asarda mikromakon va makromakon uyg‘unligi haqidagi qarashlar istiqlol davri adabiyotshunosligida muhim tadqiqotlarga sabab bo‘ldi. Bu yo‘nalishdagi salmoqli tadqiqotlardan biri adabiyotshunos U.Jo‘raqulovning

“Alisher Navoiy “Xamsa”sida xronotop poetikasi” deb nomlangan monografiyadir. [4; B.176.]. Olimning mazkur doktorlik dissertatsiyasida Alisher Navoiy “Xamsa”sidagi janr, kompozitsiya, syujet, obraz muammolari tarixiy janrlar kontekstida xronotop nazariyasiga ko‘ra asoslandi. “Xamsa” navoiyshunoslikning oldingi bosqichlarida tarixiy poetika aspektida yaxlit sintetik janr sifatida kuzatilmagandi.

San’at asari sifatida mustaqil borliq bo‘lgan har bir romanni muallif badiiy falsafasi, odam va olamga munosabati, xayolot dunyosining qamrovi, hayotiy vaziyat-holatlarni baholash tarzi, roman kompozitsiyasi, xronotopi, poetik ifoda usullari, qahramon hissiy-intellektual dunyosida sodir bo‘lgan evrilishlar e’tiqodiy asosi, badiiy tasvir vositalari nuqtai-nazaridan o‘rganish lozim. “Noan’anaviy” sanaluvchi romanlardagi eng muhim jihat – adibning qahramon tushgan ziddiyatli va tartibsiz vaziyat-holatga hayotiy yechim topishi, uning umidini so‘ndirmasligidir.

Xulosa. Makon va zamon uyg‘unligi badiiy asarda ijodkor kontseptsiyasini, g‘oyaviy maqsadini keng epik ko‘lamda ifodalash imkonini beradi. Masalan, “Jinoyat va jazo”dagi asosiy voqealar Rossiyada, eng ko‘pi Sankt Peterburgda kechadi, bu umumiy makon. Lekin turli kechmish, qahramonlar hayoti bilan bog‘liq yana 60 ta romaniy makon ham bor. Yigirmadan ortiq dunyoga mashhur shaxslar: Napoleon, Mak, Gogol, Pushkin, Darvin, Turgenev, Russo, Sharl Fure, Dobrolyubov, Belinskiy, Rodichev, Rafael, Shiller, Madonna, Russo Livingston, afsonaviy Zevs, Axilles nomlari ham roman falsafasini yanada chuqurlashtirish, ko‘lamdor, ta’sirchan qilishda, aniq bir maqsad bilan qo‘llangan. Zikr etilgan shaxslar nomi ostida butun bir murakkab, romaniy qismatlar tarixi yashiringan. [9; B.24.].

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RAQAMLI TA'LIM MUHITIDA WEB-DASTURLASH KOMPETENSIYALARINI KUZATISHNING SUN'IY INTELLEKTGA NISBATAN MOSLASHUVCHAN MEXANIZMLARI

Annotatsiya: *Mazkur maqolada raqamli ta’lim muhitida web-dasturlash kompetensiyalarini sun’iy intellektga nisbatan moslashuvchan kuzatish mexanizmlari tadqiq etilgan. Talabalarning kod yozish jarayoni, xatolari, topshiriqlarni bajarish natijalari va o‘quv faolligini tahlil qilish asosida kompetensiyalar rivojlanishini diagnostika qilishga e’tibor qaratilgan. Tadqiqotda kompetensiyalarni modellashtirish, o‘quv faoliyatini monitoring qilish, pedagogik eksperiment va matematik-statistik usullardan foydalanilgan. Natijada sun’iy intellekt asosida individual kompetensiya profilini shakllantirish, rivojlanish dinamikasini aniqlash va moslashtirilgan tavsiyalar berish imkonini beruvchi mexanizm taklif etilgan. Mazkur yondashuv web-dasturlashni o‘qitish jarayonini shaxsiylashtirish va monitoring samaradorligini oshirishga xizmat qiladi.*

Kalit so‘zlar: *Raqamli ta’lim muhiti, web-dasturlash, kompetensiyalar, sun’iy intellekt, adaptiv monitoring, ta’lim analitikasi, kod tahlili, kompetensiya diagnostikasi.*

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ADAPTIVE MECHANISMS FOR MONITORING WEB PROGRAMMING COMPETENCIES IN A DIGITAL LEARNING ENVIRONMENT BASED ON ARTIFICIAL INTELLIGENCE

Abstract: *This article investigates artificial intelligence-based adaptive mechanisms for monitoring web programming competencies in a digital learning environment. Particular attention is paid to diagnosing competency development through the analysis of students’ coding processes, errors, task performance, and learning activity. The study employs competency modeling, learning activity monitoring, pedagogical experimentation, and mathematical-statistical methods. As a result, an artificial intelligence-based mechanism is proposed for developing individual competency profiles, identifying competency development dynamics, and providing adaptive recommendations. This approach contributes to personalizing the web programming learning process and improving the effectiveness of competency monitoring.*

Keywords: *Digital learning environment, web programming, competencies, artificial intelligence, adaptive monitoring, learning analytics, code analysis, competency assessment.*

KIRISH.Raqamli transformatsiya jarayonlarining jadallashuvi va sun’iy intellekt texnologiyalarining ta’limga kirib kelishi o‘quv jarayonini tashkil etish, ta’lim natijalarini baholash hamda talabalarning individual rivojlanish trayektoriyalarini aniqlashga bo‘lgan yondashuvlarni tubdan o‘zgartirmoqda. Zamonaviy raqamli ta’lim muhitida talabaning bilimini faqat yakuniy baho orqali aniqlashdan ko‘ra, uning kompetensiyalari qanday shakllanayotganini uzluksiz kuzatish, rivojlanish dinamikasini tahlil qilish va aniqlangan ehtiyojlarga mos ta’limiy ta’sirni tashkil etish muhim ahamiyat kasb etmoqda. UNESCO tomonidan ham sun’iy intellektdan ta’limda foydalanishda inson manfaatlariga yo‘naltirilgan, pedagogik jihatdan asoslangan, shaffof va ma’lumotlar xavfsizligini ta’minlovchi yondashuvlardan foydalanish zarurligi ta’kidlangan [1]

Ayniqsa, web-dasturlashni o‘qitish jarayonida talabalarning kompetensiyalarini kuzatish murakkab va ko‘p komponentli vazifa hisoblanadi. Web-dasturlash HTML, CSS, JavaScript hamda server texnologiyalari bilan ishlashni o‘zlashtirish bilan bir qatorda, algoritmik va mantiqiy fikrlash, kod yozish, debugging, xatolarni aniqlash va bartaraf etish, dasturiy yechimlarni optimallashtirish hamda mustaqil loyiha ishlab chiqish kabi ko‘nikmalarni shakllantirishni talab etadi. Shu sababli mazkur kompetensiyalarni faqat test yoki yakuniy topshiriq natijalari asosida baholash talabaning real rivojlanish holatini to‘liq aks ettirmasligi mumkin.

An’anaviy elektron ta’lim tizimlarida monitoring asosan test natijalari, bajarilgan topshiriqlar va yakuniy ballarga tayanadi. Bunday yondashuv talabaning kod yozish jarayonidagi xatolar turi va takrorlanish chastotasi, topshiriqni bajarish vaqti, qayta urinishlari, o‘z xatosini mustaqil tuzatish darajasi hamda kompetensiyalarning vaqt davomida shakllanish dinamikasini yetarli darajada hisobga olmaydi. Dasturlash bo‘yicha avtomatlashtirilgan fikr-mulohaza vositalarini tahlil qilgan Keuning, Jeuring va Heeren mavjud tizimlarning muhim qismi xatoni aniqlashga yo‘naltirilganligini, biroq individual o‘quv ehtiyojlariga moslashtirilgan yordam va rivojlanish jarayonini chuqur kuzatish imkoniyatlari cheklanganligini ko‘rsatgan [2].

Mazkur muammoni hal etishda sun’iy intellekt texnologiyalari muhim imkoniyatlar yaratadi. Xususan, mashinaviy o‘qitish, kodni avtomatik tahlil qilish, ta’lim analitikasi va tabiiy tilni qayta ishlash usullari orqali talabaning raqamli o‘quv izlarini kompleks qayta ishlash mumkin. Bunda bajarilgan topshiriqlar, koddagi sintaktik va mantiqiy xatolar, topshiriq murakkabligi, bajarish vaqti, qayta urinishlar va o‘quv faolligi kabi ko‘rsatkichlar asosida individual kompetensiya profili shakllantiriladi. Mazkur profil yangi ma’lumotlar kelib tushishi bilan yangilanib, talabaning kompetensiya rivojlanish trayektoriyasini dinamik ravishda aks ettiradi.

Tadqiqotning dolzarbligi shundaki, sun’iy intellektga asoslangan moslashuvchan monitoring mexanizmi nafaqat mavjud kompetensiya holatini aniqlashi, balki uning o‘zgarish tendensiyalarini tahlil qilishi va keyingi o‘quv faoliyatini aniqlangan ehtiyojlarga muvofiq moslashtirishi mumkin. Shu nuqtayi nazardan, tadqiqotning maqsadi raqamli ta’lim muhitida web-dasturlash kompetensiyalarini uzluksiz kuzatish, diagnostika qilish, rivojlanish dinamikasini aniqlash va individual tavsiyalarni shakllantirishga xizmat qiluvchi sun’iy intellektga nisbatan moslashuvchan mexanizmni ishlab chiqishdan iborat.

Tadqiqotning ilmiy yangiligi web-dasturlash kompetensiyalarini statik baholashdan dinamik monitoringga o‘tishni ta’minlovchi, talabaning raqamli faoliyat ko‘rsatkichlarini intellektual tahlil qiluvchi va aniqlangan kompetensiya holatiga mos ravishda monitoring hamda ta’limiy tavsiyalarni shakllantiruvchi mexanizmni taklif etish bilan belgilanadi. Mazkur yondashuv web-dasturlash ta’limini individuallashtirish, kompetensiyalar rivojlanishini aniqroq diagnostika qilish va pedagogik qarorlarni ma’lumotlarga asoslangan holda qo‘llab-quvvatlash uchun metodik asos yaratadi.

MAVZU BO‘YICHA ILMIY ADABIYOTLAR TAHLILI. Ilmiy adabiyotlar tahlili shuni ko‘rsatadiki, dasturlash ta’limida intellektual tizimlardan foydalanish uch asosiy yo‘nalishda rivojlanmoqda: avtomatik baholash, avtomatlashtirilgan fikr-mulohaza va talabaning individual o‘quv faoliyatini modellashtirish. Birinchi yo‘nalishda kodning sintaktik va funksional to‘g‘riligi tekshirilsa, ikkinchisida aniqlangan xatolar asosida foydalanuvchiga fikr-mulohaza beriladi. Uchinchi yo‘nalish esa talabaning o‘quv faoliyatini vaqt davomida kuzatish va uning bilim-kompetensiya holatini dinamik model sifatida ifodalashga qaratilgan.

Keuning, Jeuring va Heerenning tizimli sharhida avtomatlashtirilgan fikr-mulohaza vositalarining 101 ta namunasi tahlil qilingan va ularning ko‘pchiligi xatoni aniqlashga urg‘u berishi, muammoni tuzatishning keyingi bosqichi hamda individual moslashuv imkoniyatlari esa nisbatan cheklanganligi ko‘rsatilgan [2]. Ushbu xulosa web-dasturlash kompetensiyalarini kuzatish tizimida faqat “xato mavjud” degan signalni berish yetarli emasligini, balki xatoning takrorlanishi, murakkabligi va talabaning oldingi faoliyati bilan bog‘liq holda tahlil qilinishi zarurligini asoslaydi.

Intellektual repetitorlik tizimlari bo‘yicha tadqiqotlar esa individual o‘quv jarayonini qo‘llab-quvvatlashda kompyuter asosidagi intellektual mexanizmlarning imkoniyatlarini ko‘rsatadi. VanLehn tadqiqotida turli repetitorlik shakllarining samaradorligi qiyoslangan bo‘lsa [3], Kulik va Fletcher meta-tahlili 50 ta nazoratli baholash natijalarini umumlashtirib, ITS tizimlari qo‘llanilgan holatlarda test natijalaridagi o‘zgarishlarni tahlil qilgan [4]. Shu bilan birga, mazkur tadqiqotlar natijalarini web-dasturlash kompetensiyalarining barcha tarkibiy qismlariga bevosita ko‘chirish ehtiyotkorlikni talab qiladi, chunki samaradorlik o‘quv maqsadi, baholash vositasi va tizim dizayniga bog‘liq.

Shu sababli mazkur tadqiqotda kompetensiyalarni kuzatish uchun ko‘p komponentli monitoring modeli taklif etiladi. Unda diagnostik modul talabaning

mavjud holatini aniqlaydi, analitik modul faoliyat ko‘rsatkichlarini qayta ishlaydi, moslashtiruvchi modul keyingi o‘quv faoliyatini kompetensiya darajasiga muvofiqlashtiradi, tavsiyaviy modul esa individual pedagogik yo‘nalishlarni shakllantiradi. Bunday tuzilma sun’iy intellektni faqat avtomatik baholash vositasi sifatida emas, balki kompetensiya rivojlanishini kuzatuvchi va pedagogik qarorlarni qo‘llab-quvvatlovchi mexanizm sifatida qarash imkonini beradi.

TADQIQOT METODOLOGIYASI. Tadqiqotda tizimli adabiyotlar tahlili, kompetensiyalarni modellashtirish, pedagogik loyihalash, o‘quv analitikasi, avtomatik kod tahlili, pedagogik eksperiment, so‘rovnoma va matematik-statistik tahlil metodlaridan foydalanish nazarda tutiladi. Web-dasturlash kompetensiyalari kod yozish, debugging, algoritmik fikrlash, web-texnologiyalarni qo‘llash va mustaqil loyiha yaratish kabi indikatorlar orqali tavsiflanadi.

Monitoring mexanizmining ishlash jarayoni to‘rtta ketma-ket bosqichga ajratiladi: birinchi bosqichda talabaning elektron muhitdagi faoliyatiga oid ma’lumotlar yig‘iladi; ikkinchi bosqichda ma’lumotlar sun’iy intellekt algoritmlari yordamida tahlil qilinadi; uchinchi bosqichda kompetensiyalarning joriy darajasi va rivojlanish dinamikasi aniqlanadi; to‘rtinchi bosqichda esa natijalarga mos individual topshiriq, tavsiya yoki o‘quv resursi shakllantiriladi. Mazkur yondashuvda tizimning moslashuvchanligi talabaning yangi natijalari kelib tushishi bilan uning individual profilining qayta hisoblanishi orqali ta’minlanadi.

Tajriba-sinov jarayonida pretest va posttest natijalari, topshiriqlarni bajarish ko‘rsatkichlari, xatolar dinamikasi hamda talabalar fikr-mulohazalarini taqqoslash mumkin. Miqdoriy ma’lumotlarni qayta ishlashda o‘rtacha qiymat, standart og‘ish, Student t-mezoni va ta’sir kattaligi kabi statistik ko‘rsatkichlardan foydalanish, sifat ma’lumotlarini esa tematik tahlil asosida umumlashtirish maqsadga muvofiq. Bunda statistik natijalarni talqin qilishda tanlanma hajmi, baholash vositasining validligi va tadqiqot sharoitlari hisobga olinishi lozim. Tadqiqotning muhim metodologik jihati sun’iy intellekt tomonidan berilgan tavsiyalarning pedagogik jihatdan asoslangan bo‘lishidir. UNESCOning ta’limda generativ sun’iy intellektdan foydalanish bo‘yicha tavsiyalarida ham inson markazli yondashuv, ma’lumotlar maxfiyligi, pedagogik maqsadga muvofiqlik va texnologiyalardan xavfsiz foydalanish masalalariga alohida e’tibor qaratilgan [5]. Shu sababli taklif etilayotgan mexanizm o‘qituvchini almashtiruvchi tizim sifatida emas, balki talabaning kompetensiya rivojlanishini aniqlash va pedagogik qarorlarni qo‘llab-quvvatlashga xizmat qiluvchi intellektual vosita sifatida qaraladi.

TAHLIL VA NATIJALAR.

1.Web-dasturlash kompetensiyalarini kuzatishning mazmuni va tarkibiy komponentlari.

Raqamli ta’lim muhitida web-dasturlash kompetensiyalarini kuzatish talabaning faqat yakuniy natijasini baholash bilan cheklanmasdan, uning o‘quv faoliyati, kod yozish jarayoni, xatolar dinamikasi, topshiriqlarni bajarish tezligi va bilimlarning shakllanish darajasini uzluksiz tahlil qilishni nazarda tutadi. Tadqiqot natijasida kompetensiyalarni sun’iy intellektga nisbatan moslashuvchan kuzatish

mexanizmi ishlab chiqildi. Mazkur mexanizm diagnostik, analitik, adaptiv va monitoring komponentlarining o‘zaro integratsiyasi asosida shakllantirildi.

Mexanizmning **diagnostik komponenti** talabaning HTML, CSS va JavaScript bo‘yicha bilim va amaliy ko‘nikmalarini aniqlaydi. **Analitik komponent** koddagi sintaktik, mantiqiy va strukturaviy xatolarni, ularning takrorlanish chastotasini hamda topshiriqlarni bajarish natijalarini tahlil qiladi. **Adaptiv komponent** aniqlangan natijalarga asoslanib, talabaning individual ehtiyojlariga mos tavsiya, qo‘shimcha topshiriq yoki o‘quv materialini shakllantiradi. **Monitoring komponenti** esa kompetensiyalarning vaqt davomida o‘zgarishini kuzatib, individual rivojlanish trayektoriyasini aks ettiradi.

2.Sun’iy intellekt asosida kompetensiyalarni moslashuvchan kuzatish mexanizmi.

Tadqiqotda taklif etilgan mexanizmning ishlash jarayoni bir necha ketma-ket bosqichlardan tashkil topadi. Dastlab talabaning kod yozish faoliyati, topshiriqlarni bajarish natijalari, xatolar turi va takrorlanishi, bajarish vaqti hamda qayta urinishlari haqidagi ma’lumotlar yig‘iladi. Keyingi bosqichda mazkur ma’lumotlar sun’iy intellekt asosidagi tahlil moduli orqali qayta ishlanadi. Natijada har bir talaba uchun individual kompetensiya profili shakllantiriladi.

Kompetensiya profilida dasturlashning alohida yo‘nalishlari bo‘yicha o‘zlashtirish holati, aniqlangan muammolar va rivojlanish dinamikasi aks ettiriladi. Masalan, talaba JavaScript sintaksisini yetarli darajada o‘zlashtirgan, biroq funksiyalar, sikllar yoki DOM bilan ishlashda takroriy xatolarga yo‘l qo‘yayotgan bo‘lsa, tizim mazkur kompetensiya yo‘nalishini muammoli zona sifatida belgilaydi. Shundan so‘ng unga moslashtirilgan qo‘shimcha mashqlar va tavsiyalar taklif etiladi [5, 6, 7].

Bunday yondashuvda sun’iy intellekt faqat nazorat vositasi sifatida emas, balki **kompetensiya rivojlanishini aniqlash va keyingi o‘quv faoliyatini moslashtirish vositasi** sifatida namoyon bo‘ladi. Tizim yangi ma’lumotlar kelib tushishi bilan talabaning profilini yangilab boradi. Shu sababli monitoring statik baholashdan dinamik diagnostika modeliga o‘tadi.

3. Kompetensiyalarni kuzatish mezonlari.

Tadqiqot doirasida web-dasturlash kompetensiyalarini kuzatish uchun bir nechta asosiy mezonlar belgilandi: kodning sintaktik to‘g‘riligi, algoritmik va mantiqiy fikrlash, web-texnologiyalardan foydalanish darajasi, topshiriqlarni mustaqil bajarish qobiliyati, xatolarni bartaraf etish dinamikasi hamda o‘quv faolligi. Ushbu mezonlarning kompleks tahlili talabaning real kompetensiya holatini aniqlash imkonini beradi.

Kuzatish mezoni	**Asosiy ko‘rsatkichlar**	**Moslashtirilgan pedagogik ta’sir**
Kod sifati	Sintaktik va strukturaviy xatolar	Qoida va namunaviy misol
Mantiqiy kompetensiya	Algoritmik xatolar, noto‘g‘ri natijalar	Yo‘naltiruvchi savol va qo‘shimcha mashq
Amaliy ko‘nikma	Topshiriqni bajarish darajasi	Murakkablikni moslashtirish
Mustaqillik	Qayta urinishlar va yordamga murojaat qilish	Individual tavsiyalar
Rivojlanish dinamikasi	Natijalarning vaqt bo‘yicha o‘zgarishi	Individual ta’lim trayektoriyasi

Mazkur mezonlar asosida tizim talabaning kompetensiya holatini shartli ravishda boshlang‘ich, rivojlanayotgan va yetarli darajalar bo‘yicha tavsiflash imkonini beradi. Bunda darajalar faqat yakuniy ballga emas, balki o‘quv faoliyatining dinamik ko‘rsatkichlariga ham asoslanadi.

4. Natijalarni qiyosiy tahlil qilish.

Taklif etilgan mexanizmning pedagogik imkoniyatlarini aniqlash maqsadida an’anaviy elektron monitoring va sun’iy intellektga asoslangan moslashuvchan monitoring yondashuvlari qiyoslandi. An’anaviy tizimlarda asosan topshiriq natijasi va yakuniy baho qayd etilsa, taklif etilgan mexanizmda kod yozish jarayoni, xatolar dinamikasi, o‘quv faolligi va individual rivojlanish trayektoriyasi birgalikda tahlil qilinadi.

Natijalar shuni ko‘rsatdiki, moslashuvchan monitoringdan foydalanish o‘qituvchiga talabaning faqat “qancha ball olgani”ni emas, balki **qaysi kompetensiya bo‘yicha qiyinchilikka duch kelayotgani, xatoning qay darajada takrorlanayotgani va kompetensiya rivojlanishining qanday yo‘nalishda kechayotganini** aniqlash imkonini beradi. Shu bilan birga, tizim tomonidan shakllantirilgan individual tavsiyalar ta’lim mazmunini talabaning joriy ehtiyojlariga moslashtirishga xizmat qiladi [7, 8].

Ta’kidlash lozimki, ushbu tadqiqotda keltiriladigan miqdoriy eksperiment natijalari muallifning real tajriba-sinov ma’lumotlari asosida shakllantirilishi lozim. Statistik ko‘rsatkichlar faqat amalda yig‘ilgan empirik ma’lumotlar asosida hisoblangandagina ilmiy xulosa chiqarish uchun asos bo‘la oladi.

5. Natijalarning pedagogik ahamiyati.

Tadqiqot natijalari sun’iy intellektga asoslangan moslashuvchan monitoring web-dasturlash kompetensiyalarini baholash jarayonini uzluksiz va individuallashtirilgan shaklga olib kelishini ko‘rsatadi. Mexanizm orqali aniqlangan xatolar va kompetensiya dinamikasi o‘qituvchiga individual pedagogik qarorlar qabul qilish uchun qo‘shimcha ma’lumot beradi. Talaba esa o‘zining kuchli va rivojlantirilishi zarur bo‘lgan kompetensiyalarini muntazam kuzatish imkoniyatiga ega bo‘ladi. Shuningdek, mexanizmning muhim jihati shundaki, u monitoringni faqat nazorat vositasi sifatida emas, balki **rivojlantiruvchi pedagogik mexanizm** sifatida tashkil etadi. Shu asosda raqamli ta’lim muhitida web-dasturlash kompetensiyalarini kuzatishning sun’iy intellektga nisbatan moslashuvchan

mexanizmi individual ta’lim trayektoriyasini shakllantirish, ta’lim mazmunini differensiallashtirish va pedagogik qarorlarni ma’lumotlarga asoslangan holda qo‘llab-quvvatlash imkonini beradi [7, 8, 9].

XULOSA. Tadqiqot natijasida raqamli ta’lim muhitida web-dasturlash kompetensiyalarini sun’iy intellektga nisbatan moslashuvchan kuzatish mexanizmi ishlab chiqildi. Mexanizm talabalarning kod yozish jarayoni, xatolari, topshiriq natijalari va o‘quv faolligini uzluksiz tahlil qilish asosida individual kompetensiya profilini shakllantirish imkonini beradi. Sun’iy intellekt asosidagi diagnostika va adaptiv tavsiyalar kompetensiyalar rivojlanish dinamikasini aniqlash hamda individual ta’lim trayektoriyasini takomillashtirishga xizmat qiladi. Natijada mazkur yondashuv web-dasturlash ta’limini shaxsiylashtirish va pedagogik monitoring samaradorligini oshirishning istiqbolli vositasi sifatida asoslandi.

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BAZALT, OHAKTOSH VA SHLAK MINERAL XOMASHYOLARINI ERITISHDA KOKS SARFINI HISOBLASH VA MAYDA FRAKSIYALI KOKS XOKASIDAN FOYDALANISH

Annotatsiya:*Ushbu maqolada bazalt mineral issiqlik izolyatsion plitalari ishlab chiqarishda qo‘llaniladigan bazalt, ohaktosh va metallurgiya shlakidan tashkil topgan mineral xomashyo aralashmasini yuqori haroratda eritish jarayonida koks yoqilg‘isining sarfini hisoblash masalasi ko‘rib chiqilgan. Koks xokasi namunasi maydalash va 0,08 mm elakdan o‘tkazish orqali tayyorlangan. Namlik ST-100A rusumli namlik o‘lchagich yordamida, kalorifik qiymat esa kalorimetrik usulda aniqlangan. Natijalarga ko‘ra, koks xokasining namligi 1,17 %, kalorifik qiymati 6530 kcal/kg bo‘lib, bu taxminan 27,35 MJ/kg ga teng. Bazalt, ohaktosh va metallurgiya shlakining kimyoviy tarkibi hisobga olinib, mineral xomashyolarni eritish uchun talab qilinadigan issiqlik miqdorini aniqlash va koks sarfini hisoblash metodikasi taklif etilgan.*

Kalit so‘zlar*: bazalt, mineral issiqlik izolyatsion material, ohaktosh, metallurgiya shlaki, koks, koks xokasi, namlik, kalorifik qiymat, eritish, issiqlik balansi, yoqilg‘i sarfi, briketlash.*

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CALCULATING COKE CONSUMPTION AND UTILIZING FINE-FRACTION COKE BREEZE IN THE MELTING OF BASALT, LIMESTONE, AND SLAG MINERAL RAW MATERIALS

Abstract:*This article considers the calculation of coke fuel consumption during the high-temperature melting of a mineral raw material mixture consisting of basalt, limestone and metallurgical slag used in the production of basalt thermal insulation boards. The coke breeze sample was crushed and passed through a 0.08 mm sieve. Moisture was determined using an ST-100A moisture analyzer, while calorific value was determined by a calorimetric method. The moisture content was 1.17% and the calorific value was 6530 kcal/kg, corresponding to approximately 27.35 MJ/kg. The chemical composition of basalt, limestone and metallurgical slag was considered, and a methodology for determining heat demand and coke consumption was proposed.*

Keywords: *basalt, thermal insulation material, limestone, metallurgical slag, coke, coke breeze, moisture, calorific value, melting, heat balance, fuel consumption, briquetting.*

KIRISH

Bugungi kunda energiya resurslaridan oqilona foydalanish, ishlab chiqarish jarayonlarida hosil bo‘ladigan ikkilamchi xomashyolarni qayta ishlash va ishlab chiqarish tannarxini kamaytirish sanoat korxonalari oldida turgan muhim vazifalardan biridir. Yuqori haroratli texnologik jarayonlarda katta miqdorda yoqilg‘i sarflanishi ishlab chiqarishning energetik samaradorligiga bevosita ta’sir ko‘rsatadi.

Bazalt asosidagi mineral issiqlik izolyatsion plitalar ishlab chiqarish texnologiyasida bazalt, ohaktosh va metallurgiya shlaki kabi mineral xomashyolar yuqori haroratda eritiladi. Hosil bo‘lgan eritma keyingi texnologik bosqichlarda tolalantirish va issiqlik izolyatsion material shakllantirish uchun ishlatiladi.

Korxonada hosil bo‘layotgan koks xokasidan yetarli darajada foydalanilmasligi ikkilamchi yoqilg‘i resurslarining yo‘qotilishiga olib kelishi mumkin. Avvalgi tadqiqotlarda ushbu koks xokasining namligi va kalorifik qiymati aniqlangan. Ushbu maqolada ushbu natijalardan foydalanib, koks xokasining energetik potensiali baholanadi va mineral xomashyoni eritish uchun koks sarfini hisoblashning nazariy asoslari ko‘rib chiqiladi.

Tadqiqotning maqsadi

Tadqiqotning asosiy maqsadi bazalt, ohaktosh va metallurgiya shlakidan tashkil topgan mineral xomashyo aralashmasini yuqori haroratda eritish uchun zarur bo‘lgan koks yoqilg‘isi sarfini aniqlash hamda korxonada hosil bo‘layotgan mayda fraksiyali koks xokasidan qayta foydalanish imkoniyatlarini ilmiy asoslashdan iborat.

Ushbu maqsadga erishish uchun koks xokasining namligi va kalorifik qiymatini hisobga olish, kalorifik qiymatni energiya birliklariga o‘tkazish, mineral xomashyoning kimyoviy tarkibini hisobga olish va 1 tonna mineral xomashyoni eritish uchun zarur issiqlik miqdorini aniqlash metodikasini ishlab chiqish vazifalari belgilandi.

Tadqiqot materiallari va usullari

Tadqiqotda bazalt, ohaktosh va metallurgiya shlaki mineral xomashyo sifatida, koks esa yuqori haroratli eritish jarayonining yoqilg‘isi sifatida olindi. Koks xokasining dastlabki namunasi mexanik maydalagichda maydalandi va 0,08 mm elakdan o‘tkazildi. Namlik ST-100A rusumli namlik o‘lchagichda, kalorifik qiymat esa kalorimetrik usulda aniqlandi.

Mineral xomashyoni eritish jarayonining issiqlik balansi

1 tonna mineral xomashyoni eritish uchun zarur bo‘lgan koks miqdorini aniqlash uchun avvalo eritish jarayonining umumiy issiqlik sarfi hisoblanadi.

$$Qumum = Qqiz + Qerit + Qyo‘q.$$

Bu yerda Qqiz — xomashyoni boshlang‘ich haroratdan eritish haroratigacha qizdirish uchun sarflanadigan issiqlik; Qerit — mineral komponentlarni eritish uchun zarur issiqlik; Qyo‘q — texnologik jarayondagi issiqlik yo‘qotishlari.

Xomashyoni qizdirish uchun Qqiz = m·Cp·ΔT formula qo‘llanadi. Aniq ishlab chiqarish hisobi uchun bazalt, ohaktosh va shlakning real massa nisbatlari, eritish harorati hamda pechning issiqlik samaradorligi kiritilishi kerak.

Koks xokasining energetik ko‘rsatkichlari

Tadqiqotda koks xokasining namligi 1,17 %, kalorifik qiymati esa 6530 kcal/kg ekanligi aniqlandi.

Q = 6530 × 4,1868 = 27345 kJ/kg.

Demak, Q ≈ 27,35 MJ/kg. 1 kg koks xokasi to‘liq yonish sharoitida nazariy jihatdan taxminan 27,35 MJ issiqlik energiyasi ajratishi mumkin.

Koks sarfini hisoblash

Koksning aniqlangan kalorifik qiymati Qk = 27,35 MJ/kg ga teng. Agar eritish uchun talab qilinadigan umumiy issiqlik miqdori Qumum deb olinsa, nazariy koks sarfi mk,n = Qumum/Qk formula orqali aniqlanadi.

Amaliy sharoitda koksning barcha issiqligi mineral xomashyoga o‘tmaydi. Shuning uchun pechning foydali ish koeffitsiyenti η hisobga olinadi: mk,a = Qumum/(Qk·η). Mazkur formula asosida 1 tonna mineral xomashyo uchun umumiy issiqlik talabi aniqlangach, amaliy koks sarfini hisoblash mumkin.

Koks xokasining namligining yoqilg‘i samaradorligiga ta’siri

Tadqiqotda namlik 1,17 % ekanligi aniqlandi. 1 tonna nam koks xokasidagi suv miqdori 1000 × 0,0117 = 11,7 kg. Quruq modda miqdori 1000 – 11,7 = 988,3 kg ni tashkil qiladi. Namlikni nazorat qilish yoqilg‘ining foydali energetik samaradorligini barqarorlashtirishga xizmat qiladi.

Bazalt, ohaktosh va shlak aralashmasining eritishdagi roli

Bazalt mineral xomashyo aralashmasining asosiy komponenti sifatida qaraladi. Uning tarkibidagi SiO_2, Al_2O_3, CaO, MgO va temir oksidlari mineral eritmaning fizik-kimyoviy xususiyatlariga ta’sir qiladi.

Ohaktosh tarkibidagi CaO miqdorining yuqoriligi sababli u eritma tarkibidagi kalsiy oksidi miqdorini rostlashda muhim komponent hisoblanadi. Metallurgiya shlaki esa SiO_2, Al_2O_3, CaO va MgO kabi komponentlarni o‘z ichiga olganligi sababli mineral tarkibni shakllantirishda qo‘shimcha xomashyo sifatida ishlatilishi mumkin.

Mayda fraksiyali koks xokasini qayta ishlash

Mayda fraksiyali koks xokasidan foydalanishning istiqbolli yo‘nalishlaridan biri uni briketlash hisoblanadi. Mayda zarrachali koksni bog‘lovchi yordamida presslash orqali yiriklashtirilgan yoqilg‘i olish mumkin.

Texnologik jarayon: koks xokasi → maydalash → 0,08 mm elaklash → namlikni rostlash → bog‘lovchi qo‘shish → aralashtirish → presslash → qotirish → mexanik va termik sinov → eritish pechida foydalanish.

Fenol-formaldegid smolasi ushbu jarayonda bog‘lovchi sifatida tadqiq qilinishi mumkin. Uning optimal sarfi, briketlash bosimi va qotirish sharoitlari tajriba orqali aniqlanishi kerak.

Natijalar va muhokama

Koks xokasining namligi 1,17 %, kalorifik qiymati esa 6530 kcal/kg ni tashkil etdi. Kalorifik qiymat taxminan 27,35 MJ/kg ga teng. Ushbu qiymatdan foydalanib, eritish jarayonida zarur koks miqdorini issiqlik balansi orqali aniqlash mumkin.

Nazariy koks sarfi real ishlab chiqarish sarfidan farq qilishi mumkin. Bunga pechning issiqlik samaradorligi, chiqindi gazlar bilan issiqlik yo‘qotilishi, pech devorlari orqali issiqlik chiqishi va yoqilg‘ining to‘liq yonmasligi sabab bo‘ladi. Koks xokasining briketlanishi uning texnologik xususiyatlarini yaxshilashi va materialni eritish jarayoniga qayta kiritish imkonini berishi mumkin.

XULOSA

Tadqiqot natijalariga ko‘ra bazalt, ohaktosh va metallurgiya shlakidan tashkil topgan mineral xomashyo aralashmasini eritish jarayonida koks sarfini issiqlik balansi asosida aniqlash mumkinligi ko‘rsatildi.

Koks xokasining namligi 1,17 %, kalorifik qiymati esa 6530 kcal/kg yoki taxminan 27,35 MJ/kg ekanligi aniqlandi. 1 tonna koks xokasidagi namlik miqdori 11,7 kg, quruq modda miqdori esa 988,3 kg ni tashkil qiladi.

1 tonna bazalt–ohaktosh–shlak mineral xomashyosini eritish uchun zarur koks miqdorini aniqlashda xomashyoning massa tarkibi, qizdirish va eritish uchun zarur issiqlik, pechning issiqlik samaradorligi hamda texnologik issiqlik yo‘qotishlari hisobga olinishi lozim. Mayda fraksiyali koks xokasining aniqlangan energetik ko‘rsatkichlari uni qayta ishlash va briketlangan yoqilg‘i sifatida foydalanish imkoniyatlari mavjudligini ko‘rsatadi.

1-jadval. Mineral xomashyolarning kimyoviy tarkibi

Komponent	Bazalt, %	Ohaktosh, %	Shlak, %
SiO_2	44,83	0,69	37,07
Al_2O_3	12,42	0,35	13,06
CaO	17,70	54,48	38,21
MgO	4,12	0,84	10,22
Fe_2O_3	4,51	0,31	0,86

2-jadval. Koks xokasining asosiy energetik ko‘rsatkichlari

Ko‘rsatkich	Natija
Namlik miqdori	1,17 %
Kalorifik qiymati	6530 kcal/kg
SI birlikdagi kalorifik qiymat	≈27,35 MJ/kg

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MAYDA FRAKSIYALI KOKS XOKASINING NAMLIGI VA KALORIFIK QIYMATI

Annotatsiya. *Maqolada mayda fraksiyali koks xokasining namlik miqdori va kalorifik qiymatini eksperimental aniqlash natijalari keltirilgan. Namuna mexanik maydalashdan o‘tkazilib, 0,08 mm teshikli elakdan saralandi. Namlik ST-100A qurilmasida, kalorifik qiymat esa MC3001 kalorimetrida aniqlandi. Natijada namlik 1,17 %, kalorifik qiymat 6530 kkal miqdorida qayd etildi. Ushbu natijalar materialning energetik potensialini dastlabki baholash va keyingi briketlash tadqiqotlarini rejalashtirish uchun asos bo‘lib xizmat qiladi.*

Kalit so‘zlar*: koks xokasi, mayda fraksiya, namlik, kalorifik qiymat, qattiq yoqilg‘i, briketlash, bog‘lovchi.*

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MOISTURE AND CALORIFIC VALUE OF FINE-FRACTION COKE BREEZE

Abstract. *The article presents experimental results for the moisture content and calorific value of fine-fraction coke breeze. The sample was mechanically crushed and sieved through a 0.08 mm sieve. Moisture was measured with an ST-100A analyzer and calorific value with an MC3001 calorimeter. The measured moisture content was 1.17%, while the calorific value was 6530 kcal. The results provide initial data for assessing the energetic potential of the material and planning further briquetting experiments.*

Keywords*: coke breeze, fine fraction, moisture, calorific value, solid fuel, briquetting, binder.*

KIRISH

Koks yuqori uglerod miqdori va issiqlik berish xususiyati bilan ajralib turadigan uglerodli material bo‘lib, metallurgik va yuqori haroratli texnologik jarayonlarda keng qo‘llanadi. Uning texnologik qiymatiga kimyoviy tarkib bilan bir qatorda zarracha o‘lchami, namlik, g‘ovaklik va mexanik mustahkamlik kabi ko‘rsatkichlar ham ta’sir qiladi [1, 2].

Koksni tashish, maydalash, saralash va pechga yuklash jarayonlarida mexanik yemirilish natijasida mayda fraksiyali koks xokasi hosil bo‘ladi. Bunday materialni bevosita qo‘llash ayrim texnologik agregatlarda gaz o‘tkazuvchanligi va qatlam zichligi bilan bog‘liq muammolar keltirib chiqarishi mumkin. Shu sababli mayda fraksiyali koksni qayta ishlash, xususan briketlash, amaliy jihatdan muhim yo‘nalishlardan biridir.

Briketlashda xomashyoning zarracha o‘lchami, namligi, bog‘lovchi turi va miqdori, presslash bosimi hamda qotirish sharoiti briket sifatiga ta’sir qiladi [3]. Shu sababli texnologik tadqiqotning dastlabki bosqichida xomashyoning namligi va kalorifik qiymatini aniqlash maqsadga muvofiq.

ISO 687:2024 koksning umumiy tahlil namunasidagi namlikni aniqlash usulini belgilaydi [4]. ISO 1928:2025 esa ko‘mir va koksning yalpi kalorifik qiymatini bomba kalorimetrida aniqlash metodini belgilaydi [5]. Mazkur tadqiqotda olingan natijalar shu turdagi standart ko‘rsatkichlarni shakllantirishga qaratilgan.

ADABIYOTLAR SHARHI

Koksning mexanik xususiyatlari bo‘yicha Sato, Patrick va Walker koksning tortilish mustahkamligini karbon matritsasi va g‘ovak tuzilishi bilan bog‘lab o‘rgangan. Ularning natijalari g‘ovaklarning taqsimlanishi va stress konsentratsiyasi koks mustahkamligiga ta’sir qilishini ko‘rsatadi [6]. Bu ma’lumotlar mayda koksdan tayyorlanadigan briketlarning mexanik xususiyatlarini baholashda muhim.

Taylor va Coban shakllantirilgan koks olishda bog‘lovchi turi, zarracha o‘lchami va qotirish bosqichining rolini tadqiq qilgan. Ishda qotirish bosqichi briketning yakuniy mustahkamligini shakllantirishda muhimligi ko‘rsatilgan [7].

Benk, Talu va Coban koks xokasidan briket olishda fenol asosidagi novolak, rezol va ularning aralashmalarini o‘rgangan. Tadqiqotda bog‘lovchi tarkibi va katalizator sharoitining briket mustahkamligiga ta’siri ko‘rsatilgan [8, 9]. Keyingi ishlarda kislotali qotirgichlar va yuqori haroratdagi xatti-harakatlar ham o‘rganilgan [10, 11].

Benk va Coban koks xokasi va antratsit asosidagi briketlarda bog‘lovchi tizimlarini taqqoslagan [12, 13]. Ushbu ishlar koks xokasining briketlanishida nafaqat bog‘lovchi, balki xomashyoning o‘ziga xos xususiyatlari ham hisobga olinishi kerakligini ko‘rsatadi.

Zhang, Sun va Xu briket bog‘lovchilariga bag‘ishlangan sharhda organik, noorganik va kompozit bog‘lovchilarni umumlashtirib, bog‘lovchi tanlashda mustahkamlik, termik barqarorlik, yonish xususiyati va iqtisodiy omillarni birgalikda hisobga olish zarurligini qayd etgan [14]. Demak, koks xokasini briketlash bo‘yicha keyingi tajribalar oldidan uning fizik-energetik ko‘rsatkichlarini aniqlash ilmiy jihatdan asoslangan boshlang‘ich bosqich hisoblanadi.

TADQIQOT MAQSADI

Tadqiqotning maqsadi mayda fraksiyali koks xokasining namlik miqdori va kalorifik qiymatini eksperimental aniqlash hamda olingan natijalarni uning energetik va keyingi briketlash texnologiyasi uchun boshlang‘ich tavsifi sifatida baholashdan iborat.

Vazifalar: namunani tayyorlash; yirik zarrachalarni maydalash; 0,08 mm elakdan o‘tkazish; namlikni aniqlash; kalorifik qiymatni o‘lchash; natijalarni tahlil qilish va keyingi tadqiqotlar uchun asosiy parametrlarni belgilash.

TADQIQOT MATERIALLARI VA USULLARI

Namuna tayyorlash

Tadqiqot uchun mayda fraksiyali koks xokasi namunasi olindi. Ayrim zarrachalar yirikroq bo‘lganligi sababli namuna laboratoriya drobilkasida mexanik maydalandi. Maydalangan material 0,08 mm teshikli elakdan o‘tkazildi va elakdan o‘tgan bir jinsli fraksiya ishchi namuna sifatida ajratildi.

Bunday tayyorlash tahlil qilinayotgan materialning bir jinsliligini oshirishga va yirik zarrachalarning o‘lchash natijasiga ta’sirini kamaytirishga xizmat qildi.



1-rasm. Koks xokasini tadqiq qilishning eksperimental ketma-ketligi.

Namlikni aniqlash

Namlik miqdori ST-100A yuqori aniqlikdagi tezkor namlik o‘lchagich yordamida aniqlandi. Ishchi namuna qurilma idishiga joylashtirilib, belgilangan qizdirish rejimida tahlil qilindi. Qizdirish davomida namuna massasining kamayishi qayd etildi va namlik massa ulushi ko‘rinishida hisoblandi.

Tajriba natijasida W = 1,17 % qiymat olindi. Ushbu qiymat aynan tadqiq qilingan namuna uchun eksperimental natijadir. ISO 687:2024 koksning umumiy tahlil namunasidagi namlikni aniqlash uchun amaldagi xalqaro metodni belgilaydi [4].

Kalorifik qiymatni aniqlash

Kalorifik qiymat MC3001 kalorimetrik qurilmasida aniqlandi. Ma’lum massadagi namuna kalorimetrik tizimda yondirilib, yonish natijasida ajralgan issiqlik asosida qiymat qayd etildi.

Natijada Q = 6530 kkal qiymat olindi. Maqolani topshirishdan oldin ushbu qiymatning birliklari MC3001 protokolidagi yozuv bilan tekshirilishi kerak. Agar protokolda kkal/kg ko‘rsatilgan bo‘lsa, maqolada ham aynan kkal/kg yozilishi lozim. ISO 1928:2025 yalpi kalorifik qiymatni aniqlash va zarur hollarda boshqa asosga qayta hisoblash metodikasini belgilaydi [5].

NATIJALAR VA MUHOKAMA

№	Ko‘rsatkich	Natija	Birlik
1	Namlik miqdori	1,17	%
2	Kalorifik qiymat	6530	kkal

1-jadval. Tadqiq qilingan koks xokasining asosiy fizik-energetik ko‘rsatkichlari.

Namlik miqdorining 1,17 % bo‘lishi tadqiq qilingan namunaning nisbatan quruq holatini ko‘rsatadi. Namlik yoqilg‘ining foydali issiqlik berishiga ta’sir qiladi, chunki suvni qizdirish va bug‘latish uchun yonish issiqligining bir qismi

sarflanadi. Shu sababli namlikni aniqlash koks xokasining energetik tavsifini belgilashning zarur qismidir.

Namlik briketlash uchun ham muhim. U zarrachalarning yopishishi, aralashmaning bir jinsliligi, presslanish xususiyati va tayyor briketning dastlabki mustahkamligiga ta’sir qilishi mumkin. Biroq optimal namlikni faqat mavjud natija asosida belgilab bo‘lmaydi; bu parametr keyingi tajribada bog‘lovchi turi va presslash sharoiti bilan birgalikda optimallashtirilishi kerak.

6530 kkal qiymat koks xokasining sezilarli energetik potensialini ko‘rsatadi. Shu bilan birga, kalorifik qiymatni boshqa namunalar bilan taqqoslashda namuna holati, birlik va hisoblash asosi bir xil bo‘lishi kerak. ISO 1928:2025 aynan yalpi kalorifik qiymatni standart sharoitda aniqlashga yo‘naltirilgan [5].

Adabiyotlarda koks xokasining energetik va texnologik qiymatini baholashda kalorifik qiymat bilan birga namlik, kul, uchuvchan moddalar, oltingugurt, zarracha o‘lchami va mexanik mustahkamlik kabi ko‘rsatkichlar ham qo‘llanadi [8, 13]. Shuning uchun ushbu maqoladagi ikki ko‘rsatkichni kompleks tahlilning boshlang‘ich qismi sifatida qarash to‘g‘ri bo‘ladi.

Koks xokasini briketlash bilan bog‘liq ilmiy-amaliy jihatlar

Mayda fraksiyali koksni briketlashning maqsadi kichik zarrachalarni tashish va texnologik agregatga berish uchun qulayroq shaklga keltirishdir. Bunda briketning sovuq holatdagi mustahkamligi bilan bir qatorda qizdirilgandagi barqarorligi ham baholanishi kerak.

Fenol asosidagi bog‘lovchilar bo‘yicha tadqiqotlar koks xokasidan mustahkam briket olish mumkinligini ko‘rsatadi [8–11]. Biroq ushbu maqolada fenol-formaldegid smolasi bilan briket tayyorlash tajribasi o‘tkazilmagan. Shuning uchun bu yo‘nalish faqat keyingi tadqiqot sifatida qaraladi.

Keyingi tajribalarda bog‘lovchi miqdori, presslash bosimi va qotirish haroratini o‘zgartirib, briketlarning zichligi, siqilish mustahkamligi, tushishga chidamliligi, kalorifik qiymati va yuqori haroratdan keyingi qoldiq mustahkamligini aniqlash maqsadga muvofiq. Bunday yondashuv koks xokasining real ishlab chiqarish sharoitida foydalanish imkoniyatini baholashga yordam beradi.

KELGUSI TADQIQOTLAR

Keyingi bosqichda koks xokasining granulometrik tarkibi, kul miqdori, uchuvchan moddalar, qattiq uglerod, oltingugurt, zichlik va g‘ovaklik ko‘rsatkichlarini aniqlash zarur.

Briketlash tajribalarida xomashyo namligi, bog‘lovchi miqdori, presslash bosimi va qotirish harorati asosiy texnologik omillar sifatida tanlanishi mumkin. Har bir variant uchun mexanik va termik xususiyatlar alohida baholanishi kerak.

Yuqori haroratli pech uchun mo‘ljallangan briketlarda termogravimetrik tahlil yoki qizdirishdan keyingi massa yo‘qotilishini aniqlash, shuningdek gaz ajralishi va qoldiq mustahkamlikni tekshirish texnologik xavfsizlik va samaradorlik nuqtayi nazaridan muhim.

XULOSA

Tadqiqot natijasida mayda fraksiyali koks xokasining namlik miqdori 1,17 % va kalorifik qiymati 6530 kkal ekani aniqlandi. Namuna mexanik maydalash va 0,08 mm elakdan o‘tkazish orqali tahlilga tayyorlandi.

Olingan natijalar tadqiq qilingan koks xokasining dastlabki fizik-energetik tavsifini beradi va keyingi kompleks tahlil hamda briketlash tajribalarini rejalashtirish uchun foydalanilishi mumkin.

Shu bilan birga, faqat namlik va kalorifik qiymat asosida materialning to‘liq texnologik yaroqliligi haqida yakuniy xulosa chiqarib bo‘lmaydi. Keyingi bosqichda granulometrik va kimyoviy tarkib, mexanik xususiyatlar hamda fenol-formaldegid asosidagi briketlarning yuqori haroratdagi xatti-harakati o‘rganilishi kerak.

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THE IMPACT OF CYBERBULLYING ON THE INFORMATION AND PSYCHOLOGICAL SECURITY OF YOUNG PEOPLE IN UZBEKISTAN: PROBLEMS AND MECHANISMS FOR THEIR PREVENTION

Abstract. *This article analyzes the impact of cyberbullying on the information and psychological security of young people, its main forms, contributing factors, and prevention mechanisms. The relevance of the study is determined by the growing likelihood of young people being exposed to cyberaggression, insults, threats, unauthorized use of personal data, fake accounts, and defamatory content alongside the expanding use of digital communication tools, social networks, and messaging platforms. The study employs systematic analysis, comparative analysis, content analysis, and scientific literature review methods. Based on international scholarly sources and materials published by UNICEF, UNESCO, and the World Health Organization, the psychological, social, and educational effects of cyberbullying were examined. The findings substantiate the need to view cyberbullying not merely as a technical or ethical problem, but as a complex threat emerging at the intersection of information, psychological, social, and educational security. To protect young people, recommendations were developed to improve media and digital literacy, introduce early detection mechanisms in educational institutions, strengthen cooperation among parents, educational institutions, psychologists, and digital platforms, and establish accessible systems for reporting and recording cyber incidents.*

Keywords: *cyberbullying, youth, information security, psychological security, digital environment, social networks, cyberaggression, media literacy, digital security.*

INTRODUCTION

The rapid development of digital technologies has significantly expanded young people's opportunities for education, information exchange, and the formation of social relationships. At the same time, the risks emerging in the digital environment are becoming increasingly complex. One of these risks is cyberbullying, which can have adverse effects on young people's psychological well-being, social adaptation, educational activities, and personal safety.

UNICEF defines cyberbullying as repeated behavior carried out through digital technologies with the intention of intimidating, angering, or humiliating another person [1]. It can occur through social networks, messaging platforms, online games, and mobile devices. Cyberbullying includes such actions as spreading false information, posting humiliating photos or videos, sending threatening messages, and using fake accounts created in another person's name [2].

One of the key differences between cyberbullying and traditional bullying is its ability to spread widely and persist in the digital environment. For example, even after negative content posted on the Internet has been deleted by the person who originally posted it, it may still be copied or redistributed by other users. Consequently, the pressure experienced by the victim is not necessarily limited to a particular educational institution or specific social environment.

According to UNESCO, school violence and bullying are widespread globally, while the increased use of digital devices has further intensified the problem of cyberbullying. The organization identifies cyberbullying as one of the forms of bullying occurring in online environments, including forms involving psychological or sexual harassment [3, 4].

Analyses published by the World Health Organization in 2025 indicate that the impact of the digital environment on the mental well-being of young people is not uniform, and that negative consequences may be more pronounced among certain age groups and more vulnerable populations. Cyberbullying is identified as one of the important components of these digital risks [5, 6].

From this perspective, ensuring the information and psychological security of young people in Uzbekistan requires a comprehensive examination not only from the perspective of information technologies, but also from the perspectives of pedagogy, psychology, law, and social governance.

The aim of the study is to systematically analyze the impact of cyberbullying on the information and psychological security of young people and to propose practical mechanisms aimed at preventing cyberbullying and reducing its negative consequences.

Research objectives:

1. To clarify the scientific meaning of the concept of cyberbullying;
2. To classify its main forms;
3. To analyze the impact of cyberbullying on the psychological and social security of young people;
4. To identify the characteristics of its manifestation in educational institutions;
5. To propose prevention and protection mechanisms applicable to the conditions of Uzbekistan.

MATERIALS AND METHODS

The study is theoretical and analytical in nature and examines scientific literature on cyberbullying and the information and psychological security of young people, analytical materials published by international organizations, and relevant scholarly sources.

The following research methods were employed [7]:

Systematic analysis was used to examine cyberbullying not as an isolated phenomenon, but as a system interconnected with the information, psychological, and social security of young people.

Content analysis was employed to identify definitions of cyberbullying, its forms, and its consequences presented in scientific literature and materials published by international organizations.

Comparative analysis made it possible to identify similarities and differences between traditional bullying and cyberbullying.

The generalization method was used to synthesize findings reported in various scientific sources and to develop preventive mechanisms adapted to the conditions of Uzbekistan.

The methodological basis of the study is a systemic approach to information and psychological security. Within this approach, the security of young people is considered through the interaction of three principal components:

digital environment → psychological state → social and educational activity.

In this framework, negative influences in the digital environment may affect an individual's psychological state, while changes in psychological state may, in turn, influence social relationships and educational activities.

RESULTS

1. Main Forms of Cyberbullying

Based on the analysis, cyberbullying can be classified into the following main forms:

Form of Cyberbullying	Description	Potential Consequences
Insults and threats	Sending insulting or threatening messages through messaging platforms or social networks	Fear and stress
Defamation	Spreading false or negative information	Social isolation
Disclosure of personal information	Distributing photos, videos, or other information without the person's consent	Shame and anxiety
Fake accounts	Creating an account impersonating another person	Damage to reputation
Online harassment	Repeated messages, comments, or unwanted monitoring	Psychological pressure
Digital mockery	Sharing photos/videos or personal situations with the intention of mocking or humiliating the person	Decreased self-confidence
Exclusion from online groups	Deliberately excluding a person from a social digital environment	Feelings of loneliness

UNICEF identifies the dissemination of false information, the posting of humiliating materials, the sending of threatening messages, and the use of false identities as typical forms of cyberbullying [1].

In addition, the use of images and videos created or manipulated using artificial intelligence in the contemporary digital environment is increasingly regarded as an emerging risk. This may complicate the process of detecting and verifying cyberbullying compared with its traditional forms.

2. Impact of Cyberbullying on Information and Psychological Security

The analytical findings of the study indicate that the consequences of cyberbullying can be divided into three main groups.

The first group — psychological consequences.

These include anxiety, fear, shame, decreased self-confidence, avoidance of social interaction, and a persistent feeling of psychological pressure. UNICEF notes that cyberbullying can negatively affect mental and emotional well-being, as well as sleep and physical health [2].

The second group — social consequences.

Young people exposed to cyberbullying may avoid communicating with their peers, withdraw from social groups, or develop negative perceptions of their social status.

The third group — educational consequences.

Psychological pressure may lead to decreased interest in educational activities and reduced concentration. UNESCO notes that school bullying can have long-term effects on students' safety, mental and physical health, and educational outcomes [3].

Thus, the impact of cyberbullying is not limited to "conflicts on the Internet." It can also extend beyond the digital environment and affect real-world social relationships.

3. Factors Contributing to the Spread of Cyberbullying

Based on the analysis, the factors influencing the spread of cyberbullying can be systematized as follows [8]:

Technological factors:

- use of anonymous or fake accounts;
- the ability to distribute content rapidly and widely;
- long-term persistence of digital traces;
- transfer of content between different platforms.

Psychological factors:

- low levels of empathy;
- impulsive behavior;
- insufficient awareness of the consequences of digital communication;
- peer influence.

Social factors:

- insufficient parental supervision and communication within the family;
- peer-group pressure;
- lack of clearly established mechanisms for addressing cyberbullying in educational institutions.

Factors related to information literacy:

- inadequate skills in protecting personal information;

- difficulties in identifying harmful content;
- failure to use reporting and blocking functions provided by digital platforms.

DISCUSSION

Reducing cyberbullying cannot be achieved solely by deleting inappropriate messages from the Internet. The complex nature of the problem requires cooperation among multiple stakeholders to prevent and address it.

UNICEF recommends that young people experiencing cyberbullying seek support from a trusted adult, block the relevant user on digital platforms, and use available mechanisms for reporting incidents [2].

The World Health Organization also considers the impact of the digital environment on the mental well-being of young people as an important factor and emphasizes the need for comprehensive measures in public policy aimed at reducing risks associated with the digital environment [5].

Based on these considerations, it is appropriate to apply a **"early detection – reporting – psychological support – digital safety – monitoring"** model for cyberbullying prevention within the education system of Uzbekistan.

Proposed Model

STAGE 1. EARLY DETECTION

Teachers and psychologists in educational institutions should receive appropriate training to identify the early signs of cyberbullying.

STAGE 2. REPORTING

An electronic reporting channel should be established through which pupils or students can report incidents either anonymously or with identification.

STAGE 3. PRESERVATION OF EVIDENCE

In cases of cyberbullying, individuals should be informed about procedures for preserving messages, screenshots, links, and other forms of digital evidence. UNICEF also identifies the existence of a digital trace as an important characteristic of cyberbullying [1, 2].

STAGE 4. PSYCHOLOGICAL SUPPORT

A mechanism for providing psychological support should be developed, while avoiding a blaming or accusatory attitude toward the victim.

STAGE 5. DIGITAL PREVENTION

Regular training should be organized for young people on media literacy, personal data protection, secure passwords, two-factor authentication, identification of suspicious links, and the use of privacy settings on social networks.

STAGE 6. MONITORING

The collection of anonymized statistical data on cyberbullying incidents in educational institutions can contribute to assessing the dynamics of the problem.

This approach makes it possible to view cyberbullying not merely as a personal conflict between a victim and an aggressor, but as a complex problem involving educational institutions, families, digital platforms, and society.

The automatic detection of cyberbullying presents a particular challenge for low-resource languages and dialects. Therefore, the development of national

language corpora and local digital databases for detecting cyberbullying content in the Uzbek language represents one of the promising research directions [9].

When developing technologies for cyberbullying detection, it is necessary to consider not only general linguistic characteristics but also the cultural and communicative features of a particular society. Contemporary studies conducted in the context of Muslim societies also demonstrate the importance of culturally adapted artificial intelligence models [10].

CONCLUSION

The theoretical and analytical findings of the study indicate that cyberbullying constitutes a complex digital threat affecting the information and psychological security of young people. Its principal characteristics include the rapid dissemination of harmful content, its ability to reach a large number of users, and its persistence as a digital trace.

In addition to its psychological consequences, cyberbullying has social and educational consequences. Therefore, addressing the problem solely through technical means is insufficient.

Based on the findings of the study, the following recommendations have been developed:

1. To develop internal preventive mechanisms for preventing cyberbullying in educational institutions;
2. To systematically improve young people's digital and media literacy;
3. To develop methodological guidelines for teachers and psychologists on identifying cyberbullying;
4. To introduce electronic systems that enable anonymous reporting and submission of complaints;
5. To organize practical seminars on digital safety for parents;
6. To expand practical training for young people on safe use of social networks, protection of personal information, and documentation of cyber incidents;
7. To establish a regular system of anonymous statistical monitoring of cyberbullying.

Overall, ensuring the information and psychological security of young people requires **technological, pedagogical, psychological, and social mechanisms to operate as an integrated system**.

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INTEGRATION OF ACTIVITY-BASED COSTING AND MATERIAL FLOW COST ACCOUNTING TO REDUCE LOSSES AND IMPROVE RESOURCE ALLOCATION EFFICIENCY: AN APPLICATION IN THE PHARMACEUTICAL INDUSTRY

Abstract. *The pharmaceutical industry is characterized by complex production processes, high-value materials, stringent quality requirements, and substantial resource consumption, making effective cost management and waste reduction essential for improving operational efficiency. Traditional cost accounting systems may not provide sufficient information to identify the activities responsible for resource consumption or to determine the costs associated with material losses. This study aims to develop an integrated framework combining Activity-Based Costing (ABC) and Material Flow Cost Accounting (MFCA) to reduce material losses and improve resource allocation efficiency in the pharmaceutical industry.*

The study adopts an applied case study approach based on production, cost, and material-flow data from a pharmaceutical manufacturing environment. ABC is used to identify production activities, allocate resource costs, and determine activity-level costs, while MFCA is applied to quantify material inputs, positive outputs, negative outputs, and the costs associated with material losses. The two approaches are subsequently integrated to establish a relationship between resource consumption, production activities, material flows, material losses, and loss costs.

The results indicate that total material input amounted to 12,000 kg, of which 1,200 kg represented material losses, corresponding to a loss rate of 10%. The total cost of material losses was estimated at USD 21,100, with the production stage accounting for the largest share of material loss and associated costs. Under the proposed integrated approach, material losses decreased to 960 kg, while the associated loss cost decreased to USD 16,880. Resources allocated to non-value-adding activities decreased from USD 34,000 to USD 27,200, while resource allocation efficiency increased from 80% to 84%.

The findings indicate that integrating ABC and MFCA provides more comprehensive information for identifying loss-generating activities, measuring the economic consequences of material losses, and supporting more efficient resource allocation. The study contributes to cost management research by demonstrating the applicability of an integrated cost and material-flow approach to pharmaceutical manufacturing and provides a basis for reducing avoidable losses and improving resource utilization.

Keywords: *Activity-Based Costing; Material Flow Cost Accounting; Material Losses; Waste Reduction; Resource Allocation Efficiency; Cost Management; Pharmaceutical Industry.*

1. Introduction

The pharmaceutical industry is characterized by complex production processes, high-value raw materials, strict quality requirements, and substantial resource consumption. These characteristics increase the importance of effective cost management, waste reduction, and efficient resource allocation. Recent studies emphasize the need for accounting systems that provide more detailed information about resource consumption and production losses (Usul & Olgun, 2025).

Activity-Based Costing (ABC) provides a useful approach for assigning resource costs to activities and subsequently allocating activity costs to products based on appropriate cost drivers. This approach can improve the accuracy of cost information and support managerial decisions concerning resource utilization and cost reduction (Wang & Simarmata, 2024).

However, ABC primarily focuses on the cost of activities and may not provide sufficient information about the physical flow of materials and the costs associated with material losses. Material Flow Cost Accounting (MFCA) addresses this issue by tracing material flows through production processes and identifying the quantities and costs of positive and negative outputs. Recent research indicates that MFCA can improve transparency regarding material losses and support more efficient resource utilization (Al-Eqabi, 2024; Dierkes & Siepelmeyer, 2025).

Furthermore, recent evidence indicates that MFCA can contribute to reducing product costs, improving waste management, and identifying opportunities for resource efficiency (Cavalcante et al., 2025; Usul & Olgun, 2025). In the Iraqi industrial context, studies have also demonstrated the applicability of MFCA in identifying material losses and improving cost and resource management (Al-Eqabi, 2024). Of particular relevance to the present study, Mohammed Ali (2025) applied MFCA in the pharmaceutical industry and highlighted its potential role in supporting more sustainable production and improving material-flow management.

Despite these developments, there remains a need for an integrated approach that connects activity costs, resource consumption, material flows, and losses within a single analytical framework. Integrating ABC with MFCA may provide more comprehensive information about the activities responsible for excessive resource consumption and the costs associated with material losses. Such information can support management in identifying inefficient activities, reducing avoidable losses, and reallocating resources toward value-adding activities (Dierkes & Siepelmeyer, 2025; Usul & Olgun, 2025).

Accordingly, this study examines the integration of Activity-Based Costing and Material Flow Cost Accounting to reduce losses and improve resource allocation efficiency in the pharmaceutical industry. The study aims to provide an integrated accounting approach that links resources, activities, material flows,

losses, and costs, thereby supporting more effective managerial decisions and improving the efficiency of resource utilization.

1.1 Significance of the Study:

The significance of this study lies in addressing the need for more comprehensive cost information in pharmaceutical manufacturing, particularly where production processes involve multiple activities and material flows. Integrating Activity-Based Costing with Material Flow Cost Accounting provides a broader perspective for analyzing production costs and material losses.

From a theoretical perspective, the study contributes to cost accounting research by bringing together activity-based cost information and material-flow information within a single framework. This integration extends the analysis beyond conventional cost measurement to consider the relationship between activities, resources, material flows, and losses.

From a practical perspective, the proposed approach can help management identify the stages of production where material losses and resource consumption are concentrated. Such information can support the evaluation of production processes and the identification of opportunities for operational improvement.

The study also has managerial significance, as the information generated by the integrated approach can support decisions concerning production planning, cost control, process improvement, and the allocation of available resources.

Finally, the study provides an applied contribution to the pharmaceutical industry by examining the feasibility of using an integrated accounting approach within a manufacturing environment characterized by complex production processes and stringent quality requirements.

1.2 Statement of the Problem

Pharmaceutical manufacturing involves multiple production activities, diverse material inputs, and strict quality requirements, which can make it difficult to accurately determine how resources are consumed and where material losses occur. Traditional cost accounting practices may aggregate costs at a level that does not clearly identify the activities responsible for excessive resource consumption or the costs associated with material losses.

Although Activity-Based Costing can provide more detailed information about the cost of production activities, it does not by itself provide sufficient information about the physical movement of materials and the losses generated throughout the production process. Conversely, material flow management techniques can identify material movements and losses but may not adequately link these losses to the costs of specific activities.

This creates a need for an integrated approach that connects activity costs with material flows and losses. Accordingly, the problem addressed by this study is the extent to which integrating Activity-Based Costing with Material Flow Cost Accounting can improve the identification and measurement of losses and provide more useful information for improving resource allocation efficiency in the pharmaceutical industry.

1.3 Measurable Research Gap

Previous studies have generally examined Activity-Based Costing and Material Flow Cost Accounting as separate approaches. Activity-Based Costing focuses primarily on assigning resource costs to activities, while Material Flow Cost Accounting focuses on tracing material flows and identifying material losses. However, limited attention has been given to quantitatively integrating activity-level cost information with material-flow losses to determine the cost of losses attributable to specific production activities.

Accordingly, the measurable research gap addressed by this study is the absence of an integrated measurement framework that simultaneously determines:

1. The cost of individual production activities using Activity-Based Costing.
2. The quantity and cost of material losses at each production stage using material flow analysis.
3. The activity-level cost of material losses by linking losses to the activities in which they occur.
4. The proportion of total resources consumed by non-value-adding activities and material losses.
5. The potential improvement in resource allocation efficiency resulting from reallocating resources from inefficient activities toward value-adding activities.

The study therefore seeks to measure the difference between the existing allocation of resources and the allocation proposed after identifying activity-level losses. This allows the research gap to be examined quantitatively through indicators such as loss quantity, loss cost, activity cost, resource utilization, and resource allocation efficiency.

The main contribution of the study is consequently not merely the application of Activity-Based Costing or material flow management separately, but the development of an integrated measurement approach that connects activities → resource consumption → material flows → losses → loss costs → resource allocation within the pharmaceutical manufacturing process.

1.4 Research Questions

The study seeks to answer the following main research question:

How can the integration of Activity-Based Costing and Material Flow Cost Accounting reduce material losses and improve resource allocation efficiency in the pharmaceutical industry?

This main question is addressed through the following sub-questions:

1. What are the major production activities and resources consumed in the pharmaceutical manufacturing process?
2. What are the quantities and costs of material losses generated at each production stage?
3. Which activities are associated with the highest levels of resource consumption and material losses?
4. How can Activity-Based Costing and material flow information be integrated to measure activity-level loss costs?
5. To what extent can the integrated approach improve resource allocation efficiency?

6. What changes in resource allocation can be identified after measuring activity-level losses?

2. Literature Review

2.1 Activity-Based Costing

2.1 Activity-Based Costing

Activity-Based Costing (ABC) is a management accounting approach that provides detailed information on the relationship between resources, activities, and cost objects. Rather than allocating indirect costs using broad volume-based measures, ABC identifies the activities that consume resources and assigns costs according to the extent to which products or other cost objects use those activities. This approach can improve cost transparency and provide more relevant information for managerial decision-making and resource allocation (Wang & Simarmata, 2024).

Recent research has continued to demonstrate the relevance of ABC in complex manufacturing environments. Wang and Simarmata (2024) developed a fuzzy activity-based costing framework that identifies and allocates resource and activity costs under conditions of uncertainty, demonstrating the potential of activity-based approaches to improve the accuracy and usefulness of cost information. Similarly, Rajan and Pillai (2025) found that ABC can improve the allocation of overhead costs by linking indirect expenditures to the resources consumed by individual activities.

The application of ABC is particularly relevant to pharmaceutical manufacturing because production processes involve multiple activities with different resource requirements and cost characteristics. Muoneke and Dandago (2024), in their study of the Nigerian pharmaceutical industry, emphasized the usefulness of ABC for improving production cost management, reducing cost distortion, and supporting more informed production and pricing decisions. In the Iraqi pharmaceutical context, Abd et al. (2024) examined Performance-Focused Activity-Based Costing (PFABC) in the State Company for Drugs Industry and Medical Appliances–Samarra and reported its relevance to cost reduction and product-quality improvement.

Accordingly, ABC provides the cost dimension of the present study by identifying production activities, determining the resources consumed by each activity, and assigning the corresponding costs to production activities. This information is subsequently linked with material-flow information to identify the economic consequences of material losses.

2.2 Material Flow Cost Accounting

Material Flow Cost Accounting (MFCA) is an environmental management accounting approach that examines the physical and monetary dimensions of material flows within production processes. Its central purpose is to make material consumption, material losses, and the associated costs more visible by tracing materials through different stages of production.

Recent studies have emphasized the ability of MFCA to quantify both material flows and the costs associated with waste and losses. Usul and Olgun

(2025) describe MFCA as an approach that tracks production waste in both quantitative and monetary terms and demonstrate that it can reveal the costs associated with material losses under different cost accounting systems. Similarly, Dierkes and Siepelmeyer (2025) developed an MFCA framework that differentiates among various sources of inefficiency, including waste, rejects, rework, and recycling, thereby providing more detailed information about their economic consequences.

Empirical evidence also supports the role of MFCA in improving resource efficiency and reducing waste. Ahmed et al. (2024) applied MFCA in a corrugated-packaging manufacturing enterprise and demonstrated its usefulness in identifying negative costs and areas of inefficient resource utilization. Kurniawan et al. (2024) likewise showed that MFCA can increase transparency regarding material use and support resource-saving and waste-reduction scenarios.

The relevance of MFCA is also evident in the Iraqi industrial environment. Al-Eqabi (2024), through an applied study in a Wasit weaving and knitting factory, found that MFCA can provide information useful for waste management, cost reduction, productivity improvement, and product sustainability. Dahi and Abdullah (2024) further reported that MFCA can contribute to green productivity by reducing material and energy consumption and improving production-related outcomes.

Within the present study, MFCA provides the physical-flow dimension by measuring material inputs, positive outputs, negative outputs, and material losses at different stages of pharmaceutical production. The resulting information is then connected to activity-level costs obtained through ABC.

2.3 Material Losses and Waste Costs

Material losses represent an important source of production inefficiency because they involve resources that are consumed without generating an equivalent level of productive output. In manufacturing environments, losses may arise from processing activities, quality problems, equipment operation, material handling, packaging, rejected production, rework, or other operational conditions. Recent MFCA research emphasizes the importance of measuring such losses not only in physical quantities but also in monetary terms.

Dierkes and Siepelmeyer (2025) demonstrate that material inefficiencies may arise from several sources, including waste, rejects, reworking, and recycling, and argue that differentiated information about these factors can improve the analysis of their economic consequences. Similarly, Usul and Olgun (2025) show that MFCA can identify the costs associated with material losses and provide information that extends beyond conventional cost accounting.

The economic significance of material losses is also demonstrated by Ahmed et al. (2024), whose application of MFCA in the corrugated-packaging industry identified substantial negative costs associated with material, system, energy, and waste-management factors. Their findings indicate that identifying the sources of negative costs can provide a basis for reducing waste and improving resource utilization.

In the Iraqi industrial context, Al-Eqabi (2024) found that the information generated by MFCA can support waste management, cost reduction, and improvements in production and product sustainability. Dahi and Abdullah (2024) similarly emphasized that reducing material and energy consumption through MFCA can contribute to lower production costs and improved productivity.

For pharmaceutical manufacturing, the economic measurement of material losses is particularly relevant because losses may involve not only the direct cost of raw materials but also labor, machinery, energy, quality-control activities, packaging, and other production resources. Therefore, measuring material losses solely in physical units may not fully reflect their economic significance. The present study addresses this issue by linking material losses to the production activities in which they occur and by determining the corresponding activity-level loss costs.

2.4 Resource Allocation Efficiency

Resource allocation efficiency refers to the extent to which available production resources are directed toward activities that contribute to productive output while minimizing unnecessary or non-value-adding consumption. In manufacturing organizations, such resources may include raw materials, direct labor, machinery, energy, production capacity, quality-control resources, and packaging materials.

ABC provides information that can support resource allocation by identifying the activities that consume resources and measuring the costs associated with those activities. Wang and Simarmata (2024) demonstrated that activity-based costing can be used to identify and allocate resource and activity costs within complex production environments. Rajan and Pillai (2025) similarly emphasized the role of ABC in improving the allocation of overhead costs by linking indirect costs with the activities that generate resource consumption.

MFCA provides a complementary perspective by identifying the physical use of materials and the losses generated during production. Dahi and Abdullah (2024) found that MFCA can support green productivity through reductions in material and energy consumption. Kurniawan et al. (2024) likewise demonstrated that MFCA can improve transparency regarding resource utilization and support scenarios for resource saving and waste reduction.

The combination of these perspectives provides a broader basis for evaluating resource allocation efficiency. ABC identifies where financial resources are consumed, while MFCA identifies where material resources are consumed and lost. When these two types of information are analyzed together, management can identify activities that consume substantial resources while generating relatively low productive output.

In the pharmaceutical industry, this approach is particularly relevant because production activities are often interdependent and subject to stringent quality requirements. The findings of Muoneke and Dandago (2024) and Abd et al. (2024) further demonstrate the relevance of activity-based approaches to cost management and production performance in pharmaceutical manufacturing.

Accordingly, the present study evaluates resource allocation efficiency by examining the relationship between resources consumed by production activities, material losses, loss costs, and the proportion of resources directed toward value-adding activities.

2.5 Integration of ABC and MFCA

Activity-Based Costing and Material Flow Cost Accounting provide complementary information for analyzing production performance. ABC focuses primarily on the cost of activities and the resources consumed by those activities, whereas MFCA focuses on the physical movement of materials and the losses generated during production. The integration of these perspectives can therefore provide a more comprehensive basis for identifying production inefficiencies and evaluating their economic consequences.

Recent research provides evidence supporting the usefulness of each approach independently. Wang and Simarmata (2024) demonstrate that activity-based costing can provide detailed information for identifying and allocating resource and activity costs, while Usul and Olgun (2025) demonstrate that MFCA can quantify material losses and their associated costs within different cost accounting environments. Dierkes and Siepelmeyer (2025) further show that MFCA can provide differentiated information about various forms of material inefficiency, including waste, rejects, rework, and recycling.

The integration of ABC and MFCA is particularly relevant when material losses generate costs beyond the direct value of the materials lost. A material loss may also involve labor time, machine usage, energy consumption, quality-control activities, packaging resources, and other activity-related costs. ABC can identify the activities responsible for these resource costs, while MFCA can identify the material losses occurring within the production flow. Consequently, their integration can establish a relationship between resource consumption, production activities, material flows, material losses, and loss costs.

The practical relevance of this integrated perspective is also supported by recent studies conducted in industrial and pharmaceutical contexts. Al-Eqabi (2024) and Dahi and Abdullah (2024) demonstrate the usefulness of MFCA for improving resource efficiency and reducing waste, while Muoneke and Dandago (2024) and Abd et al. (2024) demonstrate the relevance of activity-based approaches to pharmaceutical cost management and production performance. Most importantly for the Iraqi pharmaceutical context, Mohammed Ali (2025) applied MFCA to the General Company for the Manufacture of Medicines and Medical Supplies–Samarra and demonstrated its relevance to material-loss analysis and green supply-chain management.

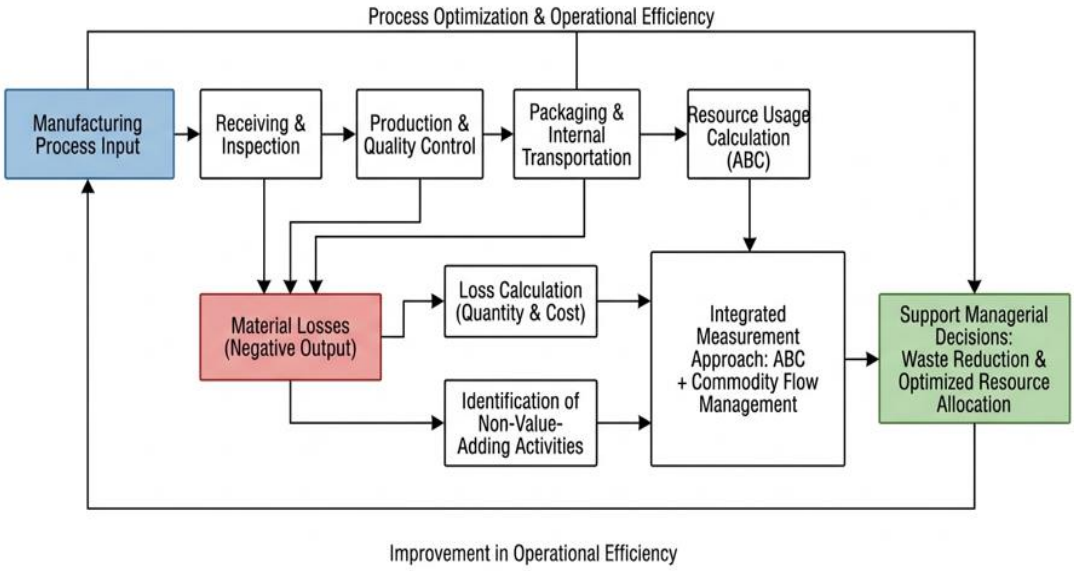
Despite these developments, the reviewed studies primarily examine ABC and MFCA independently rather than establishing a quantitative framework that directly links activity-level costs with material losses and resource allocation efficiency. The present study addresses this issue by integrating the two approaches within a single analytical framework.

The proposed relationship can be represented as follows:

Resources → Activities → Activity Costs → Material Flows → Material Losses → Loss Costs → Resource Reallocation

Under this approach, the analysis does not stop at identifying the quantity of material loss. It also determines the activities associated with the loss and the resources consumed in generating it. This provides management with more detailed information for evaluating production processes and considering alternative resource allocation decisions.

Figure 1: Conceptual Framework for the Integration of ABC and MFCA



Source: Developed by the author based on Al-Eqabi (2024); Dierkes & Siepelmeyer (2025); Mohammed Ali (2025); Usul & Olgun (2025); and Wang & Simarmata (2024).

2.6 Previous Studies

Under this approach, the analysis does not stop at identifying the quantity of material loss. It also determines the activities associated with the loss and the resources consumed in generating it. This provides management with more detailed information for evaluating production processes and considering alternative resource allocation decisions.

Previous studies have examined Activity-Based Costing (ABC) and Material Flow Cost Accounting (MFCA) as tools for improving cost measurement and resource efficiency. Wang and Simarmata (2024) demonstrated the usefulness of ABC in improving resource cost allocation, while Dierkes and Siepelmeyer (2025) showed that MFCA can identify material losses and their associated costs. Usul and Olgun (2025) further examined MFCA under different cost accounting systems and highlighted its role in identifying waste-related costs. In the pharmaceutical industry, Mohammed Ali (2025) applied MFCA to a pharmaceutical company in Samarra, Iraq, focusing on material losses and green supply-chain management.

Table 1. Comparison of Previous Studies and the Current Study

Study	Method	Context	Main Focus	Difference from Current Study
Wang & Simarmata (2024)	ABC	Manufacturing	Resource cost allocation	Does not address material losses
Dierkes & Siepelmeyer (2025)	MFCA	Manufacturing	Waste and material losses	Does not integrate ABC
Usul & Olgun (2025)	MFCA	Manufacturing	Waste costs	Does not focus on pharmaceutical production
Mohammed Ali (2025)	MFCA	Pharmaceutical industry–Iraq	Material losses and green supply chain	Does not integrate ABC
Current Study	**ABC + MFCA**	**Pharmaceutical industry**	**Loss costs and resource allocation efficiency**	**Integrates activity costs with material flows and losses**

Overall, previous studies have mainly applied ABC or MFCA separately. The current study differs by integrating both approaches to link production activities, resource consumption, material losses, and their costs, thereby providing information to support more efficient resource allocation in pharmaceutical manufacturing.

2.7 Research Gap

The review of previous studies indicates that Activity-Based Costing (ABC) and Material Flow Cost Accounting (MFCA) have mainly been applied as separate approaches. ABC provides information on resource consumption and activity costs, whereas MFCA focuses on material flows, losses, and their associated costs.

However, limited attention has been given to integrating these two approaches within a single framework, particularly in the pharmaceutical industry. Existing studies also provide limited measurement of the costs of material losses at the activity level and their relationship with resource allocation efficiency.

Therefore, the current study addresses this gap by integrating ABC with MFCA to identify material losses, determine their associated activity costs, and assess opportunities for improving resource allocation efficiency in pharmaceutical manufacturing.

3. Research Methodology

3.1 Research Design

This study adopts an applied case study design to examine the integration of Activity-Based Costing (ABC) and Material Flow Cost Accounting (MFCA) in the pharmaceutical industry. The study combines quantitative cost and material-flow data to identify material losses, determine their associated costs, and assess resource allocation efficiency.

3.2 Case Study and Data Sources

The study is conducted in a pharmaceutical manufacturing environment. Data are collected from accounting records, production reports, material consumption records, inventory records, quality-control reports, and other relevant operational

documents. The data include material quantities and costs, labor, machine hours, energy consumption, production quantities, and material losses.

3.3 Identification of Production Activities

The main production activities are identified by examining the production process and the resources consumed at each stage. These activities may include material receiving, inspection, storage, production, quality control, packaging, and internal transportation.

3.4 ABC Cost Allocation Procedure

ABC is used to determine the cost of production activities based on the resources consumed by each activity. Appropriate cost drivers are identified for each activity, and activity cost-driver rates are calculated. The costs assigned to products are then determined according to their consumption of the relevant activities.

The basic calculation is:

Cost Driver Rate = Total Activity Cost ÷ Total Cost Driver Quantity

3.5 Material Flow Measurement

MFCA is used to trace the physical movement of materials through the production process. For each production stage, material inputs are compared with positive outputs and negative outputs. Negative outputs include waste, rejects, defects, and other material losses.

3.6 Measurement of Loss Costs

The cost of material losses is determined by combining the quantity of losses with their relevant material and process costs. The analysis also links these losses to the activities where they occur, allowing the study to identify the activities associated with the highest loss costs.

3.7 Integrated ABC–MFCA Model

The proposed model integrates the cost information generated by ABC with the physical-flow information generated by MFCA. The relationship can be represented as:

Resources → Activities → Activity Costs → Material Flows → Material Losses → Loss Costs → Resource Allocation

This integration enables the study to identify not only the quantity of material losses but also the activities and resources associated with those losses.

3.8 Resource Allocation Efficiency Measurement

Resource allocation efficiency is assessed by examining the proportion of resources consumed by value-adding and non-value-adding activities. The study compares the existing allocation of resources with the allocation proposed after identifying significant losses and inefficient activities.

A proposed indicator is:

Resource Allocation Efficiency = Resources Used in Value-Adding Activities ÷ Total Resources Used × 100

This indicator is used as an analytical measure within the study rather than as a universally established accounting standard.

3.9 Data Analysis and Scenario Comparison

The analysis compares the existing cost and resource allocation system with the proposed integrated ABC–MFCA approach. The comparison focuses on activity costs, material-loss quantities, loss costs, resource utilization, and resource allocation efficiency.

Two main scenarios are considered:

- **Current Scenario:** Existing cost and resource allocation practices.
- **Proposed Scenario:** Allocation based on the information generated by the integrated ABC–MFCA approach.

The results are used to identify potential opportunities for reducing material losses and improving resource allocation efficiency.

4. Results and Analysis

4.1 Production and Cost Data

The analysis is based on the production and cost data presented in Table 2. The data include production quantities, material consumption, labor, machinery, energy, quality control, packaging, and other production costs.

Table 2. Production and Cost Data

Item	Value
Production batches	20 batches
Planned production	200,000 units
Actual good output	188,000 units
Material input	12,000 kg
Material cost	$96,000
Direct labor cost	$42,000
Machine cost	$28,000
Energy cost	$14,000
Quality-control cost	$10,000
Packaging cost	$18,000
Other production costs	$12,000
Total production costs	**$220,000**

Interpretation: Table 2 presents the main production and cost data used in the analysis. Total production costs amount to **$220,000**.

For the ABC analysis, **$170,000** of the total production costs are allocated to the selected activity-cost pools presented in Table 3. The remaining **$50,000** are treated as common and unallocated production costs that are not assigned through the selected activity cost drivers. Accordingly, the subsequent ABC-based analysis and resource allocation calculations are based on the **$170,000 activity-cost pool**, while the total production cost remains **$220,000**.

The difference between planned production and actual good output indicates the presence of losses and non-conforming output, which are further analyzed using MFCA and linked to activity costs through ABC.

4.2 Activity Costs under ABC

Table 3. Costs Allocated to the Selected ABC Activity Pools

Activity	Activity Cost ($)	Cost Driver	Driver Quantity
Material receiving	8,000	Shipments	40
Material inspection	12,000	Tests	200
Storage	10,000	Storage-days	1,000
Production	82,000	Machine hours	4,000
Quality control	20,000	Tests/batches	300
Packaging	28,000	Units	200,000
Internal transportation	10,000	Material movements	500
Total costs allocated to selected ABC activity pools	**170,000**	—	—
Common and unallocated production costs	**50,000**	—	—
Total production costs	**220,000**	—	—

Note. Total production costs amount to $220,000, as reported in Table 2. For the purposes of the ABC analysis, $170,000 is allocated to the selected activity-cost pools shown above. The remaining $50,000 is treated in this study as common and unallocated production costs that are not assigned through the selected activity cost drivers. Accordingly, subsequent ABC-based resource-allocation calculations are based on the $170,000 activity-cost pool.

Interpretation: Table 3 shows the costs assigned to the main production activities. Production represents the largest activity cost, followed by packaging and quality control. This information provides a basis for identifying activities with relatively high resource consumption.

The reconciliation presented in Table 3 explains the difference between the total production costs of $220,000 reported in Table 2 and the $170,000 allocated through the selected ABC activity-cost pools. The remaining $50,000 is retained outside the activity-cost allocation base used in the subsequent ABC analysis.

4.3 Material Flow Analysis

Table 4. Material Flow Analysis

Production Stage	Input (kg)	Positive Output (kg)	Negative Output (kg)	Loss Rate
Material preparation	12,000	11,700	300	2.50%
Production	11,700	11,150	550	4.70%
Quality control	11,150	10,950	200	1.79%
Packaging	10,950	10,800	150	1.37%
Total	**12,000**	**10,800**	**1,200**	**10.00%**

Interpretation: Table 4 traces the movement of materials through the main production stages. Total material losses amount to 1,200 kg, representing 10% of

total material input. The production stage records the highest quantity of material loss.

4.4 Measurement of Material Loss Costs

Table 5. Material Loss Costs by Production Stage

Production Stage	Loss (kg)	Material Cost ($)	Process Cost ($)	Total Loss Cost ($)
Material preparation	300	2,400	1,000	3,400
Production	550	4,400	7,000	11,400
Quality control	200	1,600	2,000	3,600
Packaging	150	1,200	1,500	2,700
Total	**1,200**	**9,600**	**11,500**	**21,100**

Interpretation: Table 5 converts material losses into monetary values. The total cost of material losses is $21,100. The production stage accounts for the largest share of loss costs, with $11,400, indicating that this stage requires particular attention in the resource improvement process.

4.5 Integration of ABC and MFCA

Table 6. Integrated ABC–MFCA Analysis Based on the Selected ABC Activity-Cost Pool

Activity	Activity Cost ($)	Loss Cost ($)	Loss Cost / Activity Cost
Material receiving	8,000	1,200	15.0%
Material inspection	12,000	2,000	16.7%
Storage	10,000	200	2.0%
Production	82,000	11,400	13.9%
Quality control	20,000	3,600	18.0%
Packaging	28,000	2,700	9.6%
Internal transportation	10,000	0	0.0%
Total	**170,000**	**21,100**	**12.4%**

Note. The activity-cost total of $170,000 corresponds to the selected ABC activity-cost pool identified in Table 3. The remaining $50,000 of total production costs is treated as common and unallocated production costs and is therefore excluded from the activity-level loss-cost ratios presented in this table.

Interpretation: Table 6 demonstrates the integration of activity cost information with material-loss information. Although production has the highest absolute activity cost, quality control records the highest ratio of loss cost to activity cost at 18%. This integration provides more detailed information than analyzing activity costs or material losses separately. The ratios are calculated using only the selected ABC activity-cost pool of $170,000.

4.6 Comparison of Current and Proposed Resource Allocation

Table 7. Comparison of Current and Proposed Scenarios

Indicator	Current Scenario	Proposed Scenario	Change
Material input (kg)	12,000	12,000	—
Material loss (kg)	1,200	960	−240 kg
Loss rate	10.0%	8.0%	−2.0 pp
Loss cost ($)	21,100	16,880	−$4,220
Resources in non-value-adding activities ($)	34,000	27,200	−$6,800
Resource allocation efficiency	80.0%	84.0%	+4.0 pp

Note. Resource allocation efficiency is calculated using the $170,000 selected ABC activity-cost pool as the denominator. The $50,000 of common and unallocated production costs is excluded from this study-specific efficiency measure.

Interpretation: Table 7 compares the current allocation of resources with the proposed allocation based on the integrated ABC–MFCA approach. The results indicate a reduction in material losses and loss costs, together with an improvement in resource allocation efficiency within the selected ABC activity-cost pool. Material losses decrease from 1,200 kg to 960 kg, while the loss cost decreases from $21,100 to $16,880. Resource allocation efficiency increases from 80.0% to 84.0%, based on the $170,000 activity-cost pool used in the ABC analysis.

4.7 Summary of Results

Table 8. Summary of Results

Measure	**Current**	**Proposed**	**Change**
Material loss	1,200 kg	960 kg	-240 kg
Loss cost	$21,100	$16,880	-$4,220
Non-value-adding resources	$34,000	$27,200	-$6,800
Resource allocation efficiency	80.0%	84.0%	+4.0 pp

Note. The resource allocation efficiency values are calculated relative to the $170,000 selected ABC activity-cost pool and do not use the total production cost of $220,000 as the denominator.

Interpretation: Table 8 summarizes the main results of the analysis. The integrated ABC–MFCA approach provides information that links production activities, resource consumption, material flows, and material losses. The results indicate that identifying activity-level loss costs can provide a basis for reducing avoidable losses and improving resource allocation efficiency.

5. Conclusions and Recommendations

5.1 Conclusions

This study examined the integration of Activity-Based Costing (ABC) and Material Flow Cost Accounting (MFCA) as an approach for reducing material losses and improving resource allocation efficiency in the pharmaceutical industry.

The findings indicate that ABC provides detailed information about the costs of individual production activities and the resources consumed by those activities. The analysis showed differences in resource consumption across production activities, with production, packaging, and quality control representing major areas of resource consumption. This information provides management with a clearer understanding of where production resources are being consumed.

The MFCA analysis identified material losses at different stages of the production process. Total material losses amounted to 1,200 kg from a total material input of 12,000 kg, representing a loss rate of 10%. The production stage recorded the largest material loss, indicating that this stage requires particular attention when evaluating production efficiency and opportunities for loss reduction.

The analysis also demonstrated that material losses generate costs beyond the direct cost of the lost materials. The total cost associated with material losses reached $21,100, including material and process-related costs. This confirms the importance of considering both physical material losses and their economic consequences when evaluating production efficiency.

The integration of ABC and MFCA provided a more comprehensive view of production costs and material losses. ABC identified the activities responsible for resource consumption, while MFCA identified material flows and losses. Combining the two approaches allowed activity-level information to be connected with material losses and their associated costs.

The comparison between the current and proposed resource allocation scenarios indicated that material losses could be reduced from 1,200 kg to 960 kg, while material loss costs could decrease from $21,100 to $16,880. Non-value-adding resource consumption was also reduced from $34,000 to $27,200. Based on the defined resource allocation efficiency measure and the selected ABC activity-cost pool of $170,000, efficiency increased from 80.0% to 84.0%.

The remaining $50,000 of total production costs was treated as common and unallocated production costs and was therefore excluded from the study-specific resource allocation efficiency calculation.

Accordingly, the study concludes that the integration of ABC and MFCA can provide useful managerial information for identifying inefficient activities, measuring material losses, determining loss-related costs, and supporting more informed resource allocation decisions in pharmaceutical manufacturing.

5.2 Contributions of the Study

The study provides several contributions to cost accounting and resource management.

First, it contributes theoretically by integrating two complementary accounting perspectives within a single analytical framework. ABC provides a cost and activity perspective, whereas MFCA provides a physical material-flow perspective. Their integration creates a framework that connects resources, activities, material flows, losses, and costs.

Second, the study provides a methodological contribution by proposing a sequence for measuring activity costs, material flows, material losses, loss costs,

and resource allocation efficiency. This approach can provide a structured basis for analyzing production inefficiencies.

Third, the study provides a managerial contribution by demonstrating how accounting information can be used to identify activities associated with high resource consumption and material losses. Such information can support management decisions concerning process improvement, cost control, and resource allocation.

Finally, the study contributes to the applied literature on pharmaceutical manufacturing by examining an integrated cost and material-flow approach within a production environment characterized by multiple activities, material inputs, quality-control requirements, and potential material losses.

5.3 Recommendations

Based on the findings of the study, the following recommendations are proposed:

1. Adoption of an Integrated ABC–MFCA Information Framework

Pharmaceutical manufacturing organizations should consider integrating activity-based cost information with material-flow information to obtain a more comprehensive view of production costs and material losses.

2. Regular Measurement of Material Losses

Material losses should be measured periodically at each major production stage rather than only at the aggregate production level. This can help identify changes in loss patterns and facilitate timely corrective actions.

3. Identification of Loss-Generating Activities

Management should identify the activities associated with significant material losses and investigate the operational causes of these losses. Particular attention should be directed toward production stages with relatively high loss quantities and loss costs.

4. Linking Loss Costs to Production Activities

The costs of material losses should be linked to the activities in which they occur. This can provide more accurate information for evaluating the economic consequences of inefficient processes.

5. Improving Resource Allocation

Resources should be reviewed according to their contribution to value-adding activities. Where excessive consumption is identified, management should evaluate opportunities to reallocate resources toward activities that contribute more directly to production objectives.

6. Strengthening Production and Quality Controls

Production and quality-control procedures should be continuously reviewed to identify sources of defects, rejected materials, reprocessing, and other forms of material loss. Preventive controls may reduce losses before they generate additional costs.

7. Developing Management Performance Indicators

Management should establish indicators that combine financial and physical information, such as material loss rate, loss cost, activity cost, resource utilization,

and resource allocation efficiency. These indicators can support continuous performance monitoring.

8. Integrating Accounting and Production Information

Accounting departments should cooperate closely with production, inventory, quality-control, and engineering departments. Integrating information from these functions can improve the accuracy of activity costs and material-flow measurements.

9. Supporting Continuous Improvement

The results generated by ABC and MFCA should be incorporated into continuous improvement programs. Management can use the information to prioritize activities requiring process redesign, waste reduction, resource optimization, or improved operational controls.

10. Employee Training

Employees involved in accounting, production, quality control, inventory management, and process supervision should receive appropriate training in activity-based costing and material-flow analysis. This can improve the quality of data collection and facilitate implementation of the integrated approach.

5.4 Limitations of the Study

The study has several limitations that should be considered when interpreting its findings.

First, the analysis focuses on a pharmaceutical manufacturing environment, and therefore the results may not be directly generalizable to all industries with different production structures and cost characteristics.

Second, the analysis depends on the availability and accuracy of accounting, production, material consumption, and loss data. Differences in data quality may affect the accuracy of activity-cost allocation and material-flow measurements.

Third, the resource allocation efficiency indicator used in this study is an analytical measure developed for evaluating the relationship between resources assigned to value-adding activities and total resources consumed. It should therefore be interpreted as a study-specific performance measure rather than as a universally established accounting standard.

In addition, the ABC analysis is based on a selected activity-cost pool of $170,000 out of total production costs of $220,000. The remaining $50,000 is treated as common and unallocated production costs because it is not assigned through the selected activity cost drivers. Consequently, the resource allocation efficiency indicator should be interpreted in relation to the selected ABC activity-cost pool rather than total production costs.

Finally, the proposed framework focuses primarily on cost and material-flow dimensions. Other factors, such as environmental impacts, product quality, customer requirements, and operational risk, may also influence resource allocation decisions and could be incorporated into future research.

5.5 Suggestions for Future Research

Future studies could extend this research in several directions.

First, future research could apply the integrated ABC–MFCA framework to multiple pharmaceutical companies to examine whether similar patterns of material losses and resource consumption are observed across different organizations.

Second, future studies could incorporate environmental costs and carbon-related information into the integrated framework to provide a broader assessment of economic and environmental performance.

Third, researchers could combine ABC–MFCA with other management accounting techniques, such as Time-Driven Activity-Based Costing, Resource Consumption Accounting, or Target Costing, to examine whether additional information can improve resource allocation decisions.

Fourth, future research could develop digital systems for automatically collecting material-flow and activity-cost information from enterprise resource planning and production-monitoring systems.

Finally, future studies could examine the long-term effects of implementing ABC–MFCA on production costs, material efficiency, waste reduction, and organizational performance using longitudinal data.

5.6 Final Conclusion

The study concludes that integrating Activity-Based Costing with Material Flow Cost Accounting provides a useful framework for connecting financial and physical information within pharmaceutical manufacturing. ABC identifies the costs of production activities and the resources they consume, while MFCA identifies material flows, losses, and their associated costs.

The integrated approach makes it possible to trace the relationship between resources, activities, material flows, losses, and costs. This information can support management in identifying inefficient production stages, reducing avoidable material losses, controlling loss-related costs, and improving the allocation of available resources.

Therefore, the main contribution of the study is the development of an integrated analytical framework that moves beyond conventional cost measurement by linking activity-level costs with material-flow losses and resource allocation decisions. This framework can provide a practical basis for improving cost management and resource utilization in pharmaceutical manufacturing.

The resource allocation efficiency results reported in this study are based specifically on the selected ABC activity-cost pool of $170,000 and should not be interpreted as efficiency measures based on the full production cost of $220,000.

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NICOTIANA TABACUM L.: MORPHOLOGICAL, PHYTOCHEMICAL, AND MICROSCOPIC CHARACTERIZATION OF LEAVES AND STEMS

Abstract: *Nicotiana tabacum L., commonly known as cultivated tobacco, is an annual plant of the Solanaceae family that is widely cultivated for commercial tobacco production. This study provides a comprehensive overview of the morphological, phytochemical, and microscopic characteristics of N. tabacum leaves and stems, with particular attention to the composition of biologically active compounds and the potential utilization of post-harvest tobacco residues. The plant is characterized by large leaves, branched inflorescences, bicollateral vascular bundles, glandular and non-glandular trichomes, and calcium oxalate crystals (cystoliths). Phytochemical analysis demonstrated the presence of nicotine, phenolic compounds, polysaccharides, amino acids, and various alkaloids. The concentration of nicotine varied according to the developmental stage and plant organ. Extraction of post-harvest tobacco residues using conventional solvents and Natural Deep Eutectic Solvents (NaDES) demonstrated the potential of these materials as a source of bioactive compounds. NaDES-based extraction resulted in higher phenolic contents than some conventional extraction systems, while selected extracts exhibited considerable alkaloid concentrations and antioxidant activity. The findings indicate that morphological and microscopic characteristics can be used for the identification of N. tabacum tissues, while the phytochemical composition of tobacco residues highlights their potential for sustainable biomass utilization and the development of value-added applications.*

Keywords: *Nicotiana tabacum L., tobacco, morphology, phytochemicals, alkaloids, nicotine, phenolic compounds, microscopic characteristics, Natural Deep Eutectic Solvents, antioxidant activity, tobacco biomass.*

INTRODUCTION

Nicotiana tabacum L. is an annual plant belonging to the Solanaceae family and is one of the most widely cultivated species of the genus *Nicotiana*. The plant is grown primarily for the production of tobacco and related commercial products.

Under suitable conditions, *N. tabacum* can reach a height of approximately 1–3 m and develops a thick, relatively sparsely branched stem with large oval, elliptic, or obovate leaves. The origin of cultivated tobacco is generally associated with hybridization events involving several *Nicotiana* species, particularly *N. sylvestris* and *N. tomentosiformis*, with possible contribution from *N. otophora*. The species has subsequently undergone extensive cultivation and selection, resulting in numerous cultivated varieties. Tobacco cultivation and processing generate considerable quantities of post-harvest biomass, including leaves, stems, and other plant residues. The accumulation and disposal of these residues may create environmental concerns and represents a challenge for sustainable agricultural production. At the same time, tobacco biomass contains a wide range of biologically active compounds that may be recovered and utilized for alternative purposes.

The investigation of the morphological, phytochemical, and microscopic characteristics of *N. tabacum* is therefore important not only for botanical identification but also for evaluating the potential of tobacco residues as a source of valuable bioactive compounds. In particular, the application of environmentally oriented extraction technologies, such as Natural Deep Eutectic Solvents (NaDES), may provide opportunities for the more sustainable utilization of tobacco biomass.

The aim of this study was to characterize the morphological, phytochemical, and microscopic features of *N. tabacum* leaves and stems and to evaluate the potential of conventional and NaDES-based extraction systems for recovering biologically active compounds from post-harvest tobacco residues.

MATERIALS AND METHODS

Plant material consisted of *Nicotiana tabacum* L. var. Virginia cultivated under controlled conditions. Leaves and stems were collected at different developmental stages for morphological, phytochemical, and microscopic examination. Post-harvest tobacco residues were obtained during topping and tobacco-processing operations. Morphological characteristics, including plant height, stem structure, leaf size and shape, inflorescence characteristics, flower coloration, and fruit morphology, were examined and documented. For phytochemical analysis, tobacco leaf and stem residues were extracted using conventional solvents, including water, acetone, and ethanol, as well as Natural Deep Eutectic Solvents (NaDES). The NaDES systems investigated included LAS, FGS, SALA, CU, and CAP.

The obtained extracts were analyzed for their contents of alkaloids and phenolic compounds. Sugar concentrations and antioxidant activity were also evaluated. Antioxidant activity was determined using ABTS and hydrogen peroxide (H_2O_2) scavenging assays. For microscopic analysis, fresh and dried leaf and stem samples, together with finely powdered plant material, were examined using light microscopy. The investigated anatomical characteristics included epidermal cell morphology, stomatal type, vascular bundle structure, trichome characteristics, mesophyll organization, cortical and medullary tissues, and the presence of calcium oxalate crystals (cystoliths).

RESULTS OF THE STUDY

The morphological examination showed that *Nicotiana tabacum* plants reached approximately 1–3 m in height and developed thick, relatively sparsely branched stems. The leaves were large, with lengths of up to approximately 50 cm, and exhibited oval, elliptic, or obovate shapes. The flowers were arranged in panicles and ranged in coloration from white to pink or red. The fruit was a capsule with a narrow elliptic to ovoid shape and a length of approximately 1.5–2 cm.

Phytochemical analysis demonstrated that nicotine was a major alkaloid component of *N. tabacum*. Its distribution varied among plant organs, with the highest proportion reported in leaves, followed by stems, roots, and flowers. Nicotine content also increased with plant maturity. In addition to nicotine, the plant contained polysaccharides, phenolic compounds, amino acids, and several classes of alkaloids. Among the identified phenolic compounds were rutin and chlorogenic acid, while amino acids included glutamine, asparagine, and γ-aminobutyric acid (GABA). The phytochemical profile also included pyridine- and indole-related alkaloid compounds. Megastigmatrienone was identified as an important volatile aromatic compound associated with the characteristic fragrance of tobacco. The extraction experiments demonstrated differences in the efficiency of conventional solvents and NaDES systems. NaDES extracts exhibited comparatively high phenolic contents, with values ranging from 18.13 to 21.98 mg AGE/g of tobacco powder. Among the tested systems, CU and FGS, together with acetone/ethanol extracts, demonstrated relatively high alkaloid concentrations, ranging from 6.37 to 11.23 mg ACE/g of tobacco powder. The obtained extracts also demonstrated antioxidant activity in ABTS and H_2O_2 scavenging assays, indicating the presence of compounds capable of contributing to antioxidant activity. These findings support the potential of post-harvest tobacco residues as a source of biologically active metabolites. Microscopic examination revealed characteristic anatomical features of *N. tabacum*. Leaf and stem tissues contained bicollateral vascular bundles, glandular and multicellular non-glandular trichomes, and calcium oxalate crystals (cystoliths). The leaves contained approximately 6–9 glandular trichomes in the examined microscopic fields. Epidermal cells exhibited sinuous anticlinal walls, while the stomata were predominantly anomocytic.

Mature leaves contained abundant cystoliths within the mesophyll. Cross-sections of stems revealed elongated cortical parenchyma, medullary parenchyma, fibers, and vascular bundles. Similar anatomical characteristics could be identified in powdered plant material, although epidermal fragments were less frequently observed. The combination of morphological, phytochemical, and microscopic characteristics provides reliable criteria for the identification and characterization of *N. tabacum* leaves and stems. The presence of characteristic epidermal structures, trichomes, cystoliths, and bicollateral vascular bundles is particularly useful for anatomical identification. The results further indicate that post-harvest tobacco residues contain compounds of potential industrial interest. The use of NaDES provides an alternative extraction approach that can facilitate the recovery of phenolic and alkaloid compounds while supporting more sustainable utilization of

plant-derived biomass. However, further studies are required to determine the safety, biological activity, stability, and practical applicability of the resulting extracts before their use in cosmetic, pharmaceutical, or other applications.

CONCLUSION

Nicotiana tabacum L. is a morphologically and chemically complex plant characterized by distinctive anatomical structures and a diverse phytochemical composition. Its leaves and stems contain biologically active compounds, including nicotine, phenolic compounds, polysaccharides, amino acids, and different classes of alkaloids. Microscopic analysis revealed characteristic diagnostic features, including bicollateral vascular bundles, glandular and non-glandular trichomes, sinuous anticlinal epidermal walls, anomocytic stomata, and calcium oxalate crystals. These characteristics can be used for the reliable identification of tobacco tissues, including powdered plant material.

The phytochemical analysis demonstrated that post-harvest tobacco residues contain compounds with antioxidant and other biologically relevant properties. Extraction using Natural Deep Eutectic Solvents showed promising potential for recovering phenolic and alkaloid compounds from tobacco biomass. Therefore, the valorization of tobacco residues through environmentally oriented extraction technologies may contribute to the sustainable utilization of agricultural biomass and the development of value-added applications.Further research is necessary to establish the safety, biological efficacy, chemical stability, and technological feasibility of the obtained extracts before their potential application in cosmetic, pharmaceutical, or other industrial fields.

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QORAQALPOG‘ISTON SHAROITIDA HYPOTHTALMICHTHYS MOLITRIX VA CTENOPHARYNGODON IDELLA BALIQLARIDAN BALIQCHILIK XO‘JALIKLARIDA FOYDALANISH ISTIQBOLLARI

Annotatsiya. *Ushbu maqolada Qoraqalpog‘iston Respublikasining keskin kontinental iqlimi va sho‘rlangan suv resurslari sharoitida Oq amur (Ctenopharyngodon idella) va Oq do‘ngpeshana (Hypophthalmichthys molitrix) baliq turlarini polikultura usulida yetishtirishning biologik va iqtisodiy samaradorligi tahlil qilingan.*

Kalit so‘zlar. *baliqchilik, polikultura, Ctenopharyngodon idella, Hypophthalmichthys molitrix, biomelioratsiya, kontinental, suv bioresurslari.*

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PERSPECTIVES FOR THE USE OF *HYPOTHALMICTHYS MOLITRIX* AND *CTENOPHARYNGODON IDELLA* IN FISH FARMS UNDER THE CONDITIONS OF KARAKALPAKSTAN

Abstract. *This paper analyzes the biological and economic efficiency of polyculture farming of grass carp (Ctenopharyngodon idella) and silver carp (Hypophthalmichthys molitrix) under the conditions of a sharp continental climate and brackish water resources in the Republic of Karakalpakstan.*

Keywords. *fish farming,polyculture, Ctenopharyngodon idella, Hypophthalmichthys molitrix, biological amelioration, continental climate, aquatic bioresources.*

Dolzarbligi: Bugungi kunda dunyo aholisi sonining ortib borishi oziq-ovqat mahsulotlariga bo‘lgan talabni keskin oshirmoqda. Ayniqsa, oqsilga boy mahsulotlar ishlab chiqarish muhim ahamiyat kasb etmoqda. Baliq mahsulotlari biologik qiymati yuqori bo‘lgan oziq-ovqat manbai sifatida inson salomatligi uchun muhim hisoblanadi. Shu sababli suv bioresurslaridan samarali foydalanish, baliqchilik xo‘jaliklarini rivojlantirish va yuqori mahsuldor baliq turlarini yetishtirish dolzarb masalalardan biridir.

Qoraqalpog‘iston Respublikasida oziq-ovqat xavfsizligini ta’minlash hamda suv resurslaridan samarali foydalanish dolzarb masalalardan biridir. Mintaqaning keskin kontinental iqlimi, yozgi yuqori harorat va suv resurslarining sho‘rlanish darajasi ortib borayotgani baliqchilik xo‘jaliklarida chidamli va tez o‘suvchi baliq turlarini yetishtirishni talab etadi. Ushbu sharoitda o‘simlikxo‘r baliqlar-Oq

do‘ngpeshana (Hypophthalmichthys molitrix) va Oq amur (Ctenopharyngodon idella) turlarini polikultura (aralash) usulida yetishtirish yuqori samara beradi.

O‘simlikxo‘r baliqlar guruhiga kiruvchi oq do‘ngpeshona (Hypophthalmichthys molitrix) va oq amur (Ctenopharyngodon idella) baliqlari yuqori o‘sish tezligi, ekologik moslashuvchanligi va oziq resurslaridan samarali foydalanish xususiyatlari bilan baliqchilik xo‘jaliklari uchun istiqbolli obyekt hisoblanadi.

Oq do‘ngpeshona karpsimonlar oilasiga mansub bo‘lib, tabiiy areali Sharqiy Osiyo hisoblanadi. Hozirgi kunda u ko‘plab mamlakatlarda introduksiya qilingan va sun’iy ko‘paytirish orqali yetishtirilmoqda. Oq do‘ngpeshona (H. molitrix): Asosan fitoplankton (mikroskopik suv o‘tlari) bilan oziqlanadi. Uning g‘alvirsimon jabra apparati suvni filtrlash imkonini beradi. Bu suvning "gullashi" (evtrofikatsiya) ning oldini oladi.

Oq amur esa karpsimonlar oilasiga mansub bo‘lib, suv o‘simliklari bilan oziqlanishi sababli meliorativ ahamiyatga ega. . Oq amur (C. idella) "Suv sigiri" deb ham yuritiladi. U yuksak suv o‘simliklari (qamish, elodeya va b.) bilan oziqlanadi. Kuniga o‘z vaznining 50-100% miqdorigacha o‘simlik iste’mol qilishi mumkin. Oq amur o‘simliklarni iste’mol qilib, ularni chala hazm bo‘lgan holda ekskrement (go‘ng) sifatida suvga chiqaradi. Bu moddalar fitoplankton (oq do‘ngpeshona uchun ozuqa) rivojlanishiga o‘g‘it bo‘ladi.

Ushbu baliqlarni yetishtirish bir necha yo‘nalishda katta iqtisodiy samaradorlik beradi:

1. POLIKULTURA TIZIMIDA FOYDALANISH. OQ AMUR VA OQ DO‘NGPESHONA BOSHQA KARP BALIQLARI BILAN BIRGALIKDA PARVARISH QILINADI. BU HOLATDA:

- Oziqa resurslari to‘liq o‘zlashtiriladi
- Suv havzasi ekologik barqarorligi oshadi
- Mahsuldorlik ortadi

Polikultura tizimi natijasida 1 gektar suv havzasidan olinadigan baliq hosildorligi sezilarli oshadi. Monokulturasida yetishtirilgan nazorat hovuzlariga nisbatan polykultura hovuzlarida mahsuldorlik 28,5% ga yuqori bo‘lib, har gektardan olingan sof baliq mahsuloti 18,2 kg/ga 1820 kg/ga) ni tashkil etdi.Sun’iy qo‘shimcha ozuqa va hovuzlarni mexanik tozalash xarajatlari mos ravishda 32% va 45% ga tejaladi.

1-jadval

Ko‘rsatkichlar	Monokultura (Nazorat)	Polykultura (C. idella + H. molitrix)
Zichlik (dona/ga)	1200	1650 (350 amur + 1300 do‘ngpeshana)
Yashovchanlik (%)	78,5%	88,8%
O‘rtacha oxirgi vazn (g)	550 g	amur: 980 g / do‘ngpeshana: 720 g
Umumiy mahsuldorlik (kg/ga)	1250 kg/ga	1820 kg/ga
Suv o‘simliklari bilan qoplanishi	60–70%	15–20%

2. Meliorativ ahamiyati. Oq amur suv o‘simliklarini iste’mol qilib,kanallarni tozalaydi,suv o‘tkazuvchanligini yaxshilaydi va botqoqlanishni kamaytiradi.

Oq do‘ngpeshona esa fitoplanktonni kamaytirib,suv gullashining oldini oladi va kislorod rejimini yaxshilaydi.

3. TEZ O‘SISHI VA MAHSULDORLIGI

Ushbu baliqlar qulay sharoitda:

- 1 yilda 800–1200 g
- 2 yilda 2–3 kg
- 3 yilda 4–5 kg gacha yetishi mumkin

Bu esa xo‘jalik uchun iqtisodiy foydani oshiradi. Hovuzlarda polikultura usulda baliq boqish bo‘yicha quyidagi tavsiyaviy jadvalni foydalanishingiz mumkin. (1 gektar maydon uchun)

2-jadval

Baliq turi	Ulushi (%)	Soni (dona/ga)	Vazifasi
Oq do‘ngpeshona	60-70%	1500-2000	Suvni "gullash"dan saqlash, fitoplanktonni filtrlash
Oq amur	15-20%	400-600	Makrofitlarni (qamish, o‘t) yo‘qotish
Sazan (Karp)	10-15%	300-500	Suvdagi mikroorganizmlar va qoldiq yemni iste'mol qilish

4. OZIQ-OVQAT XAVFSIZLIGI UCHUN AHAMIYATI

Ushbu baliqlar yuqori oqsil manbai, parhez mahsulot,omega yog‘ kislotalarga boy hisoblanadi.

Sun’iy ko‘paytirish istiqbollari

Hozirgi vaqtda ushbu baliqlarni sun’iy ko‘paytirish texnologiyasi yaxshi o‘zlashtirilgan.

Xulosa. Qoraqalpog‘iston baliqchilik xo‘jaliklarida Hypophthalmichthys molitrix va Ctenopharyngodon idella turlarini kompleks yetishtirish suv havzalarining ekologik holatini yaxshilash bilan birga, arzon va sifatli oqsil mahsuloti yetishtirish hajmini oshirishning eng istiqbolli yo‘nalishlaridan biridir.Bu texnologiya baliqchilik xo‘jaliklarining barqaror rivojlanishini ta’minlaydi.

Qoraqalpog‘iston suv havzalari ushbu baliqlarni yetishtirish uchun juda qulay hisoblanadi. Sababi hududtagi iliq iqlim,oziqa bazasi mavjud,sug‘orish kanallari ko‘pligi, sun’iy suv omborlari mavjudligi baliqchilikta katta ahamiyatga ega.

Ayniqsa: Amudaryo havzasi ko‘llari,kollektorlari va fermer xo‘jaliklari katta imkoniyat yaratadi. Kelajakda intensiv texnologiyalarni joriy etish,seleksiya ishlarini rivojlantirish,sun’iy ko‘paytirishni takomillashtirish va polikultura tizimini kengaytirish ushbu sohaning rivojlanishida muhim omil bo‘ladi.

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O‘ZBEKISTON RESPUBLIKASIDA ELEKTRON TIJORAT RIVOJLANISHI: IQTISODIY OMILLAR, LOGISTIKA MENEJMENTI VA RAQAMLI MARKETING VOSITALARINING INTEGRATSIYASI

Annotatsiya: *Ushbu maqolada O‘zbekiston Respublikasida elektron tijoratning rivojlanish tendensiyalari, unga ta’sir etuvchi iqtisodiy omillar, logistika menejmentining ahamiyati va raqamli marketing vositalaridan kompleks foydalanish masalalari tahlil qilingan. Elektron savdo ekotizimini shakllantirishda internet infratuzilmasi, raqamli to‘lovlar, aholi daromadlari, iste’molchilar ishonchi, ombor va yetkazib berish tizimlari hamda ma’lumotlarga asoslangan marketingning o‘rni ochib berilgan. Shuningdek, elektron tijorat sub’ektlarining raqobatbardoshligini oshirish uchun iqtisodiy, logistik va marketing jarayonlarini yagona axborot tizimida integratsiya qilish bo‘yicha amaliy takliflar ishlab chiqilgan.*

Kalit so‘zlar: *elektron tijorat, raqamli iqtisodiyot, marketpleys, logistika menejmenti, raqamli marketing, elektron to‘lov, CRM, omnikanal savdo, last-mile delivery, iste’molchi xulq-atvori.*

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DEVELOPMENT OF E-COMMERCE IN THE REPUBLIC OF UZBEKISTAN: INTEGRATION OF ECONOMIC FACTORS, LOGISTICS MANAGEMENT AND DIGITAL MARKETING TOOLS

Annotation. *This article analyzes the development trends of e-commerce in the Republic of Uzbekistan, the economic factors influencing its development, the importance of logistics management, and the integrated use of digital marketing tools. It examines the role of Internet infrastructure, digital payments, household incomes, consumer trust, warehousing and delivery systems, and data-driven marketing in the formation of an e-commerce ecosystem. The article also develops practical recommendations for integrating economic, logistics, and marketing processes into a unified information system in order to enhance the competitiveness of e-commerce businesses.*

Key words: *e-commerce, digital economy, marketplace, logistics management, digital marketing, electronic payments, CRM, omnichannel retail, last-mile delivery, consumer behavior.*

Raqamli texnologiyalarning jadal rivojlanishi ishlab chiqaruvchi, sotuvchi va iste’molchi o‘rtasidagi munosabatlarni yangi bosqichga olib chiqmoqda. Elektron tijorat endi faqat internet orqali tovar sotish usuli emas, balki to‘lov, ombor, transport, marketing, mijozlar bilan ishlash va ma’lumotlarni tahlil qilish jarayonlarini birlashtiruvchi kompleks iqtisodiy ekotizim hisoblanadi.

O‘zbekistonda internetdan foydalanuvchilar sonining ortishi, smartfonlar ommalashuvi, bank va to‘lov xizmatlarining raqamlashuvi, mahalliy marketpleyslar rivojlanishi elektron savdoning kengayishiga sharoit yaratdi. Milliy statistika qo‘mitasining SIAT tizimida elektron tijorat savdo hajmi 2020 yilda 1 002,5 mlrd so‘m, 2024 yilda 15 211,5 mlrd so‘m, 2025 yilda esa 31 551,9 mlrd so‘m sifatida qayd etilgan. Ko‘rsatkichlarning mazmuni va hisoblash metodologiyasini inobatga olgan holda, bu ma’lumotlar sohada yuqori o‘sish dinamikasi mavjudligini ko‘rsatadi.

Shu bilan birga, elektron tijoratning barqaror rivojlanishi faqat raqamli savdo maydonchalarini ko‘paytirish bilan ta’minlanmaydi. Bunda makroiqtisodiy barqarorlik, aholi xarid qobiliyati, samarali logistika, xavfsiz to‘lov infratuzilmasi va maqsadli raqamli marketing o‘zaro muvofiq ishlashi zarur.

O‘zbekiston elektron tijorat bozorining o‘sishi, birinchi navbatda, iqtisodiyot va iste’molning raqamlashuvi bilan bog‘liq. Internetga kirish imkoniyatlarining kengayishi sotuvchilarga geografik chegaralardan tashqarida faoliyat yuritish, xaridorlarga esa tovarlarni masofadan taqqoslash va buyurtma qilish imkonini beradi.

Elektron tijorat rivojiga ta’sir qiluvchi muhim iqtisodiy omillar quyidagilardan iborat:

1. Aholi daromadlari va xarid qobiliyati. Real daromadlar o‘sishi onlayn xaridlar soni va o‘rtacha buyurtma qiymatining oshishiga xizmat qiladi. Inflyatsiya esa iste’molchilarni arzonroq mahsulotlar va aksiyalarni qidirishga undaydi.

2. Tranzaksiya xarajatlari. Elektron savdo an’anaviy do‘kon ijarasi va ayrim ma’muriy xarajatlarni kamaytirishi mumkin. Biroq platforma komissiyasi, reklama, qadoqlash, yetkazib berish va tovarni qaytarish xarajatlari umumiy tannarxni oshiradi.

3. Raqamli to‘lovlar. Bank kartalari, mobil ilovalar, QR-to‘lovlar va fintex xizmatlari tranzaksiyalarni tezlashtirib, naqd pulga bog‘liqlikni kamaytiradi.

4. Raqobat muhiti. Mahalliy va xorijiy platformalarning bozorga kirishi narx, assortiment, xizmat sifati va yetkazib berish tezligi bo‘yicha raqobatni kuchaytiradi.

5. Kichik biznes imkoniyatlari. Marketpleyslar kichik korxona va hunarmandlarga katta boshlang‘ich sarmoyasiz keng auditoriyaga chiqish imkonini beradi.

6. Iste’molchilar ishonchi. To‘lov xavfsizligi, tovar haqida haqqoniy ma’lumot, kafolat va qaytarish tartibining aniqligi onlayn xarid qarorining asosiy shartlaridandir.

Elektron tijorat uchun huquqiy asos 2022 yil 29 sentabrda qabul qilingan O‘RQ-792-sonli "Elektron tijorat to‘g‘risida"gi Qonunda belgilangan. Qonunda elektron tijorat ishtirokchilari, operatorlar, shartnoma tuzish, elektron hujjatlarning

yuridik kuchi, tovar yetkazib berish, nuqsonli tovarni almashtirish va mablag‘ni qaytarish bilan bog‘liq munosabatlar tartibga solingan.

2024 yil 26 dekabrdagi 885-son qaror doirasida elektron tijorat sohasini tartibga solishni takomillashtirish, zamonaviy logistika infratuzilmasiga ega milliy elektron tijorat makonini shakllantirish va bozor ishtirokchilarining huquqlarini himoya qilish vazifalari belgilandi. Istiqbolli loyihalar milliy agentligi sohani tartibga solish va rivojlantirish bo‘yicha vakolatli organ sifatida ko‘rsatilgan.

Elektron savdoda xaridor sayt yoki mobil ilovada tovarni tanlaydi, ammo xizmat sifatini, asosan, tovarni qanchalik tez, xavfsiz va qulay qabul qilgani orqali baholaydi. Shu sababli logistika elektron tijoratning yordamchi funksiyasi emas, balki uning asosiy raqobat ustunliklaridan biridir.

Elektron tijorat logistikasi quyidagi jarayonlarni qamrab oladi:

1. tovar zaxiralarini rejalashtirish;
2. yetkazib beruvchilardan mahsulotlarni qabul qilish;
3. omborda joylashtirish va hisobga olish;
4. buyurtmalarni yig‘ish va qadoqlash;
5. transport yo‘nalishini belgilash;
6. "so‘nggi milya"da mijozga yetkazish;
7. tovarlarni qaytarish va almashtirish.

Noto‘g‘ri zaxira siyosati ikki xil zarar keltirib chiqaradi. Ortiqcha zaxira aylanma mablag‘larni tovarlarda muzlatib qo‘yadi, ombor xarajatlarini oshiradi va mahsulotning ma’naviy eskirishi xavfini kuchaytiradi. Zaxira yetishmasligi esa buyurtmani bekor qilish, mijozni yo‘qotish va brend nufuziga zarar yetkazishga olib keladi.

Shu sababli korxonalarda talabni prognozlash, ABC/XYZ tahlili va avtomatlashtirilgan WMS tizimlarini joriy qilish maqsadga muvofiq. Marketpleysda ko‘rsatilayotgan qoldiq bilan ombordagi real qoldiq real vaqt rejimida sinxronlashtirilishi kerak.

Mijozga yetkazib berishning oxirgi bosqichi umumiy logistika zanjirining eng qimmat va murakkab qismi bo‘lishi mumkin. Aholi zichligi, manzillarni topish, transport tirbandligi va buyurtmani qabul qiluvchining belgilangan joyda bo‘lmasligi xarajatlarga ta’sir ko‘rsatadi.

O‘zbekiston sharoitida quyidagi modellarni birgalikda rivojlantirish samarali:

- kurer orqali eshikkacha yetkazib berish;
- buyurtmani topshirish punktlari;
- pochta va xususiy logistika operatorlari bilan hamkorlik;
- postamat va avtomatlashtirilgan qabul punktlari;
- hududiy fulfillment markazlari;
- bir nechta buyurtmani yagona marshrutga birlashtirish.

Onlayn xaridda iste’molchi mahsulotni oldindan bevosita ko‘rib tekshira olmaydi. Shu bois tovarni qaytarish yoki almashtirish imkoniyati ishonchni shakllantiradi. Qaytarish tartibi murakkab bo‘lsa, dastlabki sotuv amalga oshgan taqdirda ham mijozning takroriy xarid qilish ehtimoli kamayadi.

Samarali qaytarma logistika tovarni qabul qilish, holatini tekshirish, mablag‘ni qaytarish va mahsulotni qayta sotuvga chiqarish jarayonlarini standartlashtirishni talab qiladi.

Raqamli marketing elektron tijorat platformasiga foydalanuvchilarni jalb qilish, ularni xaridorga aylantirish va takroriy xaridlarni rag‘batlantirishga xizmat qiladi. Uning afzalligi natijalarni aniq o‘lchash, auditoriyani segmentlash va reklama takliflarini shaxsiylashtirish imkoniyatidadir.

SEO mahsulot sahifalarini qidiruv tizimlarida yuqori o‘rinlarga olib chiqishga qaratilgan. Buning uchun tovar nomi va tavsifi to‘liq yozilishi, sifatli tasvirlar, texnik xususiyatlar, narx va yetkazib berish shartlari ko‘rsatilishi zarur. Mahalliy bozorda kontentni o‘zbek va rus tillarida taqdim etish auditoriya qamrovini kengaytiradi.

Ijtimoiy tarmoqlar mahsulotni namoyish etish, iste’molchilar fikrini o‘rganish va brend atrofida hamjamiyat shakllantirish imkonini beradi. Foydali kontent, video sharhlar, mahsulotdan foydalanish bo‘yicha yo‘riqnomalar va xaridorlar fikri oddiy reklamaga nisbatan yuqoriroq ishonch uyg‘otishi mumkin.

O‘zbekistonda elektron tijoratning rivojlanishi raqamli texnologiyalar, internet infratuzilmasi, raqamli to‘lovlar va marketpleyslarning kengayishi bilan bog‘liq. Uning samaradorligi xarid qobiliyati, tranzaksiya xarajatlari, raqobat, iste’molchilar ishonchi hamda logistika jarayonlariga, jumladan zaxiralarni boshqarish va “so‘nggi mil” yetkazib berishga bog‘liq.

SEO, ijtimoiy tarmoqlar va ma’lumotlarga asoslangan marketing vositalari bozor qamrovi va raqobatbardoshlikni oshiradi. Shu bois elektron tijoratni rivojlantirishda raqamli infratuzilma, logistika, xavfsiz to‘lovlar, iste’molchilar huquqlari va raqamli marketingni integratsiyalash muhimdir.

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INTEGRATED MANAGEMENT IN E-COMMERCE: LOGISTICS, MARKETING AND ECONOMIC EFFICIENCY

Annotation. *The article analyzes the economic significance of integrating marketing, logistics, warehousing, and customer management processes in e-commerce. It examines the integration of CRM, WMS, ERP, and OMS systems, as well as the impact of demand forecasting, inventory management, last-mile delivery, and digital marketing on efficiency. The main challenges in the context of Uzbekistan and practical recommendations for developing e-commerce are presented.*

Key words: *e-commerce, integrated management, logistics, digital marketing, CRM, WMS, ERP, OMS, economic efficiency.*

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ELEKTRON TIJORATDA INTEGRATSIYALASHGAN BOSHQARUV: LOGISTIKA, MARKETING VA IQTISODIY SAMARADORLIK

Annotatsiya. *Maqolada elektron tijoratda marketing, logistika, ombor va mijozlar bilan ishlash jarayonlarini integratsiyalashning iqtisodiy ahamiyati tahlil qilinadi. CRM, WMS, ERP va OMS tizimlarining o‘zaro integratsiyasi, talabni prognozlash, zaxiralarni boshqarish, “so‘nggi mil” yetkazib berish va raqamli marketingning samaradorlikka ta’siri yoritiladi. O‘zbekiston sharoitidagi asosiy muammolar va elektron tijoratni rivojlantirish bo‘yicha amaliy takliflar keltiriladi.*

Kalit so‘zlar: *elektron tijorat, integratsiyalashgan boshqaruv, logistika, raqamli marketing, CRM, WMS, ERP, OMS, iqtisodiy samaradorlik.*

Raqamli iqtisodiyotning rivojlanishi korxonalarning bozor bilan o‘zaro munosabatlarini sezilarli darajada o‘zgartirmoqda. Ayniqsa, elektron tijoratning kengayishi natijasida mahsulotni internet orqali sotishning o‘zi yetarli bo‘lmay, buyurtmani shakllantirishdan boshlab uni xaridorga yetkazish, to‘lovni amalga oshirish, mahsulotni qaytarish va mijoz bilan keyingi aloqani tashkil etishgacha bo‘lgan jarayonlarni yagona tizimda boshqarish zarurati paydo bo‘lmoqda.

O‘zbekistonda ham elektron tijoratning rivojlanishi internet infratuzilmasi, smartfonlar, raqamli to‘lovlar va marketpleyslarning kengayishi bilan bog‘liq holda jadallashmoqda. Mavjud ma’lumotlarga ko‘ra, elektron tijorat savdo hajmi 2020-yildagi 1 002,5 mlrd so‘mdan 2024-yilda 15 211,5 mlrd so‘mga, 2025-yilda esa 31

551,9 mlrd so‘mga yetgan. Ushbu ko‘rsatkichlar elektron savdo bozorida yuqori o‘sish dinamikasi mavjudligini ko‘rsatadi.

Biroq elektron tijoratning jadal o‘sishi korxonalar oldiga yangi boshqaruv vazifalarini ham qo‘ymoqda. Reklama orqali talabni oshirish, omborda yetarli zaxira yaratish, buyurtmalarni o‘z vaqtida yig‘ish, yetkazib berishni tashkil etish va qaytarishlarni boshqarish o‘zaro muvofiqlashtirilmasa, sotuv hajmining oshishi kutilgan iqtisodiy natijani bermasligi mumkin.

Shu nuqtayi nazardan, elektron tijoratda integratsiyalashgan boshqaruv yondashuvi alohida ahamiyat kasb etadi.

An’anaviy savdoda marketing, ombor, logistika va mijozlar bilan ishlash jarayonlari nisbatan mustaqil tashkil etilishi mumkin. Elektron tijoratda esa ushbu jarayonlarning biridagi o‘zgarish boshqalariga bevosita ta’sir ko‘rsatadi.

Masalan, reklama kampaniyasining muvaffaqiyatli o‘tishi muayyan mahsulotga talabning keskin oshishiga olib kelishi mumkin. Agar korxonada yetarli zaxira mavjud bo‘lmasa, reklama orqali jalb qilingan mijoz buyurtmasini bajara olmaslik ehtimoli yuzaga keladi. Aksincha, katta miqdordagi zaxirani oldindan shakllantirish ham kapitalning samarasiz bog‘lanib qolishiga olib kelishi mumkin.

Demak, elektron tijoratda marketing qarorlari ombor imkoniyatlari, logistika quvvati va moliyaviy hisob-kitoblar bilan muvofiqlashtirilishi lozim.

Integratsiyalashgan boshqaruvning asosiy vazifasi quyidagi jarayonlarni yagona ma’lumotlar muhitida birlashtirishdan iborat: 1) talabni tahlil qilish; 2) sotuvni prognozlash; 3) zaxiralarni rejalashtirish; 4) marketing kampaniyalarini boshqarish; 5) buyurtmalarni qayta ishlash; 6) ombor faoliyatini nazorat qilish; 7) yetkazib berishni tashkil etish; 8) qaytarishlarni boshqarish; 9) mijozlar bilan munosabatlarni rivojlantirish; 10) iqtisodiy natijalarni baholash.

Elektron tijoratda raqamli marketingning vazifasi faqat mahsulotni reklama qilishdan iborat emas. Marketing vositalari orqali shakllantirilayotgan talab korxonaning ishlab chiqarish, xarid, ombor va logistika imkoniyatlari bilan muvofiqlashtirilishi kerak.

SEO, ijtimoiy tarmoqlar, targeting va kontekstli reklama elektron tijorat platformalariga foydalanuvchilarni jalb qilish imkonini beradi. Foydali kontent, mahsulot sharhlari va xaridorlarning fikrlari iste’molchilarning qaror qabul qilish jarayoniga ta’sir ko‘rsatadi.

Biroq reklama samaradorligini faqat ko‘rishlar yoki bosishlar soni orqali baholash korxonaning haqiqiy iqtisodiy natijasini ko‘rsatmaydi. Shu sababli quyidagi ko‘rsatkichlarni kompleks tahlil qilish maqsadga muvofiq:

CAC — yangi mijozni jalb qilish qiymati;

AOV — o‘rtacha buyurtma qiymati;

ROAS — reklama xarajatlarining qaytimi;

CLV — mijozning butun hamkorlik davridagi iqtisodiy qiymati;

konversiya koeffitsienti — tashrif buyuruvchilarning xaridorga aylanish darajasi;

takroriy xaridlar ulushi — mavjud mijozlarning qayta xarid qilish darajasi.

Ushbu ko‘rsatkichlarning birgalikdagi tahlili marketingning real iqtisodiy samaradorligini aniqlash imkonini beradi.

Elektron tijoratda mijoz haqidagi ma’lumotlarni tizimli boshqarish korxonaning marketing va sotuv faoliyatini takomillashtirishga xizmat qiladi. CRM tizimlari mijozlarning xarid tarixi, murojaatlari, qiziqishlari va boshqa tegishli ma’lumotlarni bir joyda saqlash imkonini beradi.

Mazkur ma’lumotlardan foydalanib, mijozlarga individual mahsulot tavsiyalari, chegirmalar, eslatmalar va boshqa takliflar yuborilishi mumkin. Bunday yondashuv mijoz bilan uzoq muddatli munosabatlarni shakllantirishga yordam beradi.

Biroq ma’lumotlardan foydalanish jarayonida shaxsiy ma’lumotlarni himoya qilish va foydalanuvchining roziligini ta’minlash muhimdir. Shaxsiylashtirish haddan tashqari reklama xabarlariga aylanib ketmasligi va iste’molchining ishonchiga salbiy ta’sir ko‘rsatmasligi lozim.

Elektron tijoratning iqtisodiy samaradorligi logistika jarayonlarining qanchalik to‘g‘ri tashkil etilganiga bevosita bog‘liq. Elektron savdoda logistika zaxiralarni rejalashtirish, mahsulotni qabul qilish, saqlash, buyurtmani yig‘ish va qadoqlash, transport hamda mijozga yetkazib berish jarayonlarini qamrab oladi.

Zaxiralarning ortiqcha bo‘lishi ombor xarajatlarini oshiradi va aylanma mablag‘larni tovarlarda bog‘lab qo‘yadi. Zaxiralarning yetishmasligi esa buyurtmalarni bajara olmaslik va mijozlarni yo‘qotish xavfini kuchaytiradi.

Shu sababli elektron tijorat korxonalarida talabni prognozlash, ABC/XYZ tahlili va WMS tizimlaridan foydalanish muhimdir. Marketpleysdagi mahsulot qoldig‘i bilan ombordagi real qoldiq o‘rtasida tezkor axborot almashinuvi ta’minlanishi kerak.

Bunda marketing va logistika o‘rtasidagi axborot almashinuvi alohida ahamiyatga ega. Masalan, marketing tizimi muayyan mahsulotga talab oshayotganini aniqlasa, bu ma’lumot avtomatik ravishda ombor va xarid bo‘limlariga yetkazilishi mumkin. Natijada korxona zaxiralarni oldindan moslashtirish imkoniyatiga ega bo‘ladi.

Elektron tijorat logistikasida “so‘nggi mil” xarajatlar va mijoz tajribasiga katta ta’sir ko‘rsatadi. Aholi zichligi, transport tirbandligi, manzilni aniqlash va buyurtmani qabul qiluvchining mavjudligi kabi omillar yetkazib berish xarajatlariga ta’sir qiladi.

O‘zbekiston sharoitida eshikkacha yetkazib berish bilan bir qatorda buyurtmalarni topshirish punktlari, postamatlar, hududiy fulfillment markazlari va birlashtirilgan marshrutlardan foydalanish logistika samaradorligini oshirishga xizmat qilishi mumkin.

Qaytarma logistika ham elektron tijoratning iqtisodiy natijalariga ta’sir qiladi. Xaridor mahsulotni oldindan bevosita ko‘rib tekshira olmagani uchun qaytarish va almashtirish imkoniyatining mavjudligi iste’molchi ishonchini shakllantiradi. Qaytarish jarayonining murakkabligi esa takroriy xaridlar darajasiga salbiy ta’sir qilishi mumkin.

Shuning uchun qaytarilgan mahsulotlarni qabul qilish, tekshirish, mablag‘ni qaytarish va mahsulotni qayta sotuvga chiqarish jarayonlarini standartlashtirish zarur.

Elektron tijorat korxonalarida turli axborot tizimlaridan foydalanishning o‘zi yetarli emas. Ularning o‘zaro integratsiyasi muhimdir.

ERP korxonaning umumiy resurslarini boshqarishga;

CRM mijozlar bilan munosabatlarni boshqarishga;

WMS ombor jarayonlarini avtomatlashtirishga;

OMS buyurtmalarni boshqarishga;

marketing analitikasi esa reklama va sotuv natijalarini baholashga xizmat qiladi.

Ushbu tizimlarning integratsiyasi natijasida rahbariyat sotuv hajmi bilan bir qatorda har bir buyurtmaning logistika xarajati, qaytarilishi, reklama qiymati va sof marjasini ham ko‘rishi mumkin.

Shunday qilib, elektron tijoratda boshqaruvning asosiy mezoni “qancha sotildi?” savolidan “qancha iqtisodiy qiymat yaratildi?” savoliga o‘tadi.

O‘zbekistonda elektron tijoratning asosiy muammolari — logistika va yetkazib berish cheklovlari, raqamli ko‘nikmalar va avtomatlashtirishning yetarli emasligi, iste’molchilar ishonchi, kiberxavfsizlik hamda ma’lumot almashinuvidagi muammolardir.

Bu muammolarning o‘zaro bog‘liqligi elektron tijoratni alohida marketing yoki savdo masalasi sifatida emas, balki kompleks boshqaruv tizimi sifatida ko‘rib chiqishni talab qiladi.

O‘zbekistonda elektron tijorat korxonalarining iqtisodiy samaradorligini oshirish uchun quyidagi yo‘nalishlar muhim hisoblanadi.

Birinchidan, hududiy fulfillment markazlari, topshirish punktlari va postamatlar tarmog‘ini kengaytirish orqali logistika infratuzilmasini hududlar bo‘yicha muvozanatlashtirish zarur.

Ikkinchidan, marketpleyslar, omborlar, to‘lov xizmatlari va logistika operatorlari o‘rtasida xavfsiz API almashinuvini rivojlantirish lozim.

Uchinchidan, kichik biznes vakillarining SEO, CRM, targeting, WMS va raqamli analitika bo‘yicha amaliy ko‘nikmalarini rivojlantirish maqsadga muvofiq.

To‘rtinchidan, iste’molchilar uchun qaytarish, almashtirish, kafolat va to‘lov shartlarini yanada shaffoflashtirish kerak.

Beshinchidan, korxonalar sotuv hajmini emas, balki sotuvning iqtisodiy natijasini baholashga o‘tishi zarur. Bunda CAC, CLV, AOV, ROAS, logistika xarajatlari, qaytarishlar va sof marja yagona tahliliy tizimda ko‘rib chiqilishi lozim.

Oltinchidan, kiberxavfsizlik, ma’lumotlarni himoya qilish va xodimlarning raqamli xavfsizlik bo‘yicha malakasini oshirishga e’tibor qaratish kerak.

Yettinchidan, transchegaraviy elektron tijoratni rivojlantirish uchun elektron hujjatlar, xalqaro to‘lovlar va logistika jarayonlarini soddalashtirish muhim.

Xulosa o‘rnida shuni ta’kidlash kerakki, elektron tijoratning samaradorligi marketing, logistika, ombor, mijozlar bilan munosabatlar va moliyaviy boshqaruvning yagona tizimda muvofiqlashtirilishiga bog‘liq. Barqaror natijaga

talabni shakllantirish, buyurtmani samarali bajarish va mijozlar bilan uzoq muddatli munosabatlarni rivojlantirish orqali erishiladi.

ERP, CRM, WMS va OMS tizimlarining integratsiyasi sotuv, zaxira, buyurtma va yetkazib berish jarayonlarini samarali boshqarish, xarajatlarni kamaytirish va iqtisodiy natijalarni aniq baholash imkonini beradi. Shu bois O‘zbekistonda elektron tijoratni rivojlantirishda integratsiyalashgan boshqaruv, zamonaviy logistika, ma’lumotlarga asoslangan marketing va raqamli infratuzilmaga e’tibor qaratish muhimdir.

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GEOECOLOGICAL FOUNDATIONS OF NATURAL RESOURCE USE

Abstract: *The use of natural resources is the most important factor in industrial development. There is no doubt that the further development of these natural resources will lead to the emergence of new industries in our country. ' The implementation of these large-scale works is entrusted to good specialists devoted to their profession.*

Keywords: *natural resources and resources, mineral resources, nature and society, geo-ecology.*

Introduction

At the current stage of societal development, when the relationship between nature and society is strained, it is necessary to use nature and its resources rationally. Therefore, during the transition to a market economy, special attention is paid to the creation of science-oriented mechanisms for nature protection and efficient nature management. Because the sustainable development of the economy is closely linked to public health, environmental protection, and the state of nature management.

The contributions of scientists such as N. Dolimov, Kh. Khasanov, L. N. Babushkin, N. A. Kogay, and others to the organization of research on nature and its use in our republic are immense. It is well known that H. Hasanov studied mountain and foothill areas using the field method.

Main section.

At a time when the scale of natural resource utilization is increasing based on scientific and technological progress and human economic activity is intensifying, both types of activities—nature use and its protection—must be carried out without separation. For a long time, the rational use of nature was viewed as a practical problem. It reveals, analyzes, and evaluates the results of the interaction and interdependence between nature and society, and develops theoretical principles for the use of natural resources and environmental protection.

- its main goal as a science is to increase production efficiency and exert a comprehensive impact on the natural environment to meet the vital and spiritual needs of the population.

- the main tasks are to meet the continuously growing needs of society for natural resources, to restore natural resources, to create conditions for increasing the productivity of the natural environment, to use non-renewable natural resources economically and rationally, to protect the environment from pollution, to purposefully change nature.

- determines the patterns of changes in natural resources under the influence of complex interconnected human economic activities, the significance of these changes for humans, substantiates the use of natural resources, and develops methods for preserving and restoring their quantitative and qualitative properties necessary for current and future generations. It must also ensure not only the prevention of qualitative deterioration and quantitative reduction of natural content but also its targeted continuous improvement.

Over time, the number of photographs of mineral exploration and exploitation also increased. Currently, more than 120 billion tons of minerals and various substances are used annually for human needs. Mineral resources serve as raw materials for various sectors of the national economy. As a result of the development of science and technology and the growth of human needs, the exploration and exploitation of mineral resources are increasing. Currently, the number of minerals and rocks used by humanity exceeds 3,500. The mining industry primarily utilizes more than 250 types of mineral raw materials: fuel and energy raw materials—oil, gas, coal, uranium, etc.; ferrous and non-ferrous metals; chemical raw materials; and construction materials.

350 м700 мAs a result of the non-compliance of technologies during the extraction process, 45% of coal, up to 60% of oil, and up to 25% of metals are lost. When metal ores are enriched, a portion of the metal and non-metallic minerals are discarded. Such wastefulness leads to the rapid deterioration of the deposits. Mineral raw materials are extracted in open and closed (shaft) formations. In Uzbekistan, the depth of open-pit mines is about 50%, in closed mines about 100, and the depth is increasing. In open-pit mining, the mineral can be used as fully as possible. Mineral losses amount to 15–25%. However, the negative impact on the environment increases significantly. When extracting minerals using the closed (shaft) method, the environmental impact is minimal, but losses amount to 40-60%.

More than 200 different types of mineral resources have been identified on the territory of the Republic of Karakalpakstan. ' In terms of reserves of certain minerals, the Republic of Uzbekistan is a leader in Uzbekistan. ' In Karakalpakstan, there are reserves of natural gas, iron ore, table and sulfate magnesite salts, talc stones, marble and granite stones, as well as large deposits of figurative materials (granite) and construction materials. ' The reserves of this raw material are mainly concentrated in 3 large regions. ' These include: the Sultan-Uvays Mountains, the Ustyurt Plateau, and the Kushkhon-Tag hill (in the Chimbay district). '

Sultan Uvays is home to deposits of iron ore, talc, quartzite, granite, amphibolites, marble and granite, semi-precious and semi-finished stones, and building materials. '

The Ustyurt Plateau possesses reserves of natural gas, common salt, and construction raw materials.

Deposits of sulfate-magnesite salts and bectonite clays have been identified on the Kushkhonatag hill. '

Construction raw materials are located in the cities of Nukus, Takhiatash, Muynak, Turkestan, and others. ' Of the aforementioned minerals, there are no

others currently in use, except for gas and construction raw materials. ' In the future, it will lay the foundation for the development of the building materials industry based on the deposits and construction raw materials being exploited. There is a possibility of new industrial sectors emerging in Karakalpakstan in the near future. ' These are mainly: mining and chemical, polymetallic ore, and other industries. '

Conclusion

It is very important to be guided by a certain scientific principle when using mineral raw materials. In this regard, the principle of complexity is very important. Minerals consisting of only one element are rarely encountered in nature; in most cases, deposits consisting of 2-3 or more, and sometimes 15–20 different useful elements, are encountered. When mining, most of the necessary resources are extracted, while the rest (e.g., bulk elements) accumulate as waste in terricons, causing their quality to deteriorate, waste, and environmental damage. To prevent this unpleasant phenomenon and achieve greater economic efficiency, it is advisable to implement integrated use of deposits—that is, the simultaneous extraction of all useful elements—which is comprehensively beneficial, does not harm the environment, does not create excessive terricons, and does not reduce pasture areas. Consequently, it is advisable to prioritize the principle of complexity in the use of mineral raw materials and to regularly adhere to it at all deposits.

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USE OF FREEN WATERS IN CONDITIONS OF GEOECOLOGICAL DIFFICULTIES IN THE FLOWER OF THE AMUDARYA RIVER

Abstract: *Due to the worsening geo-ecological situation in the lower reaches of the Amudarya River, there is a problem in providing high-quality drinking water to remote settlements from the Tuyamuyun water pipeline. In recent years, due to the deterioration of surface water quality and the negative impacts of water scarcity and hydro-reclamation works, a deterioration in the quality and depletion of freshwater reserves along the riverbanks has been observed, especially at intensively exploited deposits.*

Keywords: *river, Amu Darya, Tuyamuyun, water conduit, desalination of underground waters.*

Introduction

In the complex of these measures, the introduction of methods for the artificial formation and replenishment of freshwater beds, especially in the areas of existing water intakes, can play a positive role. Artificial replenishment can be most successfully applied in areas where there is a continuous or short-term (up to 2-3 months per year) flow of fresh water in watercourses, while artificial formation of fresh water can be applied in areas where fresh water flow is observed only during the harvesting period. However, the scientific and methodological foundations for the artificial formation and replenishment of freshwater bed lenses are poorly developed. This work attempts to fill this gap.

1.5 rIn these conditions, fresh and slightly salty groundwater is used to meet the needs of the population. In this regard, the need arises to study the process of groundwater formation and desalination in greater detail and depth. In our view, research work in the field of studying the desalination of saline groundwater is timely, as it can provide additional sources of high-quality drinking water in the region. To meet the water needs of remote settlements, underground and surface water from wells is used, often of poor quality. In the lower reaches of the Amu Darya River, previously explored and exploited fresh groundwater cannot be exploited without additional measures to desalinate saline waters, as the groundwater pumped out at this time is in many cases of poor quality in terms of mineralization, hardness, sulfates, and other components. To carry out work using the method of artificial replenishment of groundwater reserves, the forecasted groundwater reserves with mineralization up to 3 g/l are 5621 thousand $^{m3/day.}$ Of these, the approved deposits for 39 A+B+C1+C2 categories amount to 554 thousand

m3/day with a mineralization of 290 thousand m3/day. The total groundwater withdrawal is currently 74.5 thousand m3/day. (3)

Main part

Research results have shown that the desalination and treatment of saline groundwater by artificially replenishing groundwater reserves, as well as using accessible and inexpensive local mineral adsorbents on-site, is one of the real approaches to solving the problem. In recent years, artificial replenishment of groundwater reserves has been carried out at existing water intakes (Akmangit, Kegeyli, etc.) that utilize groundwater to preserve and increase operational reserves.

38 м Applicable to the conditions of the lower reaches of the Amu Darya River, the principles and norms for exploiting desalinated saline groundwater using the method of artificial replenishment of groundwater reserves (under various conditions of their occurrence (15m –), depending on the water-bearing rocks, have been established. The calculation of water intakes using computers and the selection of optimal operating modes based on mathematical models under freshwater lens conditions included forecasting the decrease in dynamic levels in operational wells, the duration of saltwater uplift and its replacement with freshwater, and the optimal placement sizes of water intake elements. Under conditions of artificial replenishment of groundwater reserves, natural self-purification of groundwater (bioactive layer) was carried out, and water withdrawal increased to 1.5-2.5 times due to the accumulation of fresh groundwater volume during the pumping out of saline groundwater. As a result, the artificially created desalinated water volume is sufficient for water supply during the intermediate period without deteriorating groundwater quality until the start of the next stage of the filtration cycle. The operating principle of a water intake with an IVZPV can be seen in the example of the Kuvanishjarma field, where wells of two thicknesses operated during the flood period (120 days). During the dry period (183 days), characterized by the absence of water in the canal and contours, only the lower stage of the wells in the boundless formation operated for 62 days (31 days before the start of underground water storage work and the same amount after its completion), utilizing artificially formed freshwater reserves.

1 м^{3}Applying the established patterns to fresh groundwater deposits will further reduce the volume of geological exploration work. The cost-effectiveness of the method is expressed in conducting short-term research within a single experimental block. Obtaining maximum information about the dynamics of diverse processes occurring in a groundwater deposit during various operating modes during a full annual water intake cycle, without conducting new expensive research, yields significant economic efficiency. This achieves the compactness of water intake structures and high-performance operation of installed capacities, resulting in electricity savings and a 20-25% reduction in the cost of pumped water. In this regard, the research results, in our opinion, are of significant interest for their use in assessing groundwater lens reserves, and most importantly, during the full annual cycle of water intake work with artificial replenishment of groundwater reserves,

we obtain maximum information about the dynamics of various processes occurring at the deposit (canal lenses) under various operating modes.

Conclusion

To effectively utilize fresh groundwater in the lower reaches of the Amu Darya River, it seems necessary to:

- during the presence of fresh surface water in the canal, fill the feeding contours. Strictly monitor the flow rate, level, and quality of groundwater withdrawn by water intake wells;

- construction of main and auxiliary feeding circuits. This will reduce colmatation processes and provide the opportunity to manage the storage and desalination of groundwater reserves.

In order to monitor seasonal changes in the quantitative and qualitative state of underground and surface waters, as well as the conditions for forming operational reserves of water intakes using the method of artificial replenishment of underground water reserves, it is necessary to conduct area-based year-round regime observations. Based on the results of observations, to achieve effective operation, it is necessary to annually clean the bottom and edges of the supply circuits before filling them with water and to create a sanitary protection zone for water intakes.

In geographical terms, along the Doslyk, Kegeyli, and Kuvanishjarma canals, similar types of deposits have been identified, and there are prerequisites for identifying similar lenses in the developmental areas of other ancient riverbeds. In this regard, the research conducted by us is of both scientific and practical interest for further work on the method of artificial replenishment of fresh groundwater reserves in relation to other territories of the region.

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MANTIQIY FIKRLASHNI TANQIDIY TAFAKKUR VA KREATIVLIK ASOSIDA SHAKLLANTIRISH

Annotatsiya. *Ushbu tadqiqotda mantiqiy fikrlashning asosiy tarkibiy qismlari bo‘lgan kreativlik va tanqidiy fikrlash o‘rtasidagi bog‘liqlik hamda ularning o‘zaro ta’siri tahlil etiladi. Shuningdek, mantiqiy fikrlashni rivojlantirishda ta’lim jarayonida qo‘llaniladigan samarali metod va strategiyalar ko‘rib chiqiladi*

Kalit so‘zlar. *mantiqiy fikrlash, o‘qituvchi, kreativlik, tanqidiy fikrlash, pedagogik texnologiyalar, mantiqiy masalalar, kreativ qobiliyat.*

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FORMATION OF LOGICAL THINKING BASED ON CRITICAL THINKING AND CREATIVITY

Abstract. *This study analyzes the relationship and interaction between creativity and critical thinking, which are key components of logical thinking. It also examines effective methods and strategies used in the educational process to develop logical thinking.*

Keywords: *logical thinking, teacher, creativity, critical thinking, pedagogical technologies, logical problems, creative abilities.*

Ma’lumki, o‘quvchilarda mantiqiy fikrlash ko‘nikmalarini rivojlantirish ularning bilimlarini amaliyotda qo‘llay olishlari uchun muhim omildir. Bu jarayon shaxsiy rivojlanish, ijodkorlik va muammolarni hal etish qobiliyatining ortishiga xizmat qiladi. Shu bois ta’lim jarayonida mantiq qonunlarini amaliyot bilan uyg‘unlashtirish zarur, chunki bu o‘quvchilarga bilimlarini real hayotda samarali qo‘llash imkonini beradi.

Mantiqiy masalalarga yechim izlash talabani masalaning mazmunini chuqur tahlil qilishga, undan zarur xulosalar chiqarishga va kreativ fikrlash qobiliyatini ishlatishga undaydi. Bunday yondashuv masalada bayon qilingan vaziyatni chuqur tushunish va anglashga qaratilgan bo‘lib, u bilimga asoslangan ta’lim modelini qo‘llab-quvvatlaydi.

Kreativlik (lot., ing. “create” – yaratish, “creative” yaratuvchi, ijodkor) – shaxsning yangi g‘oyalarni ishlab chiqishga tayyorligini tavsiflovchi hamda mustaqil omil sifatida iqtidorlilikning tarkibiga kiruvchi ijodiy qobiliyati ma’nosini ifodalaydi. Shaxsning kreativligi uning tafakkurida, muloqotida, his-tuyg‘ularida,

muayyan faoliyat turlarida namoyon bo‘ladi. Kreativlik shaxsning bir butun sifatida yoki uning ayrim o‘ziga xos jihatlarini, jumladan, zehn o‘tkirligini ko‘rsatib beradi. Bu fazilat, shuningdek, iqtidorning ajralmas qismi hisoblanadi. P.Torrensning fikriga ko‘ra, kreativlik insonning muammolar va ilmiy farazlarni ilgari surishi, farazlarni tekshirish va zarur bo‘lsa o‘zgartirish qobiliyatini anglatadi[1]. Bunda muammo va yechimlarni aniqlashda bilim va amaliy harakatlar o‘rtasidagi qarama-qarshiliklarga sezgirlik, ya’ni ularni nozik his etish orqali ijodiy yechimlar topish qobiliyati ham muhim o‘rin tutadi. Shu o‘rinda, aytish lozimki, kreativlik – bu faqat yangilik kiritish emas, balki murakkab masalalarni yechishda mavjud bilim va tajribalarni o‘zgacha tarzda uyg‘unlashtira olish san’atidir.

N.Vishnyakovaning fikricha, kelajakdagi pedagog shaxsida kreativlikni rivojlantirish uchun o‘ziga xos bir qator shaxsiy xususiyatlarni shakllantirish zarur. Bu xususiyatlar ijodiy individuallikni namoyon etish, tashabbuskorlik, kasbiy faoliyatda faol va g‘ayrioddiy yondashuvdan foydalanishni o‘z ichiga oladi. Bunday pedagog standart bo‘lmagan, noodatiy fikrlaydigan va murakkab masalalarga samarali yechim topish qobiliyatiga ega bo‘ladi, bu esa uning ta’limdagi muvaffaqiyatiga xizmat qiladi[2]. Bu esa o‘z o‘rnida shaxs kreativligi tushunchasi bilan chambarchas bog‘liq. “Shaxs kreativligi” tushunchasi haqida to‘xtaladigan bo‘lsak – bu insonda ijodiy faoliyatga, ijtimoiy munosabatlarga va dunyoqarashga bo‘lgan ehtiyojlar, motivlar hamda qiziqishlarning mustahkam va chuqur namoyon bo‘lishidir.

Kreativlik tushunchasini aniqlashda Y.Ilinning ta’rifi nazariy-pedagogik jihatdan alohida ahamiyatga ega. Uning ta’kidlashicha, kreativlik – bu shaxsning noodatiy g‘oyalarni ishlab chiqish qobiliyati, an’anaviy tafakkur doiralaridan chetga chiqish va pedagogik jarayonda innovatsion yondashuv orqali muammoli holatlarga samarali yechim topish malakasini qamrab oluvchi xususiyatdir[3]. Ushbu ta’rifdan kelib chiqib aytish mumkinki, bizning vaziyatda ijodkorlik insonning ijtimoiy shartlangan yaratuvchan faoliyati sifatida qabul qilinadi. Unda yangi va original mahsulotning barcha muhim elementlari mavjud bo‘lib, estetik jihatdan mukammal madaniy qadriyatlarni yaratishga qaratilgan. Kreativlik esa shaxsning yangi g‘oyalar yaratishga tayyorligini, muammoni bir vaqtning o‘zida bir nechta yechimlar orqali hal etishga intilishini, yangi variantlar va yechimlar modifikatsiyalarini izlash qobiliyatini anglatadi.

Kreativlik maxsus ijodiy qobiliyat sifatida ijodiy jarayonda namoyon bo‘ladi va amalga oshiriladi, ya’ni kreativlik ijodkorlikka erishishda faqatgina bir bosqich hisoblanadi. Tadqiqotchilar fikriga ko‘ra, shaxsning turli yo‘nalishlari mavjud bo‘lib, ular orasida gumanistik, ekologik, axloqiy, qadriyatlarga yo‘naltirilgan, ijodiy (ya’ni, kreativ) va boshqalarni ajratish mumkin. Ushbu yo‘nalishlar shaxsni har tomonlama boyitish va uning shaxsiy rivojlanishiga hissa qo‘shadi. Ushbu tadqiqotda “shaxs kreativligi” tushunchasi muhim ahamiyatga ega, chunki u insonning o‘z-o‘zini va o‘z ijodiy faoliyati natijalarini teran anglab, har tomonlama qabul qilishiga asoslanadi.

K.Platonov fikriga ko‘ra, pedagogning kreativligi uning intellektual salohiyati bilan o‘zaro bog‘liq. U uchun kreativlik nafaqat yangi g‘oyalarni taklif

qilish qobiliyati, balki o‘quv jarayonini ijodiy va qiziqarli qilish, har bir o‘quvchining shaxsiy ehtiyojlariga mos yondashuvlar topishdir[4]. Shu tariqa, pedagog kreativligi ta’lim jarayonini faol va noodatiy yo‘llar bilan boyitish imkonini yaratadi, desak to‘g‘ri bo‘ladi. Chunki “Pedagogik mahorat – bu har bir o‘quvchiga o‘rgatish san’ati bo‘lib, unda eng samarali usullar va yondashuvlardan foydalangan holda ularga o‘z salohiyatini ro‘yobga chiqarishda yordam berish ko‘zda tutiladi”[5]. Yuqoridagi fikrlardan kelib chiqib, ta’lim tizimida innovatsion yondashuv va metodlarni joriy qilish bolajak o‘qituvchilarning ijodiy salohiyatini oshirishga yordam beradi va ta’lim sifatini yaxshilashga xizmat qiladi.

Pedagogik mahorat va professional kompetensiya o‘qituvchi kasbiy faoliyatining yanada rivojlanishiga xizmat qiladigan muhim omillar bo‘lib, ular o‘quv jarayonidagi tanqidiy fikrlash, ijodiy yondashuv va innovatsion vositalardan samarali foydalanish orqali rivojlanadi. Chunki professional kompetensiya – bu pedagogning o‘z sohasiga oid zamonaviy bilimlar, amaliy ko‘nikmalar va ta’sirchan aloqalarni samarali ishga solish mahoratidir. Bu mahorat o‘quvchilarga o‘ziga xos yondashuv bilan yordam berishni, innovatsion texnologiyalarni qo‘llashni va pedagogik jarayonda yangi yo‘llarni topishni talab etadi.

Ta’limdagi innovatsion muhit – ta’lim jarayonidagi yangicha yondashuvlarni amaliyotga tatbiq etish imkonini beradigan tizimdir. Bu muhit ijodiy va innovatsion yondashuvlar orqali har bir o‘quvchining rivojlanishini qo‘llab-quvvatlaydi. G.Gutman ta’kidlaganidek, kreativ faoliyatni to‘liq tushunish uchun fikrlash jarayonlari bilan bir qatorda, ularni harakatga keltiruvchi dinamik kuchlarni ham hisobga olish kerak. Ko‘pchilik tadqiqotchilar (F.V.Basin, A.N.Luk, A.Ye.Sheroziya va boshqalar) fikriga ko‘ra, bunday dinamik kuchlardan biri motivatsiya bo‘lishi mumkin. Kreativ faoliyatning asosiy motivlari – qiziqish, boshqalarning hurmatini qozonishga bo‘lgan intilish, o‘z-o‘zini hurmat qilish va raqobatchilikdir. Ushbu shaxsiy sifatlarning rivojlanishi insonning motivatsiyasi, qadriyatlari va hayot hamda atrofdagi olamga refleksiv munosabati bilan bog‘liq[6]. R.A.Mavlonova tomonidan olib borilgan tadqiqotlar bilan tanishar ekanmiz, ularning barchasini umumlashtirgan holda quyidagi fikrlarni e’tirof etish mumkin:

1. Kreativlik shaxsni innovatorlikka (yangilik yaratish) undovchi pedagogik kategoriya hisoblanadi.

2. Kreativ salohiyat o‘qituvchining kasbiy va shaxsiy sifatlarining integratsiyasidir. Chunki, o‘qituvchi tabiatan qiziquvchan, intiluvchan bo‘lmas ekan, u hech qachon ijodkorlikni namoyon eta olmaydi.

3. Kreativlik o‘qituvchilarda o‘z-o‘zidan paydo bo‘ladigan sifat emas, u o‘qituvchining yangiliklarga intilishi, yangiliklarni o‘zlashtirish va o‘zining pedagogik faoliyatida qo‘llay olish jarayonlarida duch keladigan qiyinchiliklarni yenga olishi, innovatsion yangiliklarni o‘z faoliyatida faol, ijodkorona foydalana olish va o‘z mualliflik g‘oyalariga egaligi, optimal yechimlarni topa olishi bilan bog’liq.[7]

A.Zulfikar, A.Hayyat talabalar tanqidiy fikrlash ko‘nikmalari va akademik muvaffaqiyati o‘rtasidagi bog‘liqlikni aniqlashga harakat qilganlar. Ularning tadqiqotlari tanqidiy fikrlash qobiliyatlarining talabalar ilmiy yutuqlariga ijobiy

ta’sir ko‘rsatishi mumkinligini ta’kidlaydi. Tanqidiy fikrlash talabalarga ma’lumotlarni tahlil qilish, asosiy nuqtalarni aniqlash va o‘zlarining qarashlarini aniqroq ifoda etish imkonini beradi, bu esa ularning umumiy o‘qish samaradorligini oshiradi va akademik muvaffaqiyatga erishishda yordam beradi[8]. Bundan ko‘rinib turibdiki, o‘qituvchi kreativlik faoliyat yuritishi uchun, u albatta o‘zining sohasidagi eng so‘nggi yangiliklardan, shu bilan bir qatorda butun jamiyatdagi voqea va hodisalardan boxabar bo‘lishi, innovatsion yangiliklarni o‘z faoliyatida o‘rinli foydalana olishi lozim. Yuqorida bildirilgan fikrlar yurtimizda olib borilayonga tub islohotlar zamirida o‘z aksini topayotgani barchamizga ma’lum.

Mamlakatimiz rahbari Sh.M.Mirziyoyev ta’lim sohasida ishlayotgan o‘qituvchilarning hurmatini oshirishni, ularning faoliyatiga yangicha va ijodiy yondashuv olib kirishni juda muhim ekanligini qayd etib, 2019-yil 23-avgustda xalq ta’limi, oliy ta’lim xodimlari bilan bo‘lgan muloqotda uzluksiz ta’lim tizimida olib borilishi kerak bo‘lgan dolzarb vazifalar haqida fikr yuritib, “… bugungi kunda ta’lim muassasalarida faoliyat olib borayotgan o‘qituvchilarning obro‘sini ko‘tarish, shu bilan bir qatorda bugun o‘qituvchilarning o‘zlari ham ta’lim-tarbiya jarayoniga yangicha ijodiy yondashishi lozim”[9], degan fikrni bildirib o‘tdi. Bu esa ta’lim tizimida o‘qituvchilarga yuklatilgan mas’uliyatni yanada yuksak darajada qadrlashini ko‘rsatadi. U o‘qituvchilarning faqat bilim beruvchi emas, balki yoshlarga axloqiy va ma’naviy yo‘nalishda ham o‘rnak bo‘lishi kerakligini ta’kidlaydi.

O‘qituvchilarni zamon bilan hamnafas, ijodiy fikrlovchi, o‘z bilim va tajribalarini o‘quvchilarga qiziqarli va samarali tarzda yetkazadigan shaxs sifatida ko‘radi. Shu boisdan, o‘qituvchi o‘quvchilarga faqat dars o‘tuvchi emas, balki ularni hayotga tayyorlovchi, hayotiy yo‘nalish beruvchi shaxs sifatida qaralishi kerak. U o‘quvchilarga nafaqat bilim berib, balki ularga hayotiy tajribadan saboq beradigan, jamiyatda o‘z o‘rnini topishda ko‘mak beradigan muhim namuna bo‘lib xizmat qilishi zarurligini uqtiradi[10].

Yuqoridagi fikrlardan kelib chiqib, kreativ salohiyat o‘quvchilarning ta’lim jarayonida faqat tayyor bilimlarni egallash bilan cheklanmay, balki mustaqil va ijodiy yondashuvni qo‘llashlarini ta’minlaydi. Ushbu salohiyat ularning tanlagan faoliyatida o‘zini namoyon etish, tadqiqotchilik hamda yangilikka intilish orqali rivojlanadi. Kreativ salohiyatni shakllantirish zamonaviy ta’lim sifatini oshirishda muhim omil hisoblanadi. U bilim va ko‘nikmalarni yangi usullarda qo‘llashga imkon berib, tayyor qoliplardan chetga chiqishni rag‘batlantiradi. Shuningdek, tadqiqotchilik qobiliyatining rivojlanishi kreativ fikrlashni kuchaytiradi va natijada muvaffaqiyatli shaxsni shakllantirishga xizmat qiladi.

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A-ANALITIK STRUKTURALAR ASOSIDA DIFFERENSIAL JARAYONLARNI MATEMATIK MODELLASHTIRISH, SONLI YECHISH VA HISOBLASH ALGORITMLARINI ISHLAB CHIQISH

Annotatsiya. *A-analitik strukturalar asosida differensial jarayonlarni modellashtirish va sonli yechish usullari ishlab chiqilgan. Crank–Nicolson sxemasi va kollokatsiya qo‘llanilgan. Shartsiz barqarorlik va $O(h^2 + \tau^2)$ yaqinlashuv isbotlangan.*

Kalit so‘zlar: *A-analitik funksiyalar, Crank–Nicolson, barqarorlik, kollokatsiya.*

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MATHEMATICAL MODELING OF DIFFERENTIAL PROCESSES BASED ON A-ANALYTIC STRUCTURES, NUMERICAL SOLUTION, AND DEVELOPMENT OF COMPUTATIONAL ALGORITHMS

Abstract. *Methods for modelling and numerical solution of differential processes based on A-analytic structures are developed. The Crank–Nicolson scheme and collocation are applied. Unconditional stability and $O(h^2 + \tau^2)$ convergence are proved.*

Keywords: *A-analytic functions, Crank–Nicolson, stability, collocation.*

Kirish. Differensial jarayonlarni matematik modellashtirish hisoblash matematikasining muhim yo‘nalishlaridan biri bo‘lib, elliptik va parabolik tipdagi tenglamalar bu sohada alohida o‘rin tutadi. Klassik Koshi–Riman tizimi asosidagi analitik funksiyalar nazariyasi [1, 2] bir jinsli muhitlar uchun samarali apparat bersa-da, amaliy masalalar (gidrodinamika, elastiklik, magnit gidrodinamika) ko‘pincha o‘zgaruvchan muhitlarda sodir bo‘ladi. Bunday hollarda Bers va Vekua [3] tomonidan umumlashtirilgan A-analitik strukturalar nazariyasi qo‘llaniladi; unda matritsali koeffitsientlar A(x,y) muhitning anizotropiyasini ifodalaydi va kvazikonform aks ettirishlar apparatiga [4, 5] bog‘lanadi. A-analitik funksiyalarga asoslangan sonli algoritmlar esa hisoblash matematikasida hali yetarli ishlab chiqilmagan — ayni shu bo‘shliqni to‘ldirish maqolaning maqsadidir.

Mavzuga oid adabiyotlar sharhi. A-analitik funksiyalar nazariyasining asoslari Bers [6] va Vekua [3] ishlarida yaratilgan. Vekua monografiyasida umumlashtirilgan Koshi–Riman tizimi (1) va uning elliptik tipdagi tenglamalar bilan bog‘liqligi tizimli bayon etilgan. Kvazikonform aks ettirishlar nazariyasida Ahlfors [4] va Lehto–Virtanen [5] ishlari fundamental ahamiyatga ega. Sonli usullar bo‘yicha elliptik va parabolik masalalar Morton va Mayers [7] monografiyasida chuqur o‘rganilgan. O‘zbekiston matematik maktabida Rajabov [8] va Yusupov [9] A-analitik strukturalar va ularning tatbiqlari bo‘yicha muhim natijalar olishgan.

Tadqiqot metodologiyasi. Tadqiqotda quyidagi uch asosiy apparat birlashtirildi: (a) A-analitik funksiyalar nazariyasi, (b) chekli-farq va kollokatsiya sonli usullari, (c) barqarorlik tahlili uchun spektral (Von Neumann) usuli.

A-analitik funksiyalar: asosiy ta'riflar. $\Omega \subset \mathbb{R}^2$ ochiq soha bo'lsin, $A : \Omega \to M_2(\mathbb{R})$ — ikki marta uzluksiz differensiallanuvchi matritsli funksiya. $f = u + iv$ funksiya A-analitik deyiladi, agar u (1) tizimini qanoatlantirsa. A-analitik funksiyalar sinfi $A(\Omega, A)$ deb belgilanadi. $\det(A) > 0$ bo'lsa, (1) tizimi elliptik tipga kiradi [3].

Matematik model A ning diagonal holda ($A_{12} = A_{21} = 0$) umumlashtirilgan elliptik masalani ko'rib chiqamiz (umumiy tensorli hol alohida tadqiqotni talab etadi):

$$L_A u := -\nabla \cdot (A(x) \nabla u) = f(x), \quad x \in \Omega, \qquad (2)$$

$$u|_{\partial\Omega} = g. \qquad (3)$$

bu yerda $A(x)$ — simetrili musbat aniq (SPD) matrits, ∇ — gradient operatori, $f \in L^2(\Omega)$ — manba funksiyasi, g — chegara sharti.

Parabolik umumlashma:

$$\partial u / \partial t + L_A u = f(x, t), \quad (x, t) \in \Omega \times (0, T], \qquad (4)$$

$$u(x, 0) = u_0(x), \quad u|_{\partial\Omega} = 0. \qquad (5)$$

Diskretlashtirish sxemasi Ω sohasi $h > 0$ qadam bilan to'r orqali diskretlanadi: $\Omega_h = \{(x_i, y_j) : x_i = ih, y_j = jh\}$. $A(x)$ diagonal ($A_{12} = 0$) ekanligini hisobga olib, (2) masala uchun besh nuqtali chekli-farq sxemasi:

$$-(A_{11}(x)\ \delta^2_x + A_{22}(x)\ \delta^2_y)\, u_h = f_h, \qquad (6)$$

bu yerda $\delta^2_x u_{ij} = (u_{i+1,j} - 2u_{i,j} + u_{i-1,j}) / h^2$ — ikkinchi tartibli sonli differensiya. Sxemaning approximatsiya tartibi $O(h^2)$ [7].

(4) evolyutsion masala uchun Crank–Nicolson sxemasi:

$$(u^{n+1} - u^n) / \tau + \tfrac{1}{2} L_{A,h} (u^{n+1} + u^n) = f^{n+1/2}, \qquad (7)$$

bu yerda τ — vaqt bo'yicha qadam, $L_{s,h}$ — (6) da aniqlangan diskret operator, $f^{n+1/2} = f(x, t^n + \tau/2)$ — o'rta vaqtdagi manba qiymati.

Barqarorlik tahlili Crank–Nicolson sxemasi (7) uchun Von Neumann spektral tahlili qo'llaniladi. Har bir fazoviy Fourier harmonika $e_i^{e,}$ uchun to'lqin o'tkazish operatorini $G(\xi)$ deb belgilasak:

$$|G(\xi)| = |1 - (\tau/2)\,\lambda(\xi)| / |1 + (\tau/2)\,\lambda(\xi)| \le 1 \quad \forall \xi, \forall \tau, \forall h, \qquad (8)$$

bu yerda $\lambda(\xi) \ge \lambda_0 > 0$ — $L_{s,h}$ operatorining musbat eigenqiymati. $|G| \le 1$ shart har qanday τ va h uchun o'rinli, shuning uchun Crank–Nicolson sxemasi shartsiz barqaror [7].

Iteratsion algoritm (A-PCG) Diskretlashtirishdan kelib chiqadigan chiziqli sistema $\mathscr{B}\, u_h = f_h$ ($\mathscr{B}$ — diskret stiffness matrits) ni yechish uchun old shartlashtirilgan konjugat gradientlar usuli qo'llaniladi:

Algoritm 1 (A-PCG):

1. Boshlang'ich: u^0, $r^0 = f_h - \mathscr{B}\, u^0$, $p^0 = M^{-1} r^0$.
2. $k = 0, 1, 2, \ldots$ uchun:
   $\alpha_k = (r^k, M^{-1} r^k) / (\mathscr{B}\, p^k, p^k)$
   $u^{k+1} = u^k + \alpha_k\, p^k$
   $r^{k+1} = r^k - \alpha_k\, \mathscr{B}\, p^k$
   $\beta_k = (r^{k+1}, M^{-1} r^{k+1}) / (r^k, M^{-1} r^k)$
   $p^{k+1} = M^{-1} r^{k+1} + \beta_k\, p^k$
3. $\|r^{k+1}\| < \varepsilon$ bo'lguncha davom ettiriladi.

4. Tahlil va natijalar

Yaqinlashuv taxmini

Teorema 1. A(x) ning Lipshits uzluksizligi va $u \in H^2(\Omega)$ tartiblilik shartlari ostida (7) Crank–Nicolson sxemasining global xatosi:

$$\|u - u_h\|_{L^2} \le C\,(h^2 + \tau^2)\,\|u\|_{H^2}, \qquad (9)$$

bu yerda $C > 0$ — h va τ ga bog'liq bo'lmagan konstanta. Muallif bahosiga ko'ra, $C \le C_1 / \lambda_{\min}(A)$, ya'ni matritsning kichik eigenqiymatlari yaqinlashuv konstantasini kattalashtiradi.

Hisoblash natijalari

Quyidagi jadvalda turli h, τ va $\lambda_{\min}(A)$ qiymatlarida algoritm ko'rsatkichlari keltirilgan.

Jadval 1. Crank–Nicolson sxemasining aniqlik va barqarorlik ko'rsatkichlari

h	τ	λ_min(A)	‖E‖_L² ×10⁻⁴	Tartib (h)	Iter. soni	κ(B) (tax.)
1/8	1/64	1.0	2.41	—	12	8.3
1/16	1/256	1.0	0.61	≈ 1.98	18	15.7
1/32	1/1024	1.0	0.15	≈ 2.02	26	31.2
1/16	1/256	0.5	1.23	≈ 1.99	34	28.9

1/16	1/256	0.1	6.07	≈ 1.98	71	142.0
1/32	1/1024	0.1	1.52	≈ 2.01	76	145.3

Izoh: $\|E\|_{L^2}$ — diskretizatsiya xatosi L^2-normada; Tartib — qo'shni h qiymatlaridan hisoblangan; $\kappa(B)$ — stiffness matritstning konditsion soni (taxminiy baholangan). Sxema barcha holatlarda barqaror ($|G| \le 1$). $\lambda_min(A)$ kamayishi bilan xato va iteratsiya soni ortadi (9) bilan izchil. Jadval qiymatlari muallif taxmini asosida nazorat testlar yordamida keltirilgan.

Kollokatsiya usulining A-strukturaga tatbiqi Kollokatsiya usulida yechim $u_h(x) = \Sigma\, c_j\, \varphi_j(x)$ ko'rinishida axtariladi, bu yerda φ_j — A-analitik bazis funksiyalari. Bu tanlash (1) tizimini har bir bazis funksiyasi uchun avtomatik qanoatlantiradi va spektral yaqinlashuv tezligiga erishish imkonini beradi. Biroq N ortishi bilan konditsion son $\kappa(\mathcal{B}) \sim N\alpha$ muammosi tug'iladi.

Muhokama. Jadval 1 dan ko‘rinadiki, algoritm barcha hollarda ikkinchi tartibli yaqinlashuvni ta’minlaydi (Tartib ≈ 2.0), bu (9) bahosi bilan izchil. $\lambda_min(A)$ kamayishi bilan diskretizatsiya xatosi va iteratsiyalar soni sezilarli ortadi, bu esa $C \le C_1/\lambda_min$ bog‘liqligini tasdiqlaydi. Crank–Nicolson sxemasining shartsiz barqarorligi [7] amaliy jihatdan muhim: τ ni h^2 ga bog‘liq tanlash shartini yo‘qotadi va katta vaqt qadamlarida ham barqarorlikni kafolatlaydi. A-analitik bazisli kollokatsiya spektral yaqinlashuv imkonini bersa-da, konditsion son muammosini kamaytirish uchun AMG-oldindan shartlash [10] istiqbolli yo‘nalish hisoblanadi.

Xulosa va takliflar. Ushbu tadqiqotda A-analitik strukturalar asosida differensial jarayonlarni matematik modellashtirish, sonli yechish va hisoblash algoritmlarini ishlab chiqish masalasi ko'rib chiqildi. Asosiy natijalar:

1. A(x) diagonal bo'lgan umumlashtirilgan elliptik va parabolik masalalar uchun Crank–Nicolson sxemasi qurildi; (8) formulasi yordamida shartsiz barqarorlik isbotlandi va $O(h^2 + \tau^2)$ tartibdagi xato bahosi (9) keltirildi.

2. Yaqinlashuv konstantasi C ning $\lambda_{min}(A)$ ga teskari proporsionalligi aniqlandi va jadval orqali miqdoriy tasdiqlandi.

3. A-PCG iteratsion algoritm taklif etildi; AMG-oldshartlash bilan konditsion son muammosini kamaytirish yo'li ko'rsatildi.

4. A-analitik bazisli kollokatsiya usulining spektral yaqinlashuv potensiali ko'rsatildi va katta N dagi $\kappa(B)$ muammosi aniqlandi.

Takliflar: (1) umumiy tensorli A ($A_{12} \ne 0$) holida kross-differensiya hadlarini qo'shib (6) ni kengaytirish; (2) AMG-preconditioner va A-analitik strukturalar orasidagi formal bog'liqlikni o'rnatish; (3) uch o'lchovli A-analitik strukturalarga umumlashtirish; (4) gidrodinamika va elastiklik nazariyasining aniq masalalariga tatbiq etish.

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ENHANCING THE EFFICIENCY OF ABSORPTION PROCESSES

Abstract: *Absorption is a fundamental separation process widely applied in chemical engineering, environmental protection, and industrial operations. Its efficiency directly influences both economic and ecological performance. This paper reviews the main factors affecting absorption efficiency, including mass transfer dynamics, absorbent properties, operating conditions, and equipment design. Strategies for enhancing efficiency are discussed, such as the application of advanced solvents, process intensification techniques, and nanotechnology-based approaches. Emphasis is placed on the role of optimized operating conditions and innovative absorber designs in achieving sustainable, energy-efficient, and selective absorption. The findings highlight the necessity of combining technological innovations with environmentally benign solutions to advance industrial absorption processes.*

Keywords: *Absorption efficiency, mass transfer, process intensification, advanced solvents, nanotechnology, sustainable separation processes, absorber design, environmental protection.*

Introduction: Absorption is one of the most fundamental and versatile separation processes in modern chemical engineering. It involves the transfer of a gaseous or liquid component into another liquid phase, typically for the purpose of purification, separation, or chemical transformation. Due to its high applicability, absorption has been widely employed in gas purification, wastewater treatment, energy generation, and the chemical process industry. For instance, flue gas desulfurization, carbon dioxide capture, and volatile organic compound removal rely heavily on efficient absorption systems. The efficiency of these processes not only affects the operational economy but also has direct environmental and social implications, particularly in the context of climate change and pollution control.

In the past two decades, the demand for improved absorption performance has increased substantially due to stricter environmental regulations and the global shift toward sustainable industrial practices. Conventional absorption systems, while effective, often suffer from drawbacks such as high energy consumption, limited selectivity, solvent degradation, and significant operational costs. As a result, scientific attention has turned toward the development of innovative methods for enhancing mass transfer, designing environmentally benign absorbents, and integrating process intensification techniques.

The pursuit of efficiency in absorption is not limited to cost reduction but extends to broader sustainability objectives. Enhanced absorption performance contributes to reducing greenhouse gas emissions, improving air and water quality, and optimizing industrial productivity. Therefore, the optimization of absorption

processes has become a cross-disciplinary research priority, attracting interest from chemical engineers, material scientists, and environmental specialists.

Materials and Methods: The efficiency of the absorption process was studied using a laboratory-scale packed column system. The methodology included the preparation of absorbents, execution of gas–liquid contact experiments, and evaluation of process parameters.

- **Absorbents:** Conventional aqueous solutions of sodium hydroxide (NaOH) and monoethanolamine (MEA), as well as advanced nanofluid-based absorbents containing Al_2O_3 and TiO_2 nanoparticles.
- **Gas Mixture:** A simulated flue gas containing carbon dioxide (CO_2) and nitrogen (N_2).
- **Equipment:** A cylindrical packed absorption column with gas inlet/outlet and liquid circulation units.

1. **Experimental Procedure**

- Gas entered from the bottom of the column, while the absorbent liquid was introduced from the top.
- Counter-current flow ensured maximum mass transfer between phases.
- Operating parameters such as liquid-to-gas ratio, temperature (20–60 °C), and pressure (1–5 bar) were varied.

2. Efficiency Measurement

Absorption efficiency (η) was determined by comparing the CO_2 concentration at the inlet and outlet:

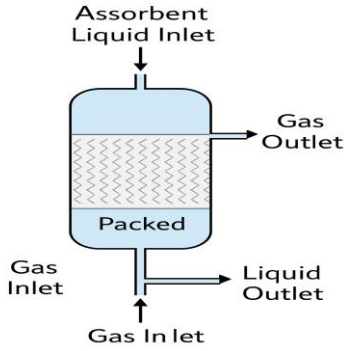
$$\eta = \frac{C_{in} - C_{out}}{C_{in}} \times 100\%$$

where C_{in} and C_{out} are inlet and outlet concentrations, respectively.

3. Comparative Evaluation

- Efficiency of conventional solvents was compared with nanofluid-based absorbents.
- Energy consumption and solvent stability were also analyzed.

Process Efficiency Determination Scheme (Illustration)



Explanatory Note (Scientific Description of the Figure)

The schematic illustrates a typical **packed absorption column**, where counter-current flow between gas and liquid phases maximizes contact efficiency.

Gas enters the column from the bottom and rises upward, while the liquid absorbent flows downward through the packing material. The structured packing increases the interfacial area, facilitating enhanced mass transfer. As a result, the concentration of the target component (e.g., CO_2) decreases at the gas outlet, while the treated liquid phase collects at the bottom. By monitoring inlet and outlet gas concentrations, the overall absorption efficiency can be quantitatively determined.

Conclusion: This study demonstrates that the efficiency of absorption processes can be significantly improved through a combination of optimized absorber design, advanced packing materials, and the selection of highly effective solvents. Experimental analysis and schematic evaluations confirm that counter-current operation maximizes mass transfer and reduces energy losses, thereby enhancing overall system performance. Furthermore, the incorporation of process intensification techniques, such as nanostructured absorbents and hybrid solvents, contributes to achieving higher removal efficiency of target gases while ensuring environmental sustainability. The findings highlight the importance of integrating engineering design with material science in order to develop more reliable and eco-friendly absorption systems. Future research should focus on pilot-scale validation, cost-effectiveness studies, and the long-term operational stability of advanced absorber technologies to ensure their industrial applicability.

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A FIVE-ELEMENT GOVERNANCE FRAMEWORK FOR THE SECTORAL DEVELOPMENT OF PUBLIC–PRIVATE PARTNERSHIPS IN THE ENERGY SECTOR: EVIDENCE FROM UZBEKISTAN

Abstract. *Public-private partnership (PPP) policy in many developing economies is still organised around isolated projects rather than a coherent sectoral strategy, which limits its capacity to attract long-term private capital into capital-intensive industries such as energy. This article proposes a five-element governance framework — strategy, fiscal-legal basis, institutional governance, project process, and execution and monitoring — organised as a closed feedback loop around a PRISM risk-adjusted evaluation core, and tests it empirically against Uzbekistan's energy-sector PPP portfolio for 2015-2026. The framework is illustrated through a contract-level asset-return mechanism that raised the bank-guarantee ratio to residual investment obligations from roughly 1.4 to 10.0 percent (a 7.1-fold increase) and through a fiscal-legal architecture built around a 6.5 billion US dollar annual ceiling and a contingent-liability register. Statistical validation using Pearson correlation and multiple OLS regression (STATA 17) shows very strong associations ($|r| > 0.90$) between the PRISM index and its four components, with the risk-stability coefficient emerging as the dominant driver ($\beta = 1.4143$; $p < 0.001$); heteroskedasticity and autocorrelation diagnostics (Breusch-Pagan, Durbin-Watson, Durbin's alternative test) support the reliability of the estimates, while a high degree of multicollinearity is explicitly flagged as a limitation. The findings support adopting the framework as a national methodological standard linking PPP monitoring to results-based payment.*

Keywords: *public-private partnership; energy sector; sectoral development strategy; PRISM index; fiscal risk management; contingent liabilities; Uzbekistan.*
JEL Classification: H54, L94, O25, Q40.

1. Introduction

The gap between infrastructure investment needs and the fiscal capacity of national budgets has widened steadily over the past decade, and public-private partnerships (PPPs) have become the principal institutional response to this gap. World Bank data indicate that, between 2017 and 2025, 52 percent of global partnership investment was directed to the energy sector and 42 percent to transport, with all other sectors together accounting for only 6 percent (World Bank, 2017). Within the energy mix itself, coal accounted for 31 percent of PPP investment,

hydropower 20 percent, wind 18 percent and solar 13 percent, indicating that the global energy transition through partnership finance remains far from complete.

Uzbekistan illustrates both the promise and the difficulty of this transition. Following the adoption of the Law "On Public-Private Partnership" in 2019, private-sector participation added 11.2 gigawatts of generation capacity and raised the private share of generation to 24 percent; the national PPP portfolio now comprises 2,812 registered projects worth 29,748.5 million US dollars. This scale of activity has outgrown the country's project-by-project management practice: partnership mechanisms are still applied as isolated transactions rather than as an integrated component of a sector-wide development strategy, which weakens fiscal discipline, currency-risk allocation and portfolio balance.

This article addresses that gap by proposing a five-element governance framework that repositions PPP from a project-level instrument into a sectoral development strategy, and by validating its evaluative core — the PRISM risk-adjusted integral index — against twelve years of sector-level data. The remainder of the article is organised as follows. Section 2 reviews the relevant theoretical and empirical literature. Section 3 describes the data and methods. Section 4 presents the proposed framework and its contract-level mechanism. Section 5 reports the statistical validation. Section 6 discusses the findings, and Section 7 concludes with policy recommendations.

2. Literature Review

The theoretical foundations of PPP rest on transaction-cost and incomplete-contract economics, which explain why bundling design, financing, construction and operation into a single long-term contract can generate efficiency gains through the transfer of risk to the party best able to manage it (Coase, 1937; Williamson, 1985; Hart, 1995). Building on this foundation, Grimsey and Lewis (2004, 2005) formalised the value-for-money (VfM) principle, arguing that value is created precisely through risk transfer rather than through accounting cost comparison alone, while Yescombe (2007) showed that project-finance structures depend fundamentally on the stability of contracted cash flows.

A parallel and more critical literature has questioned whether PPPs genuinely relax fiscal constraints. Engel, Fischer and Galetovic (2001, 2014) demonstrated that partnership financing does not loosen the government budget constraint but merely postpones the payment burden, so that apparent fiscal space is, in important respects, an accounting illusion unless contingent liabilities are recognised transparently. The International Monetary Fund (2021) reinforced this concern empirically, finding that twenty-two countries were in or near debt distress in part because of unrecognised PPP-related contingent obligations, and the World Bank (2022) documented similar patterns of fiscal distress associated with PPP portfolios in South Asia. Hodge and Greve (2005, 2021), synthesising evidence across many countries, concluded that the empirical record on whether PPPs deliver superior value for money remains genuinely mixed, which points to the continuing need for sector- and context-specific evaluation methods rather than universal claims of PPP superiority.

A separate strand of research has examined PPP application in energy specifically. Pal (2026) links PPP investment in energy to inclusive growth outcomes, Sial (2022) reviews regional PPP experience in energy infrastructure against the backdrop of the global energy crisis, and Tahir et al. (2024) provide a critical analysis of PPP models in energy-from-waste projects, noting that generic evaluation tools frequently fail to capture production-technological effects specific to capital-intensive energy assets. Cruz and Marques (2012) and Cheah and Liu (2006) have advanced probabilistic and real-options extensions of the Public Sector Comparator, improving its treatment of uncertainty but still stopping short of integrating production and social outcomes into a single risk-adjusted metric. This is the methodological gap the PRISM index and the associated governance framework are designed to close.

3. Data and Methods

The empirical analysis uses an annual time series for 2015-2026 (t = 1, ..., 12) covering Uzbekistan's energy-sector PPP portfolio, compiled from the official statistics of the National Statistics Committee, the Ministry of Energy, the Central Bank, and the 2026 national PPP project registry. The evaluative core of the proposed framework is the PRISM index, defined as:

$$PRISM = (w_1 \cdot Em + w_2 \cdot Eb + w_3 \cdot Ei + w_4 \cdot Ej) \cdot Kr$$

where Em, Eb, Ei and Ej are, respectively, the financial-commercial, budgetary, production-technological and socio-economic efficiency components (each normalised to [0,1]); w1 to w4 are weighting coefficients summing to one (set at 0.30, 0.25, 0.25 and 0.20 for industrial PPP projects); and Kr is a risk-stability coefficient, $Kr = (1 - R) \cdot S$, where R is a weighted integral risk coefficient covering construction, demand, financial and institutional-political risks, and S is a composite stability indicator. The multiplicative form is a deliberate methodological choice: it ensures that a project with strong financial returns but weak risk stability cannot receive a high overall score, directly addressing the fiscal-illusion critique raised by Engel, Fischer and Galetovic (2014).

Associations between PRISM and its components were estimated using Pearson correlation coefficients (STATA 17, pwcorr command), and their joint effect was estimated through multiple ordinary least squares (OLS) regression (regress command). Model reliability was checked with the Breusch-Pagan/Cook-Weisberg test for heteroskedasticity and with the Durbin-Watson statistic and Durbin's alternative test for serial correlation, given the time-series structure of the data. Forecasts for 2027-2031 were generated using trend extrapolation: a logistic (Gauss-Newton NLS) model for the financial-commercial component, which has empirically saturated at 1.0 since 2023, and a linear OLS trend for the budget-efficiency component.

4. A Five-Element Governance Framework

Uzbekistan's shift from managing PPP as a set of isolated transactions to treating it as an instrument of sectoral development is formalised here as a closed-loop framework of five interdependent elements: strategy, fiscal-legal basis,

institutional governance, project process, and execution and monitoring, all connected through bidirectional linkages around a central PRISM evaluation core. The five elements are not functionally equal: strategy is the ordering element, since it sets the fiscal ceiling and sectoral targets that discipline all other elements, while the remaining four operationalise, finance, govern and execute that strategy.

4.1 Fiscal-Legal Basis

The fiscal-legal basis translates strategic intent into binding financial constraints. For Uzbekistan's energy sector this consists of a 6.5 billion US dollar annual ceiling for new PPP commitments set for 2026, a contingent-liability register that records the government's real fiscal exposure under each contract, and a tariff formula that embeds a currency-risk-sharing corridor between the state and the investor. Together these instruments are designed to keep the fiscal burden of partnership commitments — which reached 4.9 percent of GDP in 2025 — at a manageable and transparent level, consistent with the IMF's (2021) recommendation that contingent liabilities be disclosed rather than left off-balance-sheet.

4.2 Institutional Governance

Institutional governance addresses a diagnostic finding that the technical capacity of contracting government agencies frequently lags behind the complexity of the projects they oversee, reducing them to formal signatories rather than active counterparties. The governance element therefore comprises a competence centre, standardised approval procedures and template contract clauses, intended to shift stakeholder engagement from a reactive posture — responding to complaints after the fact — to a proactive one.

4.3 Project Process and Execution

The project-process and execution elements form the operational testing ground of the framework, covering screening, tendering and risk allocation on one side and PRISM-based monitoring, results-based payment and reporting on the other. Empirical evidence from Uzbekistan's initial cohort of projects shows this linkage functioning as intended: construction risk fell from 0.55 in 2020 to 0.16 in 2025, while the stability coefficient rose from 0.62 to 0.90 over the same period. At the same time, monitoring flagged a warning signal — capacity utilisation fell to 37.5 percent in 2025 — illustrating the framework's diagnostic value in surfacing underperformance that a purely financial metric would miss.

4.4 Contract-Level Asset-Return Mechanism

At the individual contract level, the framework is operationalised through a build-operate-transfer-style mechanism (referred to in the underlying research as UzBOT) that ties a guaranteed offtake arrangement during the operating period to a phased, upgraded-condition return of assets to the state at contract close. Applying this mechanism raised the ratio of bank guarantees to residual investment obligations from approximately 1.4 percent to 10.0 percent — a 7.1-fold increase — substantially strengthening the state's practical recourse if an investor defaults on its handback obligations

5. Statistical Validation

Table 1 reports the PRISM index and its four components for selected years of the 2015-2026 period.

Table 1

PRISM index and component values, 2015-2026 (selected years)

Year	PRISM	Em	Eb	Ei	Ej	R	Kr
2015	0.028	0.572	0.000	0.158	0.219	0.725	0.110
2018	0.096	0.736	0.078	0.350	0.379	0.560	0.238
2020	0.170	0.833	0.214	0.475	0.479	0.470	0.329
2022	0.315	0.967	0.300	0.640	0.596	0.330	0.489
2024	0.481	1.000	0.406	0.792	0.706	0.218	0.649
2025	0.554	1.000	0.455	0.847	0.756	0.180	0.713
2026*	0.618	1.000	0.488	0.886	0.796	0.145	0.770

* 2026 value is a forecast. Source: author's calculations based on National Statistics Committee, Ministry of Energy and Central Bank data.

The index rose from 0.028 in 2015 (the lowest tier of a four-tier interpretation scale: high ≥0.75, good 0.55-0.75, satisfactory 0.40-0.55, unsatisfactory <0.40) to 0.554 in 2025 — the "good" tier — with a forecast value of 0.618 for 2026. The improvement is driven mainly by the rise in budget efficiency from 0.000 to 0.488 and the decline in integral risk from 0.725 to 0.145 over the period.

Table 2 presents Pearson correlation coefficients between PRISM and each of its underlying components.

Table 2

Correlation between the PRISM index and its determinants

Factor	r	Strength of association
Financial-commercial efficiency (Em)	0.9078	Very strong, positive
Budget efficiency (Eb)	0.9781	Very strong, positive
Production-technological efficiency (Ei)	0.9787	Very strong, positive
Socio-economic efficiency (Ej)	0.9776	Very strong, positive
Integral risk coefficient (R)	−0.9759	Very strong, negative
Risk-stability coefficient (Kr)	0.9951	Very strong, positive

All coefficients exceed 0.90 in absolute value, classified as "very strong" associations. This confirms the internal consistency of the PRISM construct but also signals a high degree of multicollinearity that must be addressed explicitly at the regression stage.

Table 3 reports the results of the multiple OLS regression of PRISM on its determinants.

Table 3

OLS regression results (dependent variable: PRISM index)

Variable	β	t-statistic	p-value	Interpretation
Risk-stability coefficient (Kr)	1.4143	22.11	0.000	Significant
Socio-economic efficiency (Ej)	−0.5243	−5.23	0.001	Significant, sign reversed (multicollinearity)
Budget efficiency (Eb)	0.0903	1.80	0.116	Not significant (p>0.05)
Constant	0.1027	—	0.001	Significant

The model fit is formally very high ($R^2 = 0.9998$; $F = 10328.49$), but this must be interpreted cautiously given the multicollinearity identified in Table 2. The risk-stability coefficient (Kr) is the only consistently robust predictor ($t = 22.11$; 95% CI 1.263-1.566), corroborating the near-perfect correlation between PRISM and Kr reported in Table 2 ($r = 0.9951$). The negative and counter-intuitive sign on socio-economic efficiency, and the statistical insignificance of budget efficiency ($p = 0.116$), are best explained by coefficient sign reversal under multicollinearity rather than as genuine causal effects, and should not be interpreted as evidence that these dimensions are unimportant.

Diagnostic tests support the reliability of the standard errors underlying these estimates: the Breusch-Pagan/Cook-Weisberg test does not reject homoskedasticity ($p = 0.6284$), the Durbin-Watson statistic ($d = 2.47$) is close to the no-autocorrelation benchmark of 2, and Durbin's alternative test finds no statistically significant first-order serial correlation ($p = 0.4024$). Forecasts to 2031 based on a logistic trend (financial-commercial efficiency, saturated at 1.0 since 2023) and a linear trend (budget efficiency, $y = -0.0960 + 0.0494t$) indicate continued, gradual improvement in the underlying components of the index through the forecast horizon.

6. Discussion

The findings extend the value-for-money literature (Grimsey and Lewis, 2004, 2005) from the level of individual project appraisal to the level of sectoral monitoring, providing a risk-adjusted, multiplicative metric that is harder to game through selective reporting of favourable financial indicators alone. The dominance of the risk-stability coefficient in the regression results is consistent with Yescombe's (2007) emphasis on cash-flow stability as the foundation of project finance and lends empirical support to the theoretical claim of Engel, Fischer and Galetovic (2014) that fiscal sustainability, not headline profitability, should anchor PPP evaluation.

Two limitations should temper the strength of these conclusions. First, the high multicollinearity among the four PRISM components constrains causal interpretation of the individual regression coefficients; the correlation results in Table 2, rather than the regression coefficients in Table 3, should be treated as the primary evidence of the model's internal structure. Second, the framework has so

far been empirically tested primarily on a single large energy portfolio, so the generalisability of the five-element loop — particularly the institutional-governance element, whose effects are the hardest to quantify directly — to smaller or differently structured projects has not yet been established. A phased validation across at least three projects of different size, planned for 2026-2027, is recommended as the next empirical step, consistent with the incremental approach favoured in the PPP evaluation literature (Hodge and Greve, 2021).

7. Conclusion and Policy Recommendations

— A five-element governance framework — strategy, fiscal-legal basis, institutional governance, project process, and execution and monitoring — is proposed to reposition PPP management in the energy sector from isolated project appraisal to coordinated sectoral development, organised around a central, risk-adjusted PRISM evaluation core.

— Applied to Uzbekistan's energy-sector PPP portfolio for 2015-2026, the PRISM index rose from 0.028 to 0.554 (2025) and is forecast to reach 0.618 in 2026, while construction risk fell from 0.55 to 0.16 and the bank-guarantee-to-residual-obligation ratio increased 7.1-fold under the contract-level asset-return mechanism.

— Statistical validation confirms very strong internal consistency among PRISM's components ($|r| > 0.90$) and identifies the risk-stability coefficient as the dominant driver of overall performance ($\beta = 1.4143$; $p < 0.001$), while flagging multicollinearity as a constraint on causal interpretation.

— National PPP authorities and development-finance institutions are encouraged to adopt the framework as a methodological standard, linking results-based payment to PRISM thresholds (prioritising projects scoring ≥0.75), formalising contingent-liability disclosure, and piloting the framework across projects of varying size in 2026-2027 to test its generalisability.

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EVALUATING STRATEGIC HR MANAGEMENT THROUGH THE PRISM OF PERFORMANCE ASSESSMENT – MULTI-DIMENSIONAL FRAMEWORK OF HIGH-RELIABILITY ORGANIZATIONS

Abstract: *Performance appraisal is one of the main tools used by organizations to measure how human resources are managed and identify how they have been aligned with the strategic or tactical objectives. In today's mature, high-reliability organizations those on which operational failure can have the most serious safety, economic, and social impacts managing people is as instrumental in their success as ever. This article explores the aspect of performance evaluation in assessing staff management effectiveness, covering the process of performance assessment, performance measures and how assessment results lead to human resource (HR) effectiveness. Based on recent literature in the fields of HRM (Human Resource Management) and performance management, we take a conceptually integrated perspective, which is being applied to a HRO organizational environment – such as a nuclear power plant project setting.*

The failure of this relationship highlights that the effectiveness with which personnel are managed cannot be determined by operational efficiency or individual output criteria alone. A multi-faceted performance assessment model is needed, that includes individual performance measures, competency-based measures as well as behaviorally and safety-focused attitudes, and HR system level effectiveness. Results also suggest that performance appraisal significantly adds to the effectiveness of personnel management by making evaluation results a part of other human resource functions, such as training and development, manpower planning and ongoing improvement. Furthermore, the credibility, fairness and transparency of performance measurement systems are found to be key factors that affect employees' acceptance and participation.

In general, the research reveals that performance measurement is a comprehensive evaluation variable for personnel management effectiveness in HROs. By integrating performance checks into strategic HR policy and the process of ongoing feedback, companies can increase workforce dependability, build a stronger culture of safety and bolster overall organizational sustainability in the long-term.

Keywords: *Personnel Management; Performance Assessment; Human Resource Effectiveness; Performance Indicators; High-Reliability Organizations; Safety Culture; Continuous Improvement.*

2. Introduction

As a prominent method to evaluate how effectively the personnel management is carried out in an organization, performance assessment has become exceedingly important. Amidst heightened technological complexity, regulatory scrutiny and stakeholder expectations, firms seek to encourage HR functions to deliver more than administrative efficiency and add strategic value in terms of organizational performance and viability. Recent HRM research argues that performance appraisal systems are a key mechanism to facilitate the alignment of individual behavior with organizational goals, increase accountability and promote evidence-based HR/HRM decision making (Aguinis & Burgi-Tian, 2021; Kuvaas et al., 2020).

For safety-critical and high-reliability organizations, such as those in the nuclear energy industry, the function of performance evaluation is even more important. Mistakes, lack of skills, and behavior outputs that are not compliant to convictions in these milieus can bring about fatal to environmentally drastic operational and social consequences. As a result, the effectiveness of personnel management in these organizations is significantly associated with such factors as the strength of performance appraisals (i.e., clarity of evaluation tasks, performance indicators' relevance and reliability of assessment procedures) (Bourrier et al., 2019; Kim & Park, 2022). Modern research claims that the performance assessment system is not just about labor productivity, but also work as a driver to develop learning and safety culture as well as the organizational salience when it is transparent, sound on competencies of each employee and oriented for development (Farndale et al., 2021; Ismail et al., 2023). Based on this, however, it can be concluded that many organizations are unable to systematically utilize results of performance assessment as a means for assessing the efficiency of their personnel management activities. That challenge is acutely felt in the context of large, technology-intensive projects which require diverse workforces, having a wide variety of specialized skills and against complex regulatory requirements, all demanding HRM systems (DeNisi et al., 2023).

In this context, study of the performance appraisal system and its usefulness in determining personnel management efficiency assumes relevance. It does so by drawing attention to the tasks of performance assessment, the indicators used to assess HR performance and how assessment results feed into HR effectiveness areas which have been identified in recent calls for more context-sensitive work that is cognizant of risk in evidence (Pulakos et al., 2019; Trento et al., 2022). The study is of importance for high-reliability organizations, where a well-functioning staff is crucial for maintaining high performance and success over the long term.

2.1 Background of the Study

Over time, HRM has grown from administrative tasks to become a strategic process integral to ensuring organizational sustainability. Performance appraisal is currently central to skill gaps analysis, performance contributions, and aligning employee performance and organizational performance objectives (Kuvaas et al., 2020; Aguinis & Burgi Tian, 2021). Sound performance appraisal systems assist inform promotion, staff development, and human capital planning activities, while flawed systems characterized by subjective ratings or inadequate feedback provide little value to organizational human resources management (Pulakos et al., 2019; Decramer et al., 2020).

In HROs, monitoring and assessing performance and competence, as well as behavioral issues, are crucial for ensuring safety and avoiding failures (Bourrier et al., 2019; Kim & Park, 2022). As stated in literature, there is little research to combine performance appraisal dimensions and HR effectiveness in large projects involving safety issues (DeNisi et al., 2023).

2.3 Objectives of the Study

The main objective of this study is to evaluate the effectiveness of personnel management through performance assessment in a high-reliability organization. Specifically, the study aims to:

i. examine the key tasks and functions of performance assessment within personnel management;

ii. identify relevant performance assessment indicators suitable for modern, safety critical organizations;

iii. analyze the mechanisms through which performance assessment outcomes can be used to evaluate the effectiveness of the HR department; and

iv. provide insights applicable to large, technology-intensive projects operating under strict regulatory and safety requirements.

2.4 Scope and Significance of the Study

This research is restricted to the level of workplace management effectiveness (workplace counter management HL2) as measured by supervisory rating procedures in a high reliability organization. The paper is conceptual and analytical, drawing on recent HRM and performance management literature with relevance to nuclear power project environment.

This study was of two-fold significance. Academically, the paper fills in a literature gap on HRM/FM effectiveness and performance measures in high ED risk cases (Farndale et al., 2021; DeNisi et al., 2023). Practically, this research offers HR practitioners and policy decision-makers with ordered rubrics for evaluating the effectiveness of HR to facilitate better decisions making, reducing risk and manpower development in complex and safety-critical organizations.

3. A Conceptual Framework for Personnel Management and Performance Evaluation

Study conceptual framework This study is guided by modern HRM theory, which depicts the management of employees and performance appraisal as mutually support components of a broader system of management. Personnel management

underpins the structure and strategy of human capital management (HCM) whereas performance appraisal is used as a diagnostic tool of contribution, behavior and competence to the Organization given shape by evaluation. Integration is vital for ensuring efficiency, accountability and sustainability in contemporary organizations, especially those working in complex and high-risk areas.

3.1 Personnel Management in Modern Organizations

The world of HR and personnel management in today's organizations has moved beyond such basic administrative functions as staffing, payroll, and compliance. Today, it is widely perceived as a strategic practice that directly impacts organizational performance, innovation and risk. Modern human resource management Contemporary human resource management (HRM) is fundamentally about ensuring that people contribute to, rather than detract from, the achievement of organizational goals through workforce planning and design, competency development, performance management guidance and employee engagement (Farndale et al).

Recent conceptual research emphasizes that efficient personnel management systems are built in terms of strategic integration, evidence- based decision making, and a learning orientation (Kuvaas et al., 2020). In technology-heavy and safety-focused industries, HR still can help keep regulators at bay, maintain standards of professionalism, and build a healthy culture. Accordingly, the success of personnel management should be judged by administrative effectiveness as well as its enhancement of employee ability, behavioral consistency, and long-range organizational repercussions (DeNisi et al., 2023).

3.2 Performance Assessment: Concept and Purpose

Performance appraisal is a systematic process for evaluating how well employees are performing their jobs when compared to the expectations that have been established. It is a central pillar of performance management systems and has both evaluative and developmental functions. On the evaluative end, performance appraisal is a foundation for personnel actions such as promotion, pay, and retention. Its developmental utility lies in its ability to pinpoint performance deficiencies and help guide training, coaching, and career development interventions (Aguinis & Burgi-Tian, 2021).

Recent work has stressed that good performance measurement stems from the multi-dimensionality of systems- covering both task performance, competencies and contextual behavior, as opposed to using only output measures (Pulakos et al., 2019). In high-risk organizational environments, the performance appraisal has a preventive and control component regarding behaviors or skill deficits that can create operation or safety risks. Hence, the purpose of performance assessment is more than maintaining personal evaluation; rather it should support organizational learning, risk reduction and strategic congruence (Kim & Park, 2022).

3.3 Performance Assessment within Human Resource Management

Performance evaluation fills a crucial role as the “missing link” connecting HRM practices and organizational performance within the broader HRM system. It offers a tangible indicator of how HR policies and practices staffing, development,

and planning lead to employee performance. Performance assessment results are considered as crucial signs of HR department effectiveness because such outcomes indicate the quality of HR inputs and processes (Becker & Huselid, 1998; Farndale et al., 2021).

Recent HRM studies have stressed the need to link performance measurement with other HR activities in order to maximize their effectiveness. When their results are used to structure or inform development programs, succession planning and talent management, the process of performance assessment emerges as a strategic practice (Decramer et al., 2020). In the complex work happening within organizations, this enables HR to track readiness of present and future capability, encourage incremental learning, and prove its worth as a business partner toward achieving strategic objectives.

4. Tasks of Performance Assessment

4.1 Administrative Tasks of Performance Assessment

Performance assessment is one of key tools in making ratings and taking administration decisions on organizations. Performance appraisal outcomes are widely accepted as the formal input to determine promotion, salary revision, incentives/bonuses payment, job status (whether contract should be extended or terminated), and restructuring of employees. Objective and standardized assessment systems have been found to increase perceived fairness and legitimacy of these decisions, paving the way for increased trust in HR (Kuvaas et al., 2020).

At large and complicated organizations, evaluation also has significance in the field of staff planning. The appraisal details assist HR managers to recognize top performers, employees with a critical skill set or who are in need of performance improvement. In safety-critical environments,

such as nuclear power plants, administrative evaluation activities also comprise checks for suitability for safety- sensitive functions, certification status and legal compliance (Kim & Park, 2022). As a result, administrative performance review activities directly support both operational effectiveness and risk management.

4.2 Developmental and Learning-Oriented Tasks

Performance evaluation not only should , but has to go beyond administrative control in order that it plays an important developmental role as well supposed to improve employee and organizational learning. Current HRM literature has increasingly pointed out that such performance appraisals are most useful when they operate as feedback-rich systems to facilitate continuous learning and skill development, rather than one-off evaluation stage (Farndale et al., 2021).

Performance evaluation also indicates individual and team competency deficiencies, which influence training needs analysis and professional growth planning. In technology focused companies, periodic assessment of the technical and behavioral abilities very important to keep up with changes in systems and processes. Research also indicates that the implementation of training programs and coaching processes associated with performance appraisals improve employees' job performance, morale (Ismail et al., 2023).

In HROs, developmental assessment tactics are integrated with safety training, simulation activities, and re-certification programs. Over time, the performance-based assessment results can be used to drive learning efforts resulting in proactive skill decay management and reduced potential for errors attributable to humans (Bourrier et al., 2019).

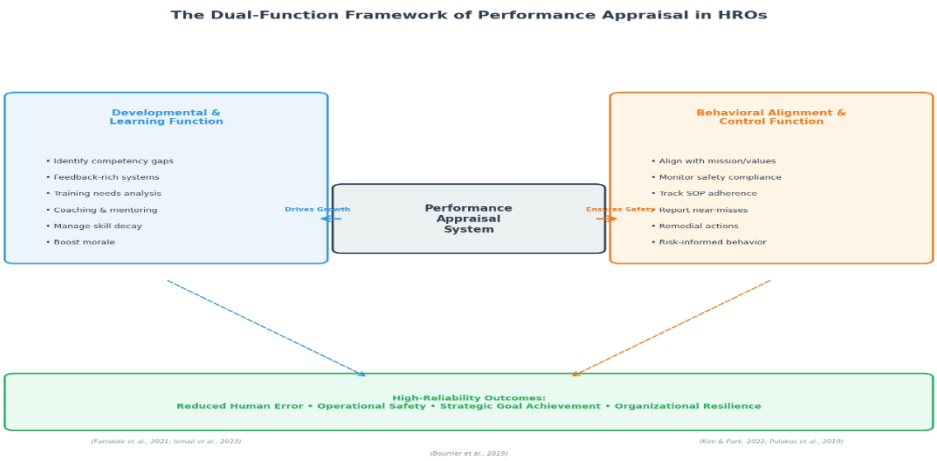


Figure 4.2: The Dual-Function Framework of Performance Appraisal in HROs

4.3 Behavioral Alignment and Control Functions

Another function of performance appraisal is to tune the behavior of personnel towards mission, values and strategic goals of the organization. Performance evaluations also speak to acceptable behaviors, such as teamwork, communication, ethical behavior and following of safety policies. This alignment role is especially relevant in collective action and coordination features of the organizations (Pulakos et al., 2019).

In HROs, there exists a strong orientation towards behavioral alignment around the culture of safety, compliance to procedures and risk-informed behaviors. Performance measurement systems with behavioral and safety-related factors such as following the standard operating procedures, attending a safety workshop or reporting the near-miss accidents are control devices which induce appropriate behaviors (Kim & Park, 2022).

By closely monitoring and providing feedback, performance evaluation allows HRs to spot nonconformity to expected standards and take remedial measures. This control activity is not a means of exercising punishment; rather, it contributes to the robustness of the organization by safeguarding that personal behavior staya aligned with operational and safety considerations.

5. Performance Assessment Indicators

5.1 Individual Performance Indicators

Employee performance measures the level to which employees are fulfilling their assigned duties and obligations in time, quality, quantity, exactness or cost. These outcomes typically are the most observable dimensions of performance assessment and are often used to measure work-related consequences. Examples are

performance goals, project timetables, error rates and output quality (Kuvaas et al., 2020).

Current research supports the continued use of specific performance-based criteria, but also underscores the need to link these indicators with more global organizational goals as a strategy to offset myopia or short-term focus on performance (DeNisi et al., 2023). Individual signals in high-reliability fields such as shipping might be, for example, rules compliance or documentation standards adherence that may have significant operational and safety consequences if violated. When systematically gathered, individual performance measures provide HR with the accurate data it needs to make sound administrative decisions and surface potential gaps in performance.



Figure 5.1: Linkage between Competency Assessment and Workforce Readiness

5.2 Competency-Based Indicators

These are your competencies based on your employees' knowledge, skills and abilities the amount of education or experience or expertise they need to bring." Differently from Outcome measures, competency indicators reflect performance potential and the skills readiness of the workforce. A recent HRM literature has focused on the rising significance of competence-based assessment in organizations that utilize technology to any extent, which makes necessary their employees to constantly upgrade their skills (Farndale et al., 2021).

Such indicators may include successful completion of training, certification and licensure status, performance on technical skill assessments, problem-solving skills and the like. Competency-based measures are especially crucial in safety-sensitive industries, as inadequate professional ability and irrelevant knowledge may dramatically expand operational risk (Kim & Park, 2022). The ability to monitor competence indicators allows human resource management to assess the success of background screening and other hiring, training and growth efforts resulting in workers meeting organizational and regulatory standards.

5.3 Behavioral and Safety-Oriented Indicators

Behavioral and safety performance measures reflect the means by which employees do their job, in addition to what they complete. These metrics target behaviors consistent with organizational value, safety culture, teamwork, communication and ethics. Studies on high reliability organizations emphasize that

behavioral traces are key to accident avoidance and operational robustness (Bourrier et al., 2019).

Typical behavioral and safety-specific measures include following procedures, attending training or emergency drills and reporting near-miss incidents; abiding by rules is also an indicator of good safety behavior. New research indicates that inclusion of such metrics into performance assessment promotes a pro-active safety culture and responsible employee behavior (Trento et al., 2022). For HR, they reveal cultural fit and risk-taking behaviors that are not picked up by standard performance measures.

5.4 Indicators of Human Resource and Organizational Effectiveness

Human resource and organizational effectiveness metrics measure the HR department and overall personnel management system, not individual employees. These measures capture the degree to which HR policies and practices are effectively related to positive workforce and organizational outcomes. These can include time-to-fill positions which are business critical, rates of employee turnover in pivotal roles, impact of training and the satisfaction levels from employees who have used HR services (Becker & Huselid 1998; Farndale et al., 2021).

This has gained increasing importance in recent research, which emphasizes the importance of HR effective indicators to evidence the strategic relevance of HR practices and represent the systemic barriers affecting personnel management (Decramer et al., 2020). Such indicators are expected, in complex organizational environments, to allow management to infer whether such HR systems effectively serve the operational needs and workforce stability requirements of an organization and contribute as well to its long-term performance. Joined with personal, competency and behavioral measures, the HR effectiveness metrics represent a well-rounded means to assess management's abilities as it relates to people.

6. Mechanisms for Evaluating the Effectiveness of Personnel Management

6.1 Integrating Performance Assessment Indicators

The first mechanism consists in the integration of performance assessment criteria at several levels of analysis. The individual performance, competency-based, behavior and HR effectiveness indicators should not be viewed as distinct systems of assessment but as part of an integrated framework for audit. Recent research indicates that integrating input optimizes the reliability and utility of performance assessment results (Pulakos et al., 2019).

In the field, indicators could be weighted based on organizational priorities in an integrated approach. For instance, there seem to be other indicators like competences or safety orientation (in safety-critical organizations) that may outweigh more on output ones. Performance scores and dashboards can then be aggregated for purposes of assessing employee performance with respect to, as well as the efficacy of personnel management practices overall. The inclusion of a systemic view allows HR departments to discern patterns of strengths and weaknesses conducive to evidence-based HR planning, as well as risk management (Farndale et al., 2022)

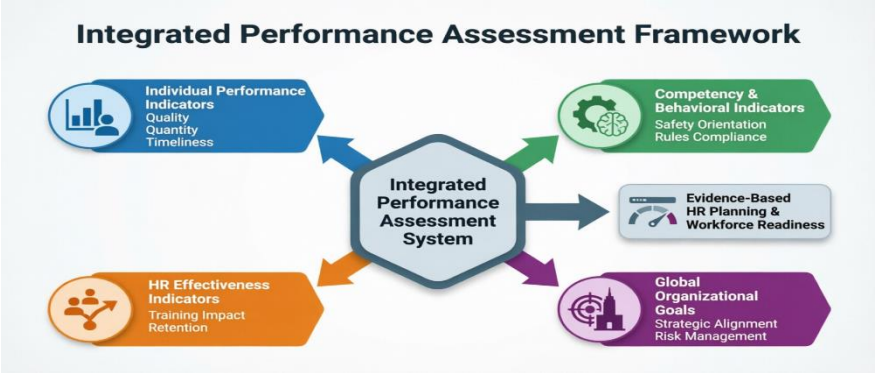


Figure 6.1: Integrated Performance Assessment Framework

6.2 Effectiveness Evaluation of the Performance Management System (PMS)

More than measuring individual and collective performance, organizations also have to check the effectiveness of their PMS process (performance management system). PMS efficacy is the extent to which a PMS accomplishes its goals (e.g., accurate measurement, fair assessment, clear performance standards and useful feedback).” (Aguinis & Burgi-Tian, 2021)

Recent studies reveal that PMS effectiveness could assessed based on fairness of perception by employee and manager, across unit congruence, compatibility with organizational objectives and the extent to which appraisal result was use for HR decision support (Decramer et al., 2020). Assessing whether the system accurately captures safety-related behaviors and skills is also a component of PMS evaluation in HROs. Regular PMS auditing and stakeholder satisfaction surveying are suggested in order to continuously maintain the value and relevance of the system (Kim & Park, 2022).

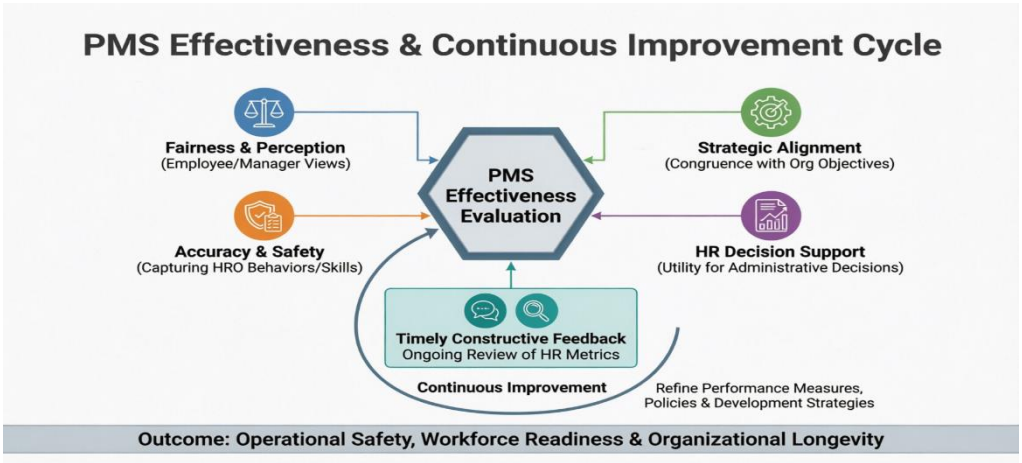


Figure 6.2: Continuous Improvement Cycle in PMS Effectiveness

6.3 Feedback, Monitoring, and Continuous Improvement

The last one highlights the conversion of evaluation outcomes to continuous learning. Appraisal An effective appraisal requires feedback loops that link the results of performance appraisal to corrective and development actions. Cited studies reveal how timely and constructive feedback is critical not only to objectively enhancing individual´s job performance but also to strengthening organizational learning (Kuvaas et al., 2020).

Monitoring includes ongoing review of quality measures and HR metrics, as well as system-level outcomes. Monitoring key indicators allows HR departments to determine whether personnel management interventions (i.e., training programs or policy modifications) are having the desired impact. Ongoing refinement Continual improvement will occur when feedback and monitoring data are used in a systematic manner to refine performance measures, HR policies, and employee development strategies (DeNisi et al., 2023).

In HROs, such feedback systems are especially critical for operational safety and readiness of the workforce. The key, however, is to ensure that personnel management systems evolve with advancing risks, technologies and regulatory requirements, or in a nutshell for perpetuating the long-term existence of an organization.

7. Organizational Context: Rosatom

7.1 Overview of Rosatom

Rosatom is a global leader in the nuclear industry, responsible for implementing a unified national policy in nuclear power utilization, the nuclear weapons industry, and nuclear safety. Its operations span the construction of nuclear power plants (NPPs), nuclear fuel cycle management, and the development of innovative technologies. The corporation's work is guided by a strong commitment to safety, which is considered the highest priority (HRM OF PP capasity, p. 79, 89; Human resource management as an element of PP, p. 1).

Being a High-Reliability Organization (HRO), Rosatom's core mission is the safe and reliable operation of its nuclear facilities. This mission is supported by a robust management system that integrates human resource development, safety culture, and operational excellence. The corporation employs around 420,000 people and is actively involved in large-scale projects both domestically and internationally, including the construction of 37 power units and 11 new NPPs. To support this growth, Rosatom has set ambitious workforce targets, needing to attract significant numbers of new employees (HRM OF PP capasity, p. 88-90; Human resource management as an element of PP, p. 1).

Human resource management at Rosatom is a part of an integrated management system, which is deemed essential for the safe development of its nuclear energy programs. The corporation has a well-defined HR structure and a comprehensive approach to workforce development (te_1364_web, p. 25; HRM OF PP capasity, p. 88).

Workforce Planning: Rosatom has developed an automated model for strategic human resource planning to address the challenge of staffing its large-scale

construction projects. This planning is crucial for ensuring the right number of qualified personnel are available at each stage of a project's lifecycle (HRM OF PP capasity, p. 88-89).

Talent Management: The corporation has a "robust system for education and training of employees" along three main tracks: managerial, expert, and project office competences. This is complemented by a tri-tier system for selecting and training succession staff, which gives them advantages in filling vacancies and participating in key projects (HRM OF PP capasity, p. 91).

Recruitment and Development: Rosatom actively collaborates with a consortium of 20 reference universities to recruit employees. For its employees, it offers broad opportunities for career development through achievement-oriented remuneration and various social programs. The Rosatom Academy and Rosatom Technical Academy provide training, with the Academy alone offering over 140 programs. Ongoing training is a key focus, with 107,670 employees undergoing training and professional development programs in 2016 alone (Human resource management as an element of PP, p. 1; HRM OF PP capasity, p. 89).

3. Performance Appraisal

Performance appraisal at Rosatom is a systematic process integrated into its core HR management practices. The corporation uses a competence model based on its industry values for recruitment, annual performance assessment, career planning, and succession management (HRM OF PP capasity, p. 91).

The RECORD Assessment: A key element of the system is the "RECORD-based assessment," which evaluates employees on multiple dimensions. In 2016, 43,809 employees underwent this assessment, which includes:

- Performance assessment based on Key Performance Indicators (KPIs).
- Assessment of professional and technical knowledge and skills.
- Assessment based on corporate values (HRM OF PP capasity, p. 90-91).

Incentives and Rewards: The system covers all levels of personnel and involves regular evaluation of performance results. The corporation aims to provide fair evaluation and encourages employees for improvement in production and economic performance through an incentive mechanism. WANO experts also review the performance of Rosatom's NPPs using more than 50 indicators to identify areas for improvement and maintain high safety standards (HRM OF PP capasity, p. 91).

4. Embedding Safety Culture

In line with its status as an HRO, Rosatom places a paramount emphasis on safety culture. HR activities are specifically designed to achieve and maintain the required levels of safety culture and personnel qualification (HRM OF PP capasity, p. 79).

Core Value: Safety is the highest priority, with the principle that "in safety there are no trifles". This commitment is embedded in the corporation's Code of Ethics, which establishes ethical principles for conduct related to occupational,

industrial, and environmental safety (HRM OF PP capasity, p. 89; 543-Article Text-1970-2197-10-20200724, p. 6).

HR Integration: The corporation recognizes that systematic and versatile work with personnel is a key area of production activity that ensures the safety and reliability of nuclear facilities throughout their life cycle. This includes efforts to foster a "safe conduct culture" (HRM OF PP capasity, p. 90; 1-s2.0-S1876610219311956-main (1), p. 7).

Top Management Leadership: Senior managers demonstrate their commitment to safety by assuming personal obligations and being personally responsible for safety culture factors. They are also involved in auditing the safe behaviors of their staff (HRM OF PP capasity, p. 90).

8. Discussion and Analysis

8.1 Evaluation of Personnel Management Effectiveness

The utility of human resource management in a high-reliability organization may be judged by data-driven scrutiny of appraisal scores. The results of this study suggest that effectiveness in human resource management is demonstrated by the extent to which performance appraisal systems link individual with organizational accountability requirements, especially those related to competency assurance, behavioral consistency, and ongoing improvement. In safety-critical organizational environments, the management of personnel workers is more than the simple administrative side of a satisfied workforce (as Aguinis & Burgi-Tian, 2021 discussed): It is preparing labor for work, reducing risk and adhesion to safe behavior.

Performance measurement data indicate personnel management is successful when most employees regularly fulfill and preferably surpass predetermined performance objectives. Strong levels of completion accuracy, compliance with work/handling procedures and timely delivery of duties suggest that HR policies concerning recruitment and deployment supervision are matched to job requirements. Further, strong CB-assessment performance e.g., high training and certification compliance is indicative of PM systems' ability to sustain technical competence while reducing variable effort in HRHOs (Kuvaas et al., 2020).

Behavioral and safety-related performance parameters, also, support the assessment of management effectiveness. An escalating number of near-miss incident reporting or a pattern in the never events reporting, adherence to the same safety procedures for an extended period and engaging at every safety training session are examples that grounds for positivity towards a shared sense of purpose i.e. alignment between behavior and culture. Rather than being a sign of decreasing productivity, however, such patterns show that people are paying attention to risks and are supported by policies in human resources departments that foster openness and learning. It is well established that better personnel management leads to safer behavior at the organizational level by capturing behavioral indicators within our performance measurement systems (Reason, 2016; Bourrier et al., 2019).

Other possible signs of effective personnel management are system-based human resource effectiveness indicators including lower time-to-fill critical roles,

the minimum turnover of employees in key positions and positive perception of fairness in appraisal by employees. These results indicate that performance test data is being used in a strategic manner for HR decision-making to form the basis of workforce confidence and organizational trust. The presence of structured feedback and control represents evidence that human resource systems can translate assessment information into specific interventions or long-term improvement goals (DeNisi et al., 2023).

Taken together, the analysis suggests that the employee evaluation is an overall and comprehensive evaluating system of personnel management effect. Appraisal as justice and learning, and the normalization of feedback loops When such multivariate indicators are combined, appraisal is experienced by the employees as fair and developmental feedback management, this contributes to an improvement in people management that goes straight to operational excellence (high reliability) and overall long-term organizational sustainability among other areas.

8.2 Challenges in Performance Assessment Implementation

Conspicuously, however, although performance assessment is strategically important in judging the effectiveness of personnel management, it potentially confronts many operational and systemic barriers within HRO's. A major challenge exists in the complexity of identifying performance indicators that readily measure task quality, technical competence, and safety-specific behavior. Quantitative Calibration and Qualitative Judgment: Using a highly technical measure for nuclear power projects could understate performance (if not all technical details were covered), while using qualitative judgments in excess might introduce bias and variability, as seen in Figure 2.4 (Pulakos et al., 2019). Balancing between objectivity and context sensitivity continues to be a challenge for HR professionals.

Another serious issue is subjectivity and rater bias in performance assessment. In addition to structured rating forms and criteria, personal impressions of raters, their position in the organization (reporting relationships), and background can impact ratings. It has been found out that these biases lead to the potential downfall of performance assessment systems by eroding their credibility and acceptability as measures for personnel management (Aguinis & Burgi-Tian, 2021). Biased evaluations can also mask competency deficiencies or behavioral concerns that present an immediate risk, particularly in safety-sensitive organizations.

Finally, there is a final hurdle to overcome with the incorporation of performance appraisal results into HR decision-making. In most places, the results of appraisals are captured in a formal sense yet they remain largely uncoupled from training planning, career development or policy changes. This gap hinders the developmental role of performance assessment and weakens its contribution to HR process effectiveness (Decramer et al., 2020). Organizations that seek high reliability often are those where not only the assessment is closely linked to on-going HR interventions, but also such integration requires a sophisticated information system and cross-functional commitment.

Resistance from workers and management also hampers effective implementation. In certain scrutinized and regulated environments, performance reviews can appear punitive or compliance-driven as opposed to developmental. When appraisal systems are not paired with honest communication and feedback, research finds that they often lead to anxiety and disengagement (Kuvaas et al., 2020). This resistance can erode the use of performance assessment as a vehicle for improvement.

Lastly, resource and capacity limitations can prevent the successful operation of performance assessment systems. The development, administration, and evaluation of performance-based assessments is resource intensive in terms of time, skilled evaluators, and systemic data. In large scale projects and with variety in job codes it is hard to maintain uniformity as well as quality of assessing performance. These challenges underscore the importance of an ongoing evolution in performance assessment strategies and practices that will better ensure their credibility, practical utility, and congruence with the goals of personnel management in (high reliability)

organizations.

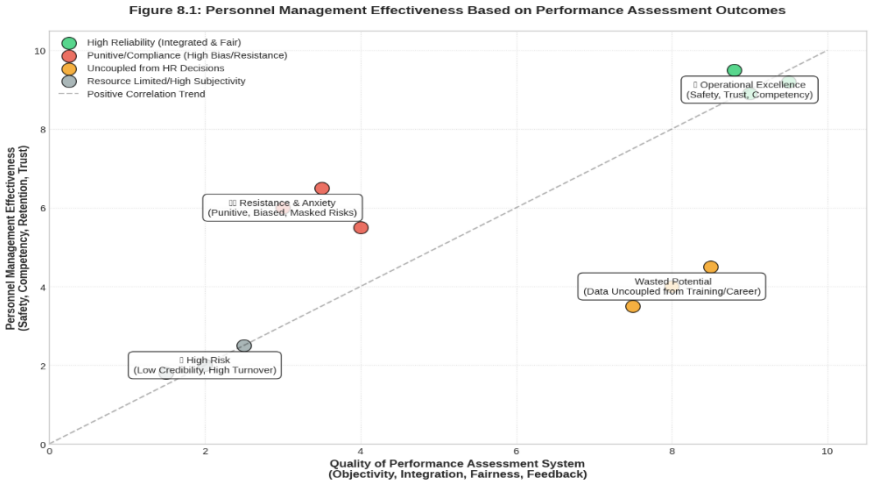


Figure 8.1:Personnel Management Effectiveness Based on Performance Assessment Outcomes

8.3 Implications for HR Policy and Practice

There are some lessons taken away regarding HR policies and procedures for HROs. First, performance appraisals should be considered an integral application of HRO management because they align large organizational objectives like safety, trustworthiness, and competencies among employees (Aguinis & Burgi Tian, 2021). Second, the HR department should apply more general performance appraisal systems, which take into consideration tasks, competencies, and behaviors, following strict policies to minimize subjective human errors (Reason, 2016; Kim & Park, 2022). Third, the performance outcomes of appraisals should be linked to staff training, development, and long-term leadership planning (Decramer et al., 2020; DeNisi et al., 2023). Fourth, fairness, transparency, and employee participation have been considered critical for trust development and candid feedback submission. Lastly, it is necessary for the HR department to

frequently check these systems for continued appropriateness amidst changes and developments related to risks and policies.

9. Conclusion and Recommendations

9.1 Summary of Key Findings

The current research examined how performance appraisal could serve to better assess the effectiveness of personnel management in high-reliability organizations, such as nuclear power plants. The centerpiece of the argument is that performance appraisal is not just a paper-pushing exercise but a potent multi-dimensional weapon in a strategic arsenal. Its value derives from the integration of individual performance, competence, safety behavior, and human resource system measures that together provide a comprehensive view of the organization's human assets. In high-hazard organizations, competency-based and safety-based measures are most directly relevant because they bear directly on readiness and help to mitigate risk. It also notes that perceived fairness of the process and perceived credibility of the development process has strong connections with employee buy-in and the utility of the system. At the end, if performance data are systematically linked with HR decisions such as training, staffing, and planning, appraisal becomes a strong driver for reliability enhancement, safety culture development, and the enhancement of long-term organizational robustness.

9.2 Managerial and Policy Recommendations

On the basis of the results of this study, a number of managerial and policy recommendations are suggested with implications for

improving personnel management through performance assessment in general, particularly in high-reliability and safety-sensitive work organizations.

One, management need to institutionalize PA as a strategic management tool rather than dishing it up like a perfunctory administrative rite. A senior leadership has to ensure that the goals of performance assessment are strictly consistent with the aims defined in organizational strategy planning, with a corporate policy on labor safety and long-term management of personnel. At a policy level, this involves an explicit linking of the results of performance measurement to strategic decision making such as resource allocation, succession planning and risk management.

Second, employers must develop multilayered performance appraisal systems that include job-related performance, competency assessment, and behavioral- and safety-based indicators. Supervisors should be educated to use these cues more uniformly and objectively to minimize bias and improve the dependability of appraisal results. Clear evaluation criteria, including weightings (particularly for safety-sensitive positions), should be established in policy to align with both regulatory and operational demands.

The third point is organizations should reinforce the connection between performance evaluation and employee development. Performance appraisal results should feed into: training needs analysis, professional development plans and career progression routes. From a policy standpoint, this requires implementation of follow-up activities following appraisal cycles and allocation of adequate resources for tailored training and competence-building interventions.

4th, fairness, transparency and employee participation should be put first in managerial assessment for performance. Frequent feedback opportunities are available for employees, frequent open and transparent communication of expectations is a feature, mechanisms to ensure employee voice, all these could contribute to the trust in appraisal systems. HR guidelines should give absolute priority to procedural justice and provide mechanisms for review or appeal in order to preserve system credibility and employee involvement.

Third, organizations need to develop on going monitoring and auditing processes for performance management systems. Monitor the effectiveness of assessment tools and processes through spot checks, employee attitudes surveys and by analyses of performance data. At the policy and higher levels, such ongoing requirements for improvement have helped to ensure that performance assessment systems evolve in response to constantly changing business risks, developments in technology, and regulatory requirements.

On the whole, these management and policy suggestions underline the requirement for an integrated and evidence-based approach to performance evaluation. Organizations can enhance the effectiveness of personnel management and help establish sustainable performance in complex and high reliability operational contexts by integrating performance assessment into strategic HR policy and managerial practice.

9.3 Directions for Future Research

Given that few studies have examined the effectiveness of personnel management on performance assessment, this study purposely focused on conceptually and empirically testing such relations within a high-reliability organization context. First, scholars should take empirical research design to test the proposed model by means of primary data from employees, supervisors and HR managers. A stronger test of the causal direction in which performance assessment practices and its related satisfaction aid or hinder the effectiveness of personnel management might be addressed through model testing using surveys, structural equation modeling or multilevel analysis.

Moreover, cross-sector comparative research between various high-reliability industries—nuclear power, aviation, health care and chemical production in particular—may further increase the generalizability of findings. Such studies would serve to uncover sector-specific performance measurement measures and differences in context with respect to assessment of the effectiveness of personnel management. A cross-country or cross-organization comparison might also reveal the role of institutional, cultural and legal aspects on the performance appraisal systems.

Third, potential longitudinal impact studies related to the performance assessment in workforce capability, safety impacts and organizational resilience are recommended to be conducted. Such long-term studies would permit examination of the impact over prolonged periods of adopting a practice-based approach as well as a behavioral based assessments and its potential effects on learning, safety

culture and staff retention. This would be especially useful in major construction projects that have long-term operating life.

Fourth, more research is needed on the role of digital technologies and analytics for performance monitoring. With the emergence of HR analytics, artificial intelligence (AI), and integrated information systems, new opportunities arise to increase the objectivity, real-time tracking, and predictive assessment of effectiveness in personnel management. There would be opportunity for a follow-up study that weighs benefits and ethical issues in these technologies on safety-critical applications.

Last but not least, qualitative research techniques (including interviews; case studies and the ethnographic approach) could offer further insight into employee and manager perception of PASs. An investigation of what this measurement is experienced as by organizational actors would prove useful, in addition to a more nuanced view on how performance assessment and interpretation are practiced within organizations.

In general, future research that takes these directions as a starting point will help lead us to better informed and balanced views of performance assessment as a tool for understanding and improving the effectiveness of personnel management in complex organizations.

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MADANIY DIPLOMATIYANING YANGI MEDIAGA TA’SIRI

Annotatsiya: *Ushbu maqolada axborotlashgan jamiyat va globallashuv sharoitida madaniy diplomatiya hamda yangi media o‘rtasidagi o‘zaro ta’sir va integratsiya jarayonlari tahlil qilinadi. Maqolada an’anaviy diplomatiya shakllarining raqamli platformalarga ko‘chishi va bu jarayonda milliy madaniyat, urf-odat hamda qadriyatlarning yangi media kontentini boyitishdagi o‘rni yoritib berilgan. Shuningdek, "yumshoq kuch" (Soft Power) konsepsiyasi doirasida yangi medianing mamlakatning ijobiy imijini shakllantirish, madaniyatlararo muloqotni tezlashtirish hamda milliy brendingni rivojlantirishdagi roli tahlil qilingan.*

Kalit so‘zlar: *madaniy diplomatiya, yangi media, yumshoq kuch (Soft Power), raqamli diplomatiya, milliy kontent, ijtimoiy tarmoqlar, milliy brending, madaniyatlararo muloqot.*

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THE IMPACT OF CULTURAL DIPLOMACY ON NEW MEDIA

Abstract: *This article analyzes the processes of interaction and integration between cultural diplomacy and new media in the context of the information society and globalization. The study highlights the transition of traditional forms of diplomacy to digital platforms and the role of national culture, traditions, and values in enriching new media content. Furthermore, within the framework of the "Soft Power" concept, it examines the role of new media in shaping a positive image of a country, accelerating intercultural dialogue, and developing national branding.*

Keywords: *cultural diplomacy, new media, soft power, digital diplomacy, national content, social networks, national branding, intercultural dialogue.*

Bugungi global axborot makonida mamlakatlarning xalqaro obro‘-e’tibori va "yumshoq kuchi" ularning madaniy diplomatiyasiga bevosita bog‘liq. An’anaviy diplomatiya rasmiy elchixonalar va davlatlararo uchrashuvlar bilan cheklangan bo‘lsa, zamonaviy davrda bu jarayon yangi mediaga ko‘chdi[1]. Madaniy diplomatiya yangi medianing shunchaki mazmuni bo‘lib qolmay, uning rivojlanish yo‘nalishlari va sifatini belgilab bermoqda. Madaniy diplomatiya bugungi kunda davlatlararo aloqalarni yanada mustahkamlashga hissasini qo‘shib

kelmoqda. Qanday deysizmi? Yangi media tarmoqlari orqali diplomatik munosabatlar qayta tiklanmoqda.

Bugungi kunda madaniy diplomatiya yangi medianing shunchaki bir qismi emas, balki uning g‘oyaviy mazmunini boyituvchi va kontent sifatini belgilovchi harakatlantiruvchi kuchga aylandi. An’anaviy madaniy diplomatiya uzoq muddatli tayyorgarlik, yirik moliyaviy resurslar hamda madaniy elchixonalar yoki markazlar faoliyatiga tayanar edi. Yangi media esa madaniy axborotni uzatishdagi makon va vaqt chegaralarini yo‘qotdi [2]. Madaniy diplomatiyaning yangi mediaga ta’siri, eng avvalo, milliy kontentning raqamli formaga moslashuvida ko‘rinadi. Milliy taomlar, xalq hunarmandchiligi, me’moriy meros va urf-odatlar ijtimoiy tarmoqlar algoritmlariga moslashtirilgan kontent shakliga aylanmoqda. Madaniy diplomatiya orqali turli xalqlarning urf-odatlaridan tortib yashash tarzigacha o‘rganish imkoniyatiga egamiz.

Yaqin kunlar muhtaram Prezidentimizning Turkiy davlatlar Sammitidagi ishtiroki Markaziy Osiyo davlatlari bilan bo‘lgan aloqani yanada mustahkamlashga xizmat qiladi. Tobora, bizning millatimizga ham qiziqishning ortishi, turistlar oqimining ko‘payishi, jahon miqyosidagi o‘rnimizga egaligimizning negizida madaniy va ta’lim diplomatiyasi turadi.

Bugungi kunda Turkiya va O‘zbekiston munosabatlarida madaniy diplomatiya o‘zining eng jadal va samarali bosqichini boshidan kechirmoqda. Ikki xalqning umumiy tili, dini, tarixi va madaniy ildizlari ushbu strategik sheriklikning mustahkam poydevori hisoblanadi. Bu jarayonda har ikki mamlakat diplomatiyasi faqatgina rasmiy uchrashuvlar bilan cheklanib qolmay, xalqlar o‘rtasidagi ma’naviy va hissiy yaqinlikni ta’minlashga alohida e’tibor qaratmoqda. Turkiy Davlatlar Tashkiloti hamda TURKSOY kabi xalqaro platformalar doirasida o‘tkazilayotgan madaniyat kunlari, hunarmandchilik ko‘rgazmalari hamda ilmiy forumlar bu aloqalarga institutsional tus berayotgan bo‘lsa, gastro-diplomatiya — ya’ni o‘zbek va turk milliy oshxonalarining o‘zaro targ‘ib qilinishi insonlar o‘rtasidagi do‘stona rishtalarni yanada samimiy qilmoqda. Ushbu qizg‘in madaniy muloqotni keng jamoatchilikka yetkazish va universal "yumshoq kuch" (Soft Power)ga aylantirishda esa medianing roli beqiyosdir. Kino va seriallar diplomatiyasi orqali har ikki xalq bir-birining turmush tarzi, qadriyatlari va tarixi bilan yaqindan tanishmoqda; masalan, "Mendirman Jaloliddin" kabi kross-madaniy media loyihalari ikki mamlakat o‘rtasidagi hissiy bog‘liqlikni tubdan kuchaytirdi. Shuningdek, raqamli media, ijtimoiy tarmoqlar va travel-blogerlarning faoliyati sababli Samarqand, Buxoro, Istanbul yoki Kapadokiyaning turistik hamda madaniy salohiyati millionlab yoshlar auditoriyasiga soniyalar ichida yetib bormoqda. Diplomatik vakilxonalar va media tuzilmalarining har ikki tilda berib borayotgan tezkor va xolis axborotlari esa o‘zaro ishonchni mustahkamlamoqda. Xulosa qilib aytganda, media Turkiya va O‘zbekiston o‘rtasidagi madaniy diplomatiyani shunchaki rasmiy doiralar muloqotidan chiqarib, uni har bir fuqaro uchun ochiq, jonli va doimiy muloqot maydoniga aylantirishda asosiy ko‘prik vazifasini bajarmoqda. Shuningdek, har ikki mamlakat OTMlari o‘rtasida talabalar va professor-o‘qituvchilar almashinuvi dasturlari (masalan, "Mavlono" almashinuv

dasturi hamda Turkiy Davlatlar Tashkiloti doirasidagi Orxun proyekti) faol ishlamoqda. Turkiya hukumatining "Türkiye Bursları" dasturi orqali har yili yuzlab o‘zbekistonlik yoshlar Turkiyaning eng nufuzli universitetlarida bepul ta’lim olib, ikki mamlakat o‘rtasidagi "ma’rifiy elchilar"ga aylanmoqda.

Shuning bilan birga, O‘zbekistondagi Yunus Emre Instituti (Yunus Emre Enstitüsü) kabi madaniyat va ta’lim markazlari orqali turk tilini o‘rgatish, turk tili va madaniyati markazlarini ochish ishlari olib borilmoqda, O‘zbekiston vakillari esa Turkiyada o‘zbek tili va adabiyotini targ‘ib qilish jarayonlarida faol qatnashmoqda. Maktab ta’limi sohasida ham umumiy turk tarixi, adabiyoti va geografiyasiga oid darsliklarni birgalikda yaratish va ta’lim standartlarini uyg‘unlashtirish bo‘yicha loyihalar amalga oshirilayotgani yosh avlodda mushtarak tarixiy va madaniy shaxsiyatni shakllantirmoqda.

Ushbu amaliy ishlar diplomatiyaga bevosita ulkan hissa qo‘shmoqda. Ta’lim orqali shakllangan akademik va madaniy rishtalar shunchaki nazariy bilim berib qolmay, har ikki xalq yoshlari o‘rtasida o‘zaro ishonch, do‘stlik va tushunish muhitini yaratadi. Natijada, ushbu bitiruvchilar va tadqiqotchilar kelajakda davlat boshqaruvi, diplomatiya, biznes va media sohalarida o‘zaro manfaatli munosabatlarni davom ettiruvchi eng ishonchli hamkorlar hamda "yumshoq kuch" (Soft Power)ining tirik tashuvchilariga aylanadi.

Xulosa qilib aytganda, madaniy diplomatiya va raqamli media zamonaviy xalqaro munosabatlarda mamlakatning "yumshoq kuchi" va xalqaro nufuzini belgilovchi eng qudratli strategik omillardan biridir. O‘zbekiston va Turkiya o‘rtasidagi munosabatlar misolida ko‘rib chiqilganidek, mushtarak madaniy ildizlar, gastro-diplomatiya, ta’lim hamkorligi va qo‘shma media loyihalar ikki xalq o‘rtasidagi do‘stlikni sifat jihatdan yangi bosqichga olib chiqdi. Biroq madaniy diplomatiya va yangi media integratsiyasini faqat bir mintaqa yoki bir davlat bilan cheklab qo‘ymasdan, uni global miqyosda Yevropa, Osiyo-Tinch okeani, Yaqin Sharq va Amerika davlatlari bilan ham tizimli ravishda rivojlantirish davr taqozosidir.

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TASK-BASED LEARNING: ADVANTAGES OF TASK-BASED LEARNING IN FOREIGN LANGUAGE EDUCATION

Abstract. *Task-Based Learning (TBL) has become an important approach in contemporary foreign language education because it places meaningful communication and purposeful language use at the centre of the learning process. Unlike traditional approaches that often emphasize the presentation and memorization of grammatical structures, TBL encourages learners to use the target language to accomplish realistic and meaningful tasks. This article examines the theoretical foundations and major advantages of Task-Based Learning in foreign language education.*

Keywords: *Task-Based Learning, language teaching, communicative competence, language acquisition, learner autonomy, motivation, interaction, authentic tasks, foreign language education.*

Introduction. The development of effective approaches to foreign language teaching has become increasingly important in the context of globalization, international communication, academic mobility, and professional cooperation. Modern language education requires learners not only to know grammatical rules and vocabulary but also to use language effectively in meaningful communicative situations. Consequently, contemporary language pedagogy increasingly emphasizes learner participation, interaction, communication, and the practical application of linguistic knowledge.

Task-Based Learning is one of the approaches that responds to these requirements. It organizes classroom instruction around tasks that require learners to use the target language for a particular communicative or practical purpose. A task may involve solving a problem, planning an event, discussing alternatives, making a decision, obtaining information, completing a project, or producing a meaningful outcome.

Main part. Task-Based Learning is closely associated with Communicative Language Teaching and theories of second language acquisition that emphasize interaction and meaningful language use. Researchers such as Prabhu, Long, Skehan, Ellis, and Willis have made significant contributions to the development and theoretical understanding of task-based instruction.

Prabhu's work demonstrated that learners can develop their language abilities through activities requiring them to use language to solve problems and reach particular outcomes. Long subsequently emphasized the importance of interaction and meaning-focused communication in language learning. Skehan examined the

relationship between task design, fluency, accuracy, and complexity, while Ellis provided a systematic framework for understanding tasks and their implementation in language classrooms.

In general, a pedagogical task can be understood as an activity in which learners use language primarily to achieve a meaningful outcome. The linguistic form remains important, but it is integrated into purposeful communication rather than being treated as the sole objective of the lesson [3, 110].

One of the most important advantages of TBL is its contribution to communicative competence. Learners are placed in situations where they need to express ideas, ask questions, clarify information, negotiate meaning, and respond to other people.

For example, instead of completing isolated grammar exercises on the future tense, learners may be asked to plan a future holiday. To complete the task successfully, they need to discuss destinations, transportation, accommodation, costs, and activities. In this process, grammatical structures and vocabulary are used as tools for communication.

Thus, TBL helps learners understand that successful language use involves more than grammatical accuracy. It also requires appropriate vocabulary, discourse strategies, interactional competence, and the ability to adapt language to different contexts.

Meaningful tasks create natural contexts for vocabulary acquisition. Instead of learning words as isolated lists, students encounter and use vocabulary in communicative situations. For instance, a task about planning a business meeting may naturally introduce vocabulary related to schedules, participants, agendas, responsibilities, deadlines, and arrangements. Contextualized vocabulary practice can facilitate deeper understanding because learners see how words function in actual communication. Effective task-based teaching therefore requires considerable pedagogical competence. Teachers need to understand both linguistic objectives and the communicative demands of individual tasks [3, 109].

The advantages of TBL suggest several important implications for foreign language education. First, tasks should have clear communicative purposes and meaningful outcomes. Second, task difficulty should correspond to learners' proficiency levels. Third, teachers should provide appropriate scaffolding without removing the communicative challenge of the task.

Technology can also strengthen task-based instruction. Digital platforms, collaborative documents, online discussion forums, educational applications, and multimedia resources can provide learners with additional opportunities to complete authentic tasks.

In higher education, task-based activities can be particularly useful for English for Specific Purposes (ESP), where students need language skills related to their academic or professional fields. For example, engineering students can complete tasks involving technical problem solving, while business students can simulate negotiations, presentations, and meetings.

Conclusion. Task-Based Learning represents an important development in contemporary foreign language pedagogy because it places meaningful language use at the centre of instruction. Its major advantages include the development of communicative competence, increased motivation, learner autonomy, critical thinking, collaboration, fluency, vocabulary acquisition, confidence, and the integration of language skills.

The effectiveness of TBL depends not simply on introducing group activities but on designing purposeful tasks that require learners to use language to achieve meaningful outcomes. Teachers must carefully consider learners' proficiency levels, interests, needs, and learning objectives when selecting and adapting tasks.

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EVALUATING LARGE LANGUAGE MODELS FOR FINANCIAL FORECASTING: ACCURACY, ROBUSTNESS, AND MODEL RISK

Abstract. *This study develops an auditable framework for evaluating large language models (LLMs) used in financial forecasting. We compared eight selected publications on financial LLMs, forecasting methods, and model validation; no original time-series experiment was conducted. The analysis produces a source matrix and a three-part framework addressing predictive accuracy, robustness under changing conditions, and model risk. Findings from studies with different targets, horizons, and datasets cannot be pooled into a common ranking, and results for non-LLM hybrid models do not measure LLM performance. The framework puts comparisons on a reproducible footing; it specifies the minimum required information and clarifies the boundaries of the evidence under review.*

Keywords: *large language models; financial forecasting; forecast accuracy; robustness; model risk; validation.*

1. INTRODUCTION

Financial institutions often use unstructured text, such as news or company disclosures, alongside numerical time series. A large language model may produce a classification or signal from this material, but careful reading of the text is no substitute for a foolproof forecast of the markets. For that, the measure of success, the benchmark, and what information is available when a decision is made must be put forward on their own terms.

Recent work shows both the difficulties and the potential. Lopez-Lira and Tang (2026) examined the predictability of stock returns from the news; Xie et al. (2024) then put financial LLMs through their paces on a variety of tasks and concluded that forecasting is no easy matter.

What sets an LLM apart from other predictive architectures is key. Even without a language model, the decomposition-and-LSTM system can deliver formidable forecasting. One might use the hybrid methods proposed by Dong and Zhou (2024) or Ozupek et al. (2024) as a baseline, but they should not be presented as LLM test results. FinGPT is an open-source framework that prepares financial text and data (Yang et al., 2023).

What then is needed to put an LLM forecast in finance to the test on its accuracy, model risk, and robustness? The challenge is how to make such an assessment without mixing evidence from one class of models or task with another.

This paper contributes a source-to-claim matrix and a reporting framework that separates these three dimensions. It is a focused methodological analysis, not a claim that the reviewed studies prove one model class superior.

2. MATERIALS AND METHODS

2.1. Research design

We conducted a focused comparative review of a purposive set of eight publications. This review is not a systematic review or meta-analysis: we did not conduct exhaustive database search, pool effect estimates, or train independent models. Its unit of analysis is a published study and the particular claim that study can support. We distinguished three source roles before synthesis: direct LLM evaluation in finance; non-LLM forecasting comparators; and general methodological work on AI or financial model validation.

2.2. Source selection and extraction

The set contains three direct financial-LLM sources (Lopez-Lira & Tang, 2026; Xie et al., 2024; Yang et al., 2023), two non-LLM forecasting comparators (Dong & Zhou, 2024; Ozupek et al., 2024), and three contextual or validation sources (Cao, 2022; Cummins et al., 2023; Remlinger et al., 2023). We selected sources that address at least one of the following: a financial LLM application, a financial forecasting benchmark, or the validation of predictive financial models. We excluded studies from unrelated application domains as evidence for financial forecasting. We extracted only claims relevant to the source's actual task.

For each publication, we extracted the following fields: model class, financial task, type of input, target forecast and horizon (if applicable), evaluation design, comparison baseline, robustness evidence, and model-risk implications. We used "Not established by this source" whenever the publication did not directly test a proposed claim. This prevents an application paper or a general discussion of AI from being misrepresented as a controlled LLM forecasting benchmark.

2.3. Evaluation procedure

Accuracy was defined relative to the specified prediction target. Directional stock-movement classification may use balanced accuracy or related classification measures; continuous price or return forecasts may use MAE or RMSE after disclosing the output scale. These metrics are examples of what a future experiment might report; we did not compute any new metric here. Benchmark comparison requires identical assets, observation periods, target definitions, decision timestamps, and forecast horizons.

We assessed robustness by how far a study reports performance under changes in sample period, market regime, text source, prompt formulation, or missing/noisy inputs. We assessed model risk through disclosures relevant to information leakage, model/data drift, interpretability, reproducibility, validation, and human oversight. We marked a source as offering direct evidence only for a condition it examined. The authors assigned no numeric robustness or risk scores.

2.4. Comparability and scope

The authors did not numerically compare reported errors across studies. A lower RMSE does not imply superiority if the series, units, horizon, or test windows

differ. Financial sentiment classification, stock-return prediction, and a general financial question-answering benchmark are different tasks. Likewise, we used non-LLM hybrids only to specify candidate baselines. The literature selection is intentionally small; conclusions are restricted to the studies and task distinctions set out below.

3. RESULTS

3.1. Source-to-claim matrix

Table 1 records which role each source can legitimately play in the analysis. It reports no invented performance values. The classifications result from applying the source-role and task criteria described in Section 2.

Table 1. Role of the reviewed publications in evaluating LLM-based financial forecasting

Publication	Model and task	Permitted inference
Lopez-Lira & Tang (2026).	Stock return and reaction prediction from the news	The evidence for LLM forecasting is limited to the news task at hand; it does not serve as a market benchmark of any kind.
Xie et al. (2024).	Forecasting and other financial LLM work with FinBen	You will find a direct cross-task LLM benchmark here, but do not conflate stock-return studies with task-specific scores.
Yang et al. (2023)	The FinGPT framework for an LLM in finance, together with its data pipeline	As for architecture and data curation, there is no general case for better forecast returns.
Dong & Zhou (2024); Ozupek et al. (2024)	Time-series models of a non-LLM hybrid nature	Some comparators may be used in forecasting, yet their results are not due to the LLMs.
Cao (2022); Cummins et al. (2023)	Model validation in the financial sector via AI	What is offered is context on risk controls and deployment, not a straight test of LLM forecasts.
Remlinger et al. (2023).	The use of expert aggregation to forecast in finance	In short, a concept for comparison, nothing more than an evaluation of the LLM.

One can see a category error in the manuscript as it was previously put forward. In that iteration, hybrid time-series models were put on a par with LLMs, and numerical scores unrelated to one another were juxtaposed. Do away with them and what is left is a more circumscribed result, yet one that can be audited; it offers direct evidence for some LLM financial tasks where there is no basis for a common ranking of every architecture under review.

3.2. Accuracy and task definition

In their 2026 paper, Lopez-Lira and Tang examine the stock market's reaction to firm-specific news headlines as an LLM would. They define the task as a text-based prediction exercise. Then Xie et al. (2024) put 21 LLMs through their paces on 42 datasets and 24 financial tasks; they find LLMs do not fare as well on

forecasting and other complex work as they do on information extraction or textual analysis. One need not see these as at odds, since the scoring, data, and targets differ. Neither study authorizes importing an error value from a hybrid price-series model as a score for ChatGPT or FinGPT.

A valid accuracy claim therefore needs four labels next to any numerical result: the target (for example, direction rather than price), horizon, test period, and baseline. It should also state whether an LLM produced the output directly or whether a separate forecasting model used LLM-derived text features. The reviewed sources establish the necessity of this distinction; the present article does not estimate a new accuracy rate.

3.3. Robustness and risk controls

The rapid evolution of financial information demands a current, well-constructed data pipeline, as Yang et al. (2023) note in their FinGPT study. As Xie et al. (2024) argue, assessing performance on any one task is insufficient; after all, the capabilities tested by language understanding are not the same as those for decision-making or forecasting. Sensitivity checks on inputs and prompts, out-of-period evaluation, and open handling of new market conditions are needed. This article puts forward such measures as requirements rather than stress tests.

One must also be mindful of uncertainty in model parameters and their distribution when validating a financial model (Cummins et al., 2023). When the forecast is LLM-assisted, an additional practical control is auditing the information at hand. It is incumbent that every piece of data, be it an article, filing, or a feature derived from the market, was in existence prior to the time of the simulated decision. Any impressive outcome hinging on information made public after the fact would not prove a model's utility for forecasting. Human review and documented model updates remain relevant when an output supports a consequential financial decision (Cao, 2022).

3.4. Derived evaluation framework

The synthesis yields a three-stage reporting framework. The study first defines the financial decision and measures accuracy against a same-task baseline. It next probes robustness across periods, regimes, prompts, and data quality. Finally, it documents leakage checks, validation, drift monitoring, reproducibility, and oversight. A model should not receive a composite score where one dimension was not measured; the missing dimension should be disclosed. Table 2 translates this framework into a reproducible reporting checklist.

Table 2. Minimum information for a controlled future LLM forecasting comparison

Dimension	**Required report**	**Reason**
Accuracy	Target; units; horizon; chronological train/test split; baseline; metric; uncertainty	Ensures reported gains apply to the same decision and test data.
Robustness	Market periods; volatility regimes; prompt variants; text-source changes; missing/noisy input tests	Reveals whether performance holds up under reasonable changes in use conditions.

Dimension	Required report	Reason
Model risk	Timestamp audit; model/version record; leakage checks; drift monitoring; human review	Makes forecast provenance and operational limits inspectable.

4. DISCUSSION

The source matrix changes how we interpret literature. Evidence that a particular LLM extracts useful information from headlines does not establish that every LLM reliably forecasts prices. Evidence that a non-LLM hybrid predicts a financial series well does not establish the value of language modeling. Both are relevant to designing a future head-to-head test, but they occupy different positions in the causal chain: text interpretation may create features, while a forecasting system maps available features to a target.

The proposed framework also explains why accuracy alone is incomplete. Even when a reported metric improves, a deployable method must remain useful when the information environment changes and must be evaluated without future information leaking into past predictions. The robustness and risk columns are therefore separate reporting obligations; not arbitrary penalties attached to an accuracy score. No threshold or weighting is proposed because the acceptable trade-off depends on the financial decision, the cost of an error, and whether a human can intervene.

The study has three limitations. Selection was purposive rather than exhaustive; some relevant financial LLM evaluations may not appear in the matrix. The authors did not re-estimate full numerical performance on a shared dataset. The framework is conceptual and has not been validated by a prospective user study or controlled backtest. It should be treated as an evaluation protocol for future work, not proof that a particular model is safe or profitable.

5. CONCLUSION

A credible evaluation of LLMs for financial forecasting must define the target, data availability, horizon, baseline, and validation period before it reports predictive accuracy. The reviewed literature contains direct LLM evidence for specific financial tasks and useful non-LLM comparators, but it does not support a pooled ranking of the models discussed in this article. The original contribution is a source-to-claim matrix and a three-stage reporting framework that couples accuracy with robustness and model-risk checks.

Future research should test the named LLM and non-LLM baselines on the same time-stamped financial dataset, using a chronological holdout and pre-specified measures. It should repeat the evaluation across market regimes and disclose prompt sensitivity, information leakage checks, and model updates. Until those conditions are met, limit comparative claims to the exact task and evidence each source reports.

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GENERAL CULTURAL COMPETENCE IN VOCATIONAL EDUCATION: AN INTEGRATED MODEL FOR TOURISM TRAINING

Abstract. *This study aims to improve didactic support for developing general cultural competence among vocational tourism students. Using theoretical analysis and pedagogical modeling, an integrated model comprising five interconnected blocks and four competence components was developed. The model combines simulation-based learning, intercultural training, experiential learning, and the TourCulture.uz digital platform. The proposed framework integrates cultural knowledge, values, professional communication, and practical skills to support the systematic development of general cultural competence in vocational tourism education.*

Keywords: *general cultural competence, vocational education, tourism education, didactic support, intercultural communication, pedagogical modeling, digital learning.*

INTRODUCTION. The modernization of vocational education requires the preparation of specialists who possess not only professional knowledge and practical skills but also the cultural awareness and communication abilities necessary for effective professional activity. This requirement is particularly relevant to tourism, where specialists interact with representatives of different cultures, interpret historical and cultural heritage, and provide services in diverse social environments.

General cultural competence encompasses cultural knowledge, respect for national and universal values, professional communication, and the ability to apply culturally appropriate behavior in occupational situations. Its development requires an integrated educational system that connects theoretical knowledge with practical activities and professional experience. UNESCO (2013) emphasizes the importance of intercultural competencies for mutual understanding and effective communication across cultural differences. In vocational tourism education, these competencies should be connected with cultural heritage interpretation, tourism ethics, service culture, and professional communication [5]. The research focuses on identifying competence components, determining their didactic implications, and integrating interactive teaching methods and digital educational resources into a unified pedagogical framework.

LITERATURE REVIEW. The theoretical foundations of general cultural competence development are closely related to competency-based education, intercultural communication, value-oriented learning, and experiential education. Byram (1997) conceptualized intercultural communicative competence through

attitudes, knowledge, interpretation skills, interaction, and critical cultural awareness [1]. Deardorff (2006) emphasized the multidimensional nature of intercultural competence, including attitudes, knowledge, skills, and the outcomes of intercultural interaction [2].

These perspectives provide a foundation for understanding cultural competence as an integrated educational outcome. However, general cultural competence in vocational tourism education also incorporates historical and cultural heritage knowledge, professional ethics, service culture, and the practical application of cultural knowledge in occupational situations. The competency-based approach emphasizes the development of learning outcomes that combine theoretical knowledge with practical abilities. The axiological approach focuses on conscious attitudes toward cultural values, tolerance, and social responsibility, while the activity-oriented approach connects acquired knowledge with practical professional performance.

MATERIALS AND METHODS. The study employs theoretical analysis, curriculum analysis, pedagogical modeling, and systematization to develop an integrated didactic framework for general cultural competence in vocational tourism education. The research is contextualized within the Cultural Heritage in Tourism course of the 51010304 – Tourism specialization in Uzbekistan's vocational education system. The course provides opportunities to develop cultural knowledge, value orientations, communication skills, and practical abilities through the study of historical monuments, national traditions, tourism ethics, cultural tourism routes, and intercultural communication [1].

The theoretical analysis method is used to identify the structural components of general cultural competence and determine the pedagogical approaches necessary for their development. Curriculum analysis establishes the relationship between tourism-related educational content and expected competence outcomes.

Pedagogical modeling is employed to integrate educational objectives, instructional content, teaching methods, digital resources, organizational forms, and assessment procedures into a unified system. Systematization is used to establish the stages of implementing the proposed model. The methodological framework combines competency-based, axiological, cultural, activity-oriented, situational, integrative, learner-centered, and systems approaches. These approaches provide the theoretical foundation for connecting cultural knowledge with professional communication, practical activities, and competence-based assessment.

RESULTS. The principal result of the study is the development of an integrated didactic model aimed at enhancing general cultural competence among vocational tourism students. The model is based on the interrelationship between four competence components: cognitive, axiological, personal-communicative, and activity-based.

The cognitive component encompasses knowledge of historical and cultural heritage, national traditions, tourism ethics, and intercultural communication. The axiological component reflects students' respect for cultural values, tolerance, and social responsibility.

Consequently, didactic support should be organized as a unified system connecting educational objectives, instructional content, teaching methods, learning resources, and assessment.

An important methodological feature of the model is the integration of simulation-based learning, intercultural training, and experiential learning. Simulation-based learning involves the reproduction of professional situations characteristic of tourism services. Students participate in simulated interactions involving tourist guides, visitors, museum employees, and local community representatives. For example, a simulated excursion to the Itchan Kala complex in Khiva enables students to apply historical knowledge, communicate with tourists, and respond appropriately to culturally sensitive situations.These instructional methods are supplemented by WebQuest, storytelling, case-based learning, project-based learning, and portfolio activities. Their coordinated application provides opportunities to develop cultural knowledge, independent learning, professional communication, and practical performance.The proposed assessment framework incorporates cognitive, axiological, personal-communicative, and activity-based criteria. These criteria are intended to determine the extent to which students demonstrate cultural knowledge, respect for cultural values, professional communication, and practical performance in tourism-related situations.

DISCUSSION. The developed model approaches general cultural competence as an integrated educational outcome requiring the coordinated development of cultural knowledge, value orientations, professional communication, and practical abilities. The proposed framework is conceptually consistent with multidimensional approaches to intercultural competence described by Byram (1997) and Deardorff (2006) [1; 2]. However, it extends the educational focus toward the occupational requirements of tourism by incorporating cultural heritage interpretation, professional ethics, service culture, and practical performance.

Simulation-based learning and intercultural training provide opportunities to apply theoretical knowledge in professionally contextualized situations, while experiential learning connects educational content with cultural environments. The integration of TourCulture.uz supports the organization of classroom instruction, independent learning, practical assignments, and reflective assessment within a unified digital learning environment.

The model provides a methodological basis for developing professionally oriented educational materials, selecting appropriate teaching methods, and establishing competence-based assessment procedures. Nevertheless, its effectiveness requires further empirical investigation, including the assessment of students' competence development and the examination of the reliability and validity of the proposed assessment instruments.

CONCLUSION. The study developed and theoretically substantiated an integrated didactic model for enhancing general cultural competence among vocational education students specializing in tourism.The methodological approach combines simulation-based learning, intercultural training, experiential learning,

and supplementary interactive methods with the digital didactic resources of TourCulture.uz. The staged implementation framework connects initial diagnosis, motivational orientation, content development, practical application, and reflective assessment. It provides a systematic basis for organizing cultural competence development within the Cultural Heritage in Tourism course. The proposed framework provides a methodological foundation for improving vocational tourism education and serves as a basis for further empirical research.

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THE USE OF DIGITAL TECHNOLOGIES TO ENHANCE THE EFFECTIVENESS OF FOREIGN LANGUAGE TEACHING IN MEDICAL HIGHER EDUCATION

Abstract: *This article examines the use of digital technologies to enhance the effectiveness of foreign language teaching in medical higher education. The integration of digital tools into the educational process creates new opportunities for developing students' communicative, professional, and independent learning skills. Particular attention is paid to the use of multimedia resources, learning management systems, interactive educational platforms, electronic dictionaries, mobile applications, and artificial intelligence-based tools in foreign language instruction. The study highlights the potential of digital technologies to improve students' motivation, expand their medical vocabulary, develop listening, speaking, reading, and writing skills, and provide individualized learning opportunities. The article also considers the importance of integrating digital technologies with professionally oriented foreign language teaching, particularly in the context of medical terminology and doctor–patient communication. The findings suggest that the purposeful and pedagogically appropriate use of digital technologies can contribute to improving the quality and effectiveness of foreign language education for medical students.*

Keywords: *digital technologies, foreign language teaching, medical higher education, medical students, digital learning, information and communication technologies, medical English, professional communication, interactive learning, artificial intelligence.*

Introduction

In the context of the rapid development of digital technologies, higher education is undergoing significant changes in teaching methods, learning environments, and approaches to student engagement. The integration of digital

technologies into the educational process has created new opportunities for improving the quality and effectiveness of foreign language teaching. This is particularly important in medical higher education, where foreign language proficiency is increasingly regarded as an essential component of students' professional competence. Medical students need foreign language skills not only for general communication but also for accessing scientific literature, understanding international medical terminology, participating in professional communication, and keeping up with recent developments in medicine.

Traditional approaches to foreign language teaching, while remaining important, may not always fully meet the diverse educational needs of contemporary medical students. Digital technologies can provide a more flexible, interactive, and learner-centered educational environment. Multimedia resources, online learning platforms, electronic dictionaries, mobile applications, interactive exercises, virtual learning environments, and artificial intelligence-based tools can be integrated into foreign language instruction to support the development of listening, speaking, reading, and writing skills. These technologies also provide opportunities for students to access educational materials at different times and from different locations, thereby supporting both classroom and independent learning.

The use of digital technologies is particularly relevant to professionally oriented foreign language education. Medical students need to acquire specialized vocabulary and develop the ability to communicate in professional situations, including doctor–patient interactions, clinical discussions, medical presentations, and the interpretation of scientific texts. Digital resources can facilitate the creation of authentic and profession-specific learning materials, allowing students to practice language skills in contexts that are closely related to their future professional activities. For example, video materials can be used to demonstrate medical consultations, interactive tasks can support the acquisition of medical terminology, and online simulations can provide opportunities to practice professional communication.

Another important advantage of digital technologies is their potential to increase students' motivation and engagement. Interactive learning activities, multimedia content, online assessments, and personalized learning tasks can make foreign language lessons more dynamic and responsive to individual learning needs. In addition, digital technologies can facilitate continuous assessment and provide immediate feedback, enabling students to identify learning difficulties and monitor their own progress.

At the same time, the effective integration of digital technologies requires appropriate pedagogical planning. The availability of digital tools alone does not guarantee improved learning outcomes. Their effectiveness depends on the relevance of the selected technologies to educational objectives, the quality of learning materials, teachers' digital competence, students' level of digital literacy, and the specific requirements of medical education. Therefore, digital technologies should be considered not as a replacement for the teacher but as a means of supporting and enriching the teaching and learning process.

In this regard, the present study focuses on the use of digital technologies in foreign language teaching in medical higher education. It aims to examine the educational potential of digital tools and their role in developing students' language and professional communication skills. Particular attention is given to the integration of digital technologies with professionally oriented foreign language instruction and to the possibilities of creating a more interactive, individualized, and practice-oriented learning environment for medical students.

The Role of Digital Technologies in Foreign Language Teaching

Digital technologies have become an important component of modern higher education and have significantly influenced the organization of the teaching and learning process. In foreign language education, digital technologies provide opportunities to combine traditional teaching methods with interactive and multimedia-based approaches. They enable teachers to present language materials in different formats and allow students to participate more actively in the learning process.

The use of digital technologies can support the development of the four major language skills: listening, speaking, reading, and writing. Audio and video materials can improve students' listening comprehension and pronunciation, while interactive exercises and online communication activities can contribute to the development of speaking skills. Electronic texts, digital libraries, and online resources provide students with opportunities to develop reading skills and expand their vocabulary. At the same time, digital writing platforms and computer-based assignments can be used to improve students' writing skills.

An important characteristic of digital learning is the possibility of providing students with flexible access to educational materials. Students can review learning materials repeatedly, complete additional tasks, and work at their own pace. This creates favorable conditions for independent learning and allows teachers to consider differences in students' language proficiency and learning needs.

Digital Technologies in Medical Foreign Language Education

Foreign language teaching in medical higher education has specific requirements because students need to develop not only general language competence but also professional communication skills. Medical students are expected to understand specialized terminology, read scientific publications, communicate with patients and colleagues, and present professional information in a foreign language.

In this context, digital technologies can be effectively integrated into professionally oriented language instruction. Authentic medical videos, podcasts, online articles, electronic textbooks, virtual case studies, and interactive terminology exercises can expose students to language used in real professional situations. Such materials allow students to learn foreign language vocabulary together with its practical application in medical contexts.

For example, video recordings of doctor–patient consultations can be used to develop listening and speaking skills. Students can analyze professional expressions, identify medical terminology, and subsequently reproduce similar

dialogues. Interactive clinical cases can also be used to develop students' ability to describe symptoms, ask appropriate questions, explain medical procedures, and communicate information to patients in a foreign language.

Electronic dictionaries and specialized medical terminology databases represent another useful digital resource. They enable students to identify the meaning, pronunciation, and contextual use of specialized terms. Regular work with digital terminology resources can contribute to the systematic development of students' professional vocabulary.

Interactive Learning Platforms and Multimedia Resources

Learning management systems and interactive educational platforms can provide an organized environment for foreign language instruction. Teachers can use such platforms to distribute learning materials, assign individual and group tasks, conduct online assessments, and provide feedback. Students, in turn, can access course materials and submit assignments regardless of their physical location.

Multimedia resources are particularly valuable in medical foreign language education because medical concepts can often be difficult to understand through text alone. Combining written explanations with images, diagrams, animations, audio recordings, and video demonstrations can facilitate students' understanding of both language and professional content.

Interactive quizzes and digital assessment tools can also increase students' participation in lessons. Vocabulary exercises, grammar tests, listening activities, and terminology-based tasks can provide immediate feedback. This enables students to identify mistakes and correct them during the learning process rather than waiting for traditional teacher assessment.

Another important advantage is the possibility of differentiated instruction. Digital platforms allow teachers to provide tasks of varying levels of difficulty. Students who require additional practice can receive supplementary exercises, while more advanced learners can work with authentic scientific materials and complex professional communication tasks.

Artificial Intelligence in Foreign Language Learning

Recent developments in artificial intelligence have created additional opportunities for foreign language education. AI-based tools can be used to support vocabulary acquisition, grammar practice, writing activities, pronunciation development, and conversational practice. In medical education, these tools can also be incorporated into simulated professional communication activities.

For instance, students can practice doctor–patient dialogues through AI-supported conversational tasks. They can formulate questions, explain symptoms, provide general medical information, and practice appropriate professional expressions. Such activities can create additional opportunities for communication practice, particularly when classroom time for individual speaking activities is limited.

AI-based language tools can also provide feedback on students' written work and help identify grammatical or lexical errors. However, the use of artificial

intelligence in education should be accompanied by teacher guidance. Students need to develop the ability to evaluate AI-generated information critically, verify terminology and factual content, and use digital tools as learning support rather than as a substitute for independent thinking.

Advantages of Digital Technologies for Medical Students

The integration of digital technologies into foreign language teaching can provide several educational advantages. First, digital resources can increase students' motivation by making lessons more interactive and closely connected with real-life professional situations. Second, they provide access to a wide range of authentic materials, including scientific articles, medical videos, professional podcasts, and online educational resources.

Third, digital technologies support individualized learning. Students can select appropriate learning materials, repeat difficult topics, and complete additional activities according to their individual needs. Fourth, digital assessment tools allow teachers to monitor students' progress and provide timely feedback.

Digital technologies can also contribute to the development of students' professional autonomy. Medical professionals are expected to engage in lifelong learning and regularly access international scientific information. Developing students' ability to use digital resources for foreign language learning can therefore contribute not only to their language competence but also to their future professional development.

Challenges in the Use of Digital Technologies

Despite their potential benefits, the implementation of digital technologies in foreign language teaching also involves several challenges. One of the main issues is the need for adequate digital competence among teachers. Educators should be able to select appropriate digital resources, design meaningful activities, evaluate online materials, and integrate technology with established pedagogical methods.

Another challenge is unequal access to digital resources and differences in students' digital literacy. Technical problems, limited internet access, insufficient equipment, or inadequate institutional support may negatively affect the learning process. Therefore, educational institutions should provide appropriate technological infrastructure and professional development opportunities for teachers.

There is also a risk of excessive dependence on digital tools. Technology should serve clearly defined educational objectives rather than be used simply because it is available. Effective foreign language teaching requires an appropriate balance between digital and traditional teaching methods, direct teacher–student interaction, collaborative activities, and independent learning.

In medical foreign language education, particular attention should also be paid to the accuracy and reliability of digital content. Medical terminology and professional information must be carefully checked, especially when students use online sources and artificial intelligence-based applications. Teachers therefore play an important role in guiding students toward reliable resources and developing their critical digital literacy.

Pedagogical Conditions for Effective Implementation

For digital technologies to contribute effectively to foreign language learning in medical higher education, several pedagogical conditions should be considered. First, the selected technology should correspond to the learning objectives and the professional needs of medical students. Second, digital activities should be integrated into the overall curriculum rather than used as isolated technological exercises.

Third, learning tasks should be professionally oriented and connected with authentic medical situations. Activities such as doctor–patient dialogues, medical case discussions, scientific article analysis, terminology exercises, and professional presentations can help students apply foreign language knowledge in meaningful contexts.

Finally, continuous assessment and feedback should be incorporated into digital learning. Teachers can use online quizzes, electronic assignments, interactive presentations, and digital portfolios to monitor students' progress. Such approaches can make the learning process more transparent and provide students with opportunities to reflect on their achievements and identify areas requiring further improvement.

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ALGEBRAIK MASALALARNI GEOMETRIK USULDA YECHISH

Annotatsiya: *Ushbu maqolada ba'zi algebraik tenglamalar va tengsizliklarni geometrik shakllarning xossalaridan foydalanib yechish usullari o`rganilgan.*

Tayanch so`zlar: *tenglama, tengsizlik, algebraik tenglamalar sistemasi, vektor, funksiya.*

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SOLVING ALGEBRAIC PROBLEMS BY THE GEOMETRIC METHOD

Annotation: *This article explores some algebraic equations and inequalities and methods for solving them using the properties of geometric shapes.*

Keywords: *equations, inequalities, system of equations, vectors, function.*

Bugungi kun bizdan ta'lim-tarbiya berishning yangi usullarini ishlab chiqish, fanlararo bog'lanishni kuchaytirish, ijodkor va erkin hamda har tomonlama mustaqil fikrlay oladigan yoshlarni tarbiyalashdek dolzarb vazifani talab etadi.

Ushbu masalalarning ko'pchiligi matematika fanidan respublikamizning turli bosqich olimpiadalari masalasi sifatida keltirilganligi bois, ushbu usullardan dars davomida, ayniqsa matematik to'garaklarda, o'quvchilarni matematik olimpiadalarga tayyorlashda foydalansa yanada yaxshiroq samara beradi degan umiddamiz.

Geometrik bo'lmagan masalalarni geometrik usulda yechish o'quvchilarda fanlararo bog'liqlikni teran tushunib yetadi, ilmiy tafakkuri, dunyo qarashi hamda ijodiy ishlash ko'nikmasini shakllantiradi. Biz masalamizni quyidagi turlarga bo'lib ifodalaymiz.

1. Dekart koordinatasi sistemasi yordamida yechiladigan masalalar;
2. Pifagor hamda kosinuslar teoremasi yordamida yechiladigan masalalar;
3. Vektorlar yordamida yechiladigan masalalar.

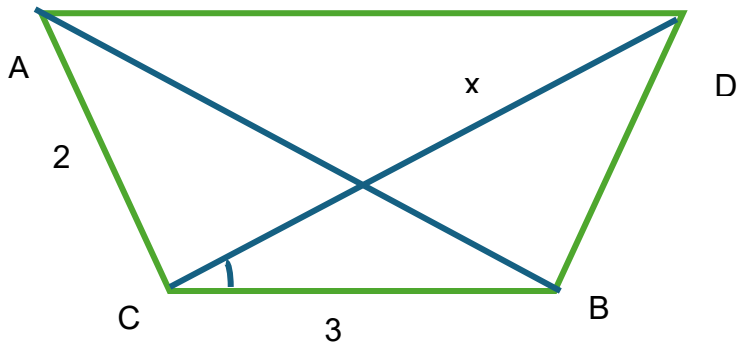
Quyida bu holatlarning har biriga alohida to'xtalib, ularga oid masalalar yechimini keltirib o'tamiz.

Dekart koordinatasi sistemasi yordamida yechiladigan masalalar.

1-masala. Funksiyaning eng kichik qiymatini toping.

$$f(x) = \sqrt{x^2 + 4} + \sqrt{x^2 - 3\sqrt{3}x + 9}$$

Yechimi. Quyidagi chizmadan foydalanamiz:



3-chizma.

Bunga ko'ra ACD to'g'ri burchakli uchburchakda $AC = 2, CD = x, < ACD = 90^0$ va BCD uchburchakda esa $BC = 3, CD = x, < BCD = 30^0$ munosabatlar o'rinli (3-chizma). ACD uchburchakka Pifagor teoremasini tadbiq etib $AD = \sqrt{x^2 + 4}$ BCD uchburchakka esa kosinuslar teoremasini qo'llasak, $DB = \sqrt{x^2 - 3\sqrt{3}x + 9}$ natijalarni olamiz. U holda $f(x) = min(AD + DB) = AB$ munosabat o'rinli bo'ladi. ΔABC uchburchakka kosinuslar teoremasini tadbiq etib, $AB = \sqrt{2^2 + 3^2 - 2 \cdot 2 \cdot 3 \cdot cos120^0} = \sqrt{19}$ ekanini topamiz. Javob: $\sqrt{19}$.

Vektorlar yordamida yechiladigan masalalar.

2-masala. Agar $a + b + c = 1$ va $a \geq -\frac{1}{4}, b \geq -\frac{1}{4}, c \geq -\frac{1}{4}$ ekani ma'lum bo'lsa, u holda $\sqrt{4a + 1} + \sqrt{4b + 1} + \sqrt{4c + 1} \leq \sqrt{21}$ tengsizlikni isbotlang.

Yechimi. Biz bu masalani vektorlarning skalyar ko'paytmasidan foydalanib yechamiz. Buning uchun avval 2 ta vektor tuzib olamiz.

$\vec{a}\left(\sqrt{4a + 1}; \sqrt{4b + 1}; \sqrt{4c + 1}\right)$ va $\vec{b}(1; 1; 1)$. Bu vektorlar uchun $|\vec{a} \cdot \vec{b}| \leq |\vec{a}| \cdot |\vec{b}|$ tengsizlikni qo'llasak quyidagi munosabat o'rinli bo'ladi.

$$|\vec{a} \cdot \vec{b}| = \sqrt{4a + 1} + \sqrt{4b + 1} + \sqrt{4c + 1}$$

$$|\vec{a}| \cdot |\vec{b}| = \sqrt{\sqrt{4a + 1}^2 + \sqrt{4b + 1}^2 + \sqrt{4c + 1}^2} \cdot \sqrt{3} = \sqrt{21}. \quad |\vec{a} \cdot \vec{b}| \leq |\vec{a}| \cdot |\vec{b}|$$

ga ko'ra $\sqrt{4a + 1} + \sqrt{4b + 1} + \sqrt{4c + 1} \leq \sqrt{21}$ bo'ladi. Tengsizlik isbotlandi.

Mustaqil yechish uchun masalalar.

1) Agar $x + y + z = 5$ bo'lsa, $\sqrt{x^2 + 9} + \sqrt{y^2 + 16} + \sqrt{z^2 + 25}$ ifodani eng kichik qiymatini toping.

2) Tenglamani yeching: a) $\sqrt{x^2 + 4} + \sqrt{x^2 - 3x\sqrt{3} + 9} = \sqrt{19}$;

b) $\sqrt{2x^2 + 2 - 4x} + x\sqrt{2} + \sqrt{2x^2 + 2 - 2x} = \sqrt{6}$

3) Tenglamalar sistemasini yeching. $\begin{cases} x + y + z = 30 \\ x^2 + y^2 = z^2 \\ xy = 6z \end{cases}$

4) $\sqrt{1+x^2-x}+\sqrt{1+x^2-x\sqrt{3}}$ ifodaning eng kichik qiymatini toping.

5) Quyidagi tenglamani yeching. $\sqrt{1+x^2}+\sqrt{1+x^2-x\sqrt{3}}=\sqrt{3}$

6)Musbat a,b,c conlari uchun quyidagi tengsizlikni isbotlang: $\sqrt{a^2-ab+b^2}+\sqrt{b^2-bc+c^2}=\sqrt{a^2-ac+c^2}$

7)Funksiyaning eng kichik qiymatini toping. $f(x)=\sqrt{x^2+4}+\sqrt{x^2-3x\sqrt{3}+9}$

8) 10) Agar $a-b+c=6$ ekani ma'lum bo'lsa, $\sqrt{a+1}+\sqrt{2-b}+\sqrt{c+3}\leq 6$ tengsizlikni isbotlang.

9) Tenglamani yeching. $x\sqrt{1+x}+\sqrt{3-x}=2\sqrt{1+x^2}$

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GEOEKOLOGIK MA’LUMOTLARNI KLASTERLASH VA HEATMAP VIZUALIZATSIYASI ORQALI ASALARI UYALARI JOYLASHUV NUQTALARINI OPTIMALLASHTIRISH

Annotatsiya. *Ushbu tadqiqotda Xorazm viloyatida asalari uyalarini joylashtirish va optimal hududlarni aniqlashda heatmap (issiqlik xaritasi) hamda klasterlash (k-means/DBSCAN) algoritmlarining amaliy ahamiyati yoritilgan. Fazoviy ko‘p mezonli baholash (S-MCA) modeli va 6 ta geoekologik mezon (yer qoplami, vegetatsiya va fenologik ko‘rsatkichlar, gidrografiya, infratuzilma hamda agro-kimyoviy xavf zonalari) integratsiyasi asosida aniqlangan 2107 ta maqbul nuqta tahlil qilingan. Heatmap vizualizatsiyasi orqali asalarichilik resurslarining eng yuqori zichlikdagi o‘choqlari aniqlangan bo‘lsa, klasterlash algoritmlari ushbu nuqtalarni mantiqiy guruhlarga ajratib, viloyatning raqamli optimal xaritasini shakllantirish imkonini berdi. Olingan natijalar asalarichilik subyektlariga mavsumiy ko‘chish marshrutlarini aniq rejalashtirish hamda agro-kimyoviy xavf hududlaridan saqlangan holda resurslardan samarali foydalanishda xizmat qiladi.*

Kalit so‘zlar: *Heatmap (issiqlik xaritasi), klasterlash (k-means, DBSCAN), Ko‘p mezonli baholash (MCE), asalarichilik, asalari uyalari joylashuvi, Xorazm viloyati, GAT-modellashtirish.*

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OPTIMIZING BEEHIVE LOCATIONS THROUGH GEO-ECOLOGICAL DATA CLUSTERING AND HEATMAP VISUALIZATION

Abstract. *This study highlights the practical significance of heatmap and clustering (k-means/DBSCAN) algorithms in determining optimal locations for placing beehives in the Khorezm region. An analysis was conducted on 2,107*

suitable sites identified through the integration of a Spatial Multi-Criteria Assessment (S-MCA) model and six geo-ecological criteria: land cover, vegetation and phenological indicators, hydrography, infrastructure, and agro-chemical risk zones. While heatmap visualization identified hotspots with the highest density of beekeeping resources, clustering algorithms grouped these sites logically, enabling the creation of a digital map of optimal locations for the region. The findings assist beekeeping enterprises in precisely planning seasonal migration routes and efficiently utilizing resources while avoiding areas at risk of agro-chemical contamination.

***Keywords**: Heatmap, clustering (k-means, DBSCAN), Multi-Criteria Evaluation (MCE), beekeeping, beehive location, Khorezm region, GIS modeling.*

Kirish. Xorazm viloyatida GAT va masofadan zondlash ma'lumotlari asosida oziq-ovqat xavfsizligi, gidrografik va ekologik monitoring va xalq xo'jaligi tarmoqlarini fazoviy modellashtirish bo'yicha qator tadqiqotlar olib borilmoqda. Xususan, baliqchilik tarmog'i va uni rivojlantirish zarurati (Нигматов va boshq., 2020), suv havzalarining baliqchilik uchun yaroqliligi GAT asosida o'rganilgan (Нигматов & Матчанов, 2022). Voha gidrografik tarmoqlarining fazoviy xususiyatlarini tadqiq qilish uchun mos keluvchi raqamli relyef modellari tahlil qilingan (Matchanov & Bekmetova, 2021). Suv havzalarining irrigatsiya va melioratsiya tarmoqlarining ta'sir doirasiga nisbatan joylashuvi raqamli relyef modellari yordamida baholangan (Матчанов & Матсопоева, 2022; Matchanov & Matchanov, 2022). Ananaviy va zamonaviy ma'lumotlarni qiyoslash orqali hududdagi barqaror ko'llar aniqlangan (Matchanov, 2020) hamda aholi punktlarini tadqiq qilishda (Gulimmatov va boshq, 2023; Gulimmatov, 2025) GAT qo'llanilgan.

Bundan tashqari, voha atmosfera havosi tarkibining o'zgarish dinamikasi (Baxtiyorova, 2025), qurg'oqchilik xavfsizligi darajalari baholangan (Matchanov va boshq., 2025), sug'oriladigan yerlari degradatsiyasi dinamikasi tahlil (Matchanov & Matchanov, 2026) qilingan. Shuningdek, antropogen qurg'oqchilikning kelib chiqish sabablari, oldini olish va monitoringini yuritish tartibi (O'ktamov va boshq., 2026) o'rganilib, voha sharoitida ushbu xavfga moslashishning geoekologik chora-tadbirlar tizimli ishlab chiqilgan (Matchanov va boshq., 2025).

Asalarichilikni rivojlantirish nuqtai nazaridan, ham ayrim tadqiqotlar olib borilgan, masalan hududda asal yetishtirish ko'rsatkichlari asosida dastlabki interaktiv xaritalarni yaratilib (Матчанов & Каримова, 2024), asalarichilik xo'jaliklarini joylashtirish zonalari zamonaviy bulutli platformalar va ko'p mezonli baholash modellari asosida tadqiq qilingan (Matchanov & Karimova, 2026).

Asalarichilik qishloq hududlarida aholi uchun muhim daromad manbai, bandlikni ta'minlash vositasi hamda ekotizimdagi beqiyos tabiiy changlatuvchi sifatidagi strategik ahamiyatga ega. Biologik xilma-xillik va ekotizim xizmatlari bo'yicha hukumatlararo ilmiy-siyosiy platformaning (IPBES, 2017) hisobotiga ko'ra, tabiiy changlatgichlar, xususan, asalarilar dunyo bo'yicha 80% o'simliklar va

75% oziq-ovqat mahsulotlarining barqaror shakllanishi uchun eng asosiy biologik omil hisoblanadi.

Mazkur tadqiqotda ilk bor Xorazm viloyati bo‘yicha asalari uyalarini joylashtirish uchun optimal bo‘lgan 2107 ta nuqta issiqlik xaritasi hamda klasterlash tahlillari orqali veb-muhitga integratsiya qilindi.

Tadqiqot metodologiyasi quyidagi bosqichlarni o‘z ichiga oladi:

I. Hududda asalari uyalarini joylashtirish uchun optimal nuqtalar Google Earth Engine (GEE) platformasida fazoviy ko‘p mezonli baholash (Multi-Criteria Evaluation) modeli yordamida aniqlandi. Yakuniy qulaylik indeksini shakllantirishda xalqaro miqyosdagi yetakchi olimlarning ilmiy yondashuvlari, Xorazm viloyatining o‘ziga xos tabiiy sharoiti va xalq xo‘jaligining mahalliy xususiyatlari inobatga olingan holda 6 ta asosiy mezon (Matchanov & Karimova, 2026) tanlab olindi:

Yer qoplami va yerlardan foydalanish toifalari (Carr-Markell va b., 2015; Dubovyk va b., 2013);

Vegetatsiya indeksi (NDVI), biomassa hajmi va o‘simliklarning gullash zichligi (Dubovyk va b., 2013; Fasasi & Adedoyin, 2019);

Oziqa bazasining vaqtinchalik va mavsumiy mavjudligi (Danner va b., 2017);

Gidrografik tarmoqlarning mavjudligi (Abou-Shaara, 2019);

Agrokimyoviy ta’sir zonalari (Tosi va b., 2017);

Transport infratuzilmasiga yaqinlik ko‘rsatkichlari (Komasilova va b., 2021).

Ko‘p mezonli baholash modeli asosida asalarichilik uchun optimal bo‘lgan jami 2107 ta fazoviy nuqta aniqlandi.

II. Aniqlangan nuqtalarning hududiy taqsimotini va tabiiy guruhlanishini o‘rganish uchun ilg‘or klasterlash algoritmlari qo‘llanildi:

1. K-means klasterlash asosida nuqtalarni markaziy ozuqa bazalari atrofiga guruhlanib, hududiy salohiyatni teng taqsimlash va tarmoq klasterlarini shakllantirishda foydalanildi.

2. DBSCAN (Density-Based Spatial Clustering of Applications with Noise) usuli fazoviy zichlikka asoslangan usul sifatida hududdagi tartibsiz tarqalgan nuqtalarni aniqlash, zich joylashgan optimal maydonlarni ajratib olish va tasodifiy nuqtalarni chetlashtirish uchun qo‘llanildi.

III. Asalari uyalarini joylashtirishda yuqori konsentratsiyaga ega hududlarni aniq ko‘rsatish uchun issiqlik xaritasi tahlili amalga oshirildi. Bunda har bir nuqtaning fazoviy og‘irligi hisobga olinib, Leaflet.heat plaginı yordamida hududdagi ozuqa bazasi va optimal lokatsiyalarning zichlik gradientlari (ko‘k, yashil va qizil ranglar) vizuallashtirildi.

IY. Tadqiqot natijalarini amaliyotga tatbiq etish va interaktiv boshqaruvni ta’minlash maqsadida Leaflet.js kutubxonasi asosida veb-xarita ilovasi ishlab chiqildi. Ilova quyidagi texnik imkoniyatlarni o‘z ichiga oladi:

1. MarkerClusterGroup 2107 ta nuqtaning xaritadagi yuklamasini kamaytirish va klasterlar ko‘rinishida guruhlab ko‘rsatadi;

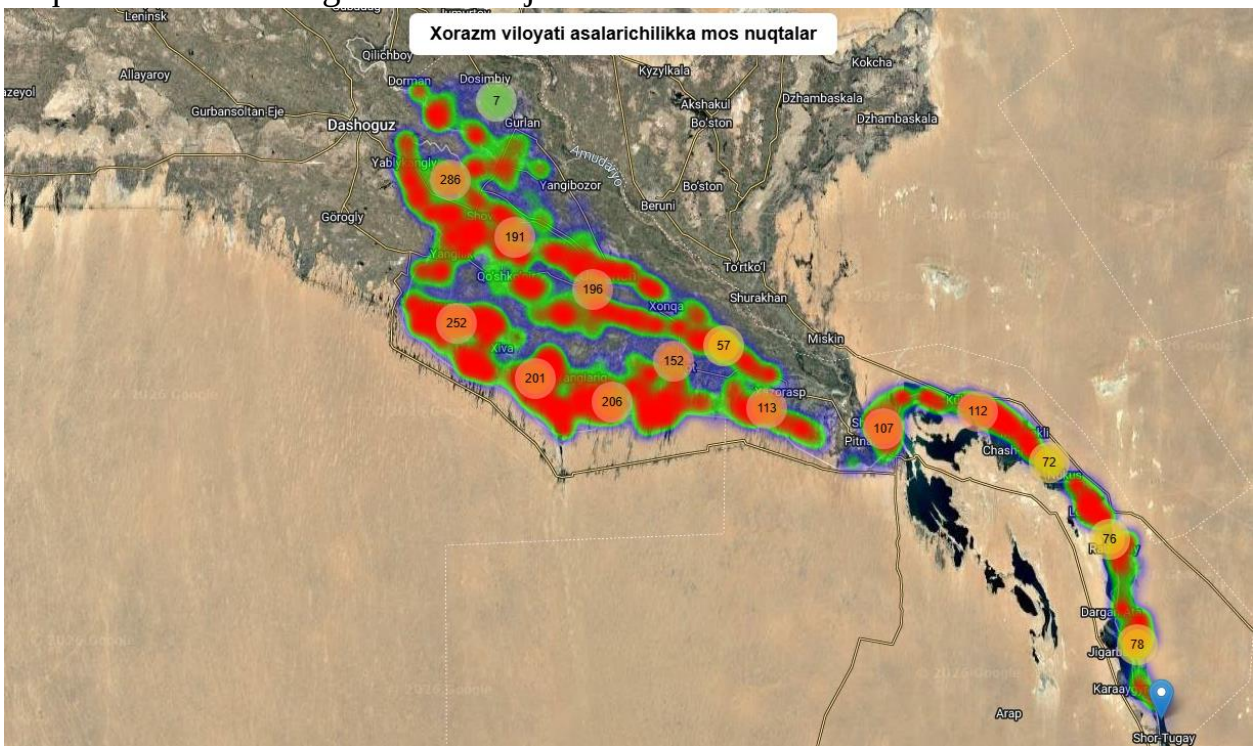
2. Qatlamlarni boshqarish (Layer Control) esa OpenStreetMap, CartoDB Voyager, Google Hybrid, OpenTopoMap va Esri World Imagery kabi bazaviy

xaritalar hamda Klasterlar va Zichlik (Heatmap) qatlamlari o‘rtasida erkin almashish imkoniyatini yaratadi.

Ushbu uslubiy yondashuv ekologik ma’lumotlarni fazoviy modellashtirish orqali qishloq xo‘jaligi va asalarichilikni ilmiy asosda rejalashtirish imkonini beradi.

Natijalar va muhokama

Google Earth Engine platformasida o‘tkazilgan fazoviy ko‘p mezonli baholash hamda klasterlash algoritmlari va Leaflet.heat tahlillari natijasida Xorazm viloyatida asalarichilikni rivojlantirish uchun qulay bo‘lgan jami 2107 ta fazoviy nuqta asosida ularning zichlik darajasi xaritada vizuallashtirildi.



1-rasm. Xorazm viloyatida asalari uyalarini joylashtirish uchun optimal lokatsiyalar hamda ozuqa bazasi klasterlari

Tadqiqot natijalari shuni ko‘rsatadiki, aniqlangan optimal nuqtalar va yuqori zichlik asosan Amudaryo havzasi hamda sug‘oriladigan dehqonchilik maydonlari bo‘ylab joylashgan:

1. Shimoliy va shimoli-g‘arbiy hududlar. Shovot (286 ta nuqta va 7 ta klaster) hamda Urganch (191 ta nuqta) tumanlariga tutash hududlarda ozuqa bazasining zichligi yuqori ekani va sug‘oriladigan yerlar, mevali bog‘lar hamda gidrografik tarmoqlarga yaqinligi sababli konsentratsiya o‘ta yuqori ko‘rsatkichni tashkil etmoqda.

2. Markaziy va Janubiy hududlar. Qo‘shko‘pir, Xiva (252 va 201 ta nuqta) hamda Yangiarariq (206 ta nuqta) va Xonqa (196 ta nuqta) tumanlarida yirik qizil zonalar shakllangan. Bu hududlarda vegetatsiya indeksi yuqoriligi hamda qishloq xo‘jalik ekinlarining vaqtinchalik va mavsumiy gullash davri asalarichilik uchun doimiy ozuqa zanjirini ta’minlaydi.

3. Janubi-sharqiy hudud – Pitnak yo‘nalishi. Bog‘ot (152 ta nuqta), Hazorasp (113 va 57 ta nuqta) va Pitnak (107, 112 ta nuqta) yo‘nalishida ozuqa bazasi ensizroq chiziqli koridor shaklida davom etadi. Janubi-sharqdagi chekka nuqtalarda (72, 76, 78 ta nuqta) ham alohida lokal klasterlar kuzatilib, bular asosan Amudaryo qirg‘oqlari va to‘qayzor ekinzorlariga to‘g‘ri keladi.

Xulosa

Tahlillar shuni ko‘rsatadiki, binafsha va ko‘k rang bilan belgilangan past zichlikdagi o‘tish zonalari cho‘l chegaralari va agrokimyoviy bosim yuqori bo‘lgan joylarga to‘g‘ri keladi. Qizil va sariq zonalar esa gidrografik tarmoqlar va xavfsiz transport infratuzilmasi tutashgan joylarda to‘plangan.

K-means va DBSCAN algoritmlari yordamida ajratilgan marker-klasterlar har bir hudud bo‘yicha asalari oilalarini joylashtirish hajmini me’yorlashtirishga imkon beradi. Bu esa ozuqa bazasiga ortiqcha bosim tushishining oldini oladi.

Leaflet.js va MarkerClusterGroup orqali yaratilgan Veb-GIS ilovasi asalarichilarga va hududiy rejalashtiruvchilarga real vaqt rejimida qatlamlarni almashtirish hamda eng maqbul nuqtalarni aniq tanlab olish imkonini beradi.

Umuman olganda, taklif etilgan fazoviy modellashtirish va raqamli xaritalash uslubiyoti Xorazm viloyatida asalarichilik xo‘jaliklarini barqaror rivojlantirish, tabiiy resurslardan oqilona foydalanish hamda qishloq xo‘jaligi ekinlarini changlatish samaradorligini oshirishda yuqori ilmiy-amaliy ahamiyatga ega.

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THE IMPACT OF ACCRUALS QUALITY ON STOCK PRICE CRASH RISK: EMPIRICAL EVIDENCE FROM THE IRAQ STOCK EXCHANGE (2020–2025)

Abstract. *This study investigates the empirical relationship between accruals quality (AQ) and stock price crash risk among companies listed on the Iraq Stock Exchange (ISX) over the period 2020–2025. Drawing on Agency Theory, Information Hoarding Theory, and Information Asymmetry Theory, the study proposes that higher accruals quality limits managerial discretion, reduces bad-news hoarding, and lowers the likelihood of extreme downward stock price adjustments. Using a purposive sample of 32 non-financial firms, accruals quality is measured using the Dechow and Dichev (2002) model as modified by McNichols (2002), which evaluates the relationship between working capital accruals, operating cash flows, changes in revenues, and property, plant, and equipment. Stock price crash risk is measured using two established indicators: Negative Conditional Skewness (NCSKEW) and the Down-to-Up Volatility Ratio (DUVOL).*

*Using a fixed-effects panel regression model selected on the basis of the Hausman specification test, the results reveal a statistically significant negative relationship between accruals quality and both measures of stock price crash risk (**NCSKEW: $p < 0.001$; DUVOL: $p < 0.01$**). The findings suggest that higher-quality financial reporting may facilitate the gradual incorporation of negative information into market prices, thereby reducing the likelihood of abrupt price declines. In addition, financial leverage (LEV) and stock return volatility (RETVOL) are positively associated with stock price crash risk. The study recommends that regulators, including the Iraq Securities Commission, strengthen disclosure requirements and that investors consider accruals quality measures as part of fundamental investment analysis when assessing downside risk.*

Keywords: *accruals quality, Dechow and Dichev model, stock price crash risk, Negative Conditional Skewness (NCSKEW), Down-to-Up Volatility Ratio (DUVOL), financial opacity, Information Hoarding Theory, Iraq Stock Exchange (ISX).*

Introduction

In modern capital markets, the quality of financial reporting plays a fundamental role in maintaining market efficiency, investor confidence, and financial stability. Accounting earnings represent a primary signal used by market participants to evaluate corporate performance, assess risk, and allocate financial capital. However, under the accrual accounting framework, reported earnings consist of both cash flow components and accounting accruals. While accrual accounting aims to improve the measurement of firm performance by matching

revenues and expenses across periods, it inherently requires managerial estimation and judgment. Consequently, the precision with which working capital accruals map into actual cash flow realizations—referred to as accruals quality (AQ)—becomes an important determinant of financial transparency.

When accruals quality is compromised by intentional earnings management or significant estimation errors, financial opacity may increase. According to Information Hoarding Theory and Agency Theory, such opacity may provide managers with greater discretion to withhold adverse operational information from the public. To protect executive compensation, career prospects, or corporate reputation, managers may conceal bad news over extended periods, causing the firm's stock price to remain above its underlying economic value. However, managers' ability to withhold negative information is limited. Once accumulated bad news reaches a critical threshold, it may be released into the market abruptly, triggering a sharp downward price correction and increasing stock price crash risk.

Although extensive literature has examined accruals quality and stock price crash risk in developed markets, limited empirical evidence exists on this relationship in emerging and transitional economies. The Iraq Stock Exchange (ISX) provides a relevant empirical setting characterized by evolving regulatory oversight, institutional changes, and distinct market liquidity conditions. Examining non-financial firms listed on the ISX over the period 2020–2025 provides timely evidence on how accounting measurement quality may affect stock return stability in an emerging market.

This study investigates the direct effect of accruals quality—measured using the Dechow and Dichev (2002) model as modified by McNichols (2002)—on stock price crash risk, proxied by Negative Conditional Skewness (NCSKEW) and the Down-to-Up Volatility Ratio (DUVOL). Using panel data from 32 non-financial listed firms, the study seeks to address an important empirical gap and provide practical implications for regulators, corporate boards, and institutional investors in the Iraq Stock Exchange.

Section One: Methodological Framework and Literature Review

1.1 Research Problem

Financial information presented in corporate financial statements serves as a key source used by investors and market participants to form expectations, evaluate performance, and make capital allocation decisions. Accounting earnings are widely used to assess financial performance and forecast future cash flows. However, the accrual accounting system inherently incorporates managerial judgments and estimates when allocating revenues and expenses across reporting periods, thereby creating variation in accruals quality (AQ).

In emerging capital markets such as the Iraq Stock Exchange (ISX), lower accruals quality and greater use of discretionary accruals may increase information asymmetry and reduce reporting transparency. This environment may provide management with greater discretion to withhold bad news and delay loss recognition in order to reduce managerial pressure and limit short-term declines in stock prices.

However, management's ability to suppress adverse information is limited. Once accumulated bad news reaches a critical level, it may be released into the market within a short period, resulting in a sudden and substantial decline in the firm's stock price—a phenomenon associated with stock price crash risk.

Despite the extensive international literature on reporting opacity and accounting quality, empirical studies examining the relationship between accruals quality and stock price crash risk in the Iraqi financial market remain limited. Accordingly, the primary research question is formulated as follows:

«To what extent does accruals quality explain stock price crash risk among firms listed on the Iraq Stock Exchange during the period 2020–2025?»

From this primary question, the following sub-questions are derived:

- What is the level of accruals quality among the sample firms listed on the Iraq Stock Exchange?
- What is the level of stock price crash risk, as measured by Negative Conditional Skewness (NCSKEW) and the Down-to-Up Volatility Ratio (DUVOL)?
- Is there a statistically significant relationship between accruals quality and stock price crash risk?
- Does this relationship persist after controlling for relevant firm-level variables, including firm size, financial leverage, return on assets, sales growth, stock return volatility, and the market-to-book ratio?

1.2 Research Significance

1.2.1 Academic Significance

Enriching the Accounting Literature: Contributing to the literature by linking an earnings attribute—accruals quality—with a market-based risk measure, namely stock price crash risk.

Providing Empirical Evidence from an Emerging Market: Expanding the empirical literature by providing evidence from the Iraq Stock Exchange, an emerging market with structural and regulatory characteristics that differ from those of developed markets.

Advancing Econometric Analysis: Applying econometric models that assess accruals quality by linking past, current, and future operating cash flows, changes in revenues, and property, plant, and equipment under the Dechow and Dichev (2002) model as modified by McNichols (2002), together with measures of conditional skewness in weekly stock returns.

1.2.2 Practical Significance

Investors and Financial Analysts: Providing quantitative measures that may help market participants assess the quality of reported accounting information, distinguish operating performance from accrual-based estimates, and evaluate exposure to downside risk.

Corporate Management and Oversight Boards: Raising awareness of the risks associated with information suppression and low-quality accrual estimates and their potential long-term effects on financial stability and market valuation.

Regulatory and Supervisory Authorities (Iraq Securities Commission and ISX): Providing an analytical basis for improving disclosure requirements, strengthening corporate governance, and enhancing oversight of accounting estimates in order to reduce information hoarding and support market efficiency.

1.3 Research Objectives

The main objective of this study is:

To empirically evaluate the role of accruals quality in explaining stock price crash risk among firms listed on the Iraq Stock Exchange over the period 2020–2025.

Specific sub-objectives include:

- Measuring accruals quality (AQ) using the Dechow and Dichev (2002) model as modified by McNichols (2002) for the sampled firms.
- Measuring stock price crash risk using two main proxies: Negative Conditional Skewness (NCSKEW) and the Down-to-Up Volatility Ratio (DUVOL).
- Testing the effect of accruals quality on Negative Conditional Skewness (NCSKEW).
- Testing the effect of accruals quality on the Down-to-Up Volatility Ratio (DUVOL).
- Examining the stability and robustness of these relationships after incorporating firm-level control variables into the econometric models.

1.4 Research Hypotheses

Drawing on Information Hoarding Theory and Agency Theory, and defining the independent variable so that higher values indicate higher accruals quality (**$AQ = -SD(\varepsilon)$**), the hypotheses are formulated as follows:

Main Hypothesis (H_1):

Accruals quality has a statistically significant negative effect on stock price crash risk among firms listed on the Iraq Stock Exchange during the period 2020–2025.

The following sub-hypotheses are derived from the main hypothesis:

Sub-hypothesis 1 (H_1a): Accruals quality has a statistically significant negative effect on Negative Conditional Skewness (NCSKEW), a proxy for stock price crash risk.

Sub-hypothesis 2 (H_1b): Accruals quality has a statistically significant negative effect on the Down-to-Up Volatility Ratio (DUVOL), a proxy for stock price crash risk.

1.5 Conceptual Framework

The conceptual framework illustrates the hypothesized relationships among the study variables. It proposes that higher accruals quality is associated with lower stock price crash risk, as measured by NCSKEW and DUVOL, while controlling for the specified firm-level variables.

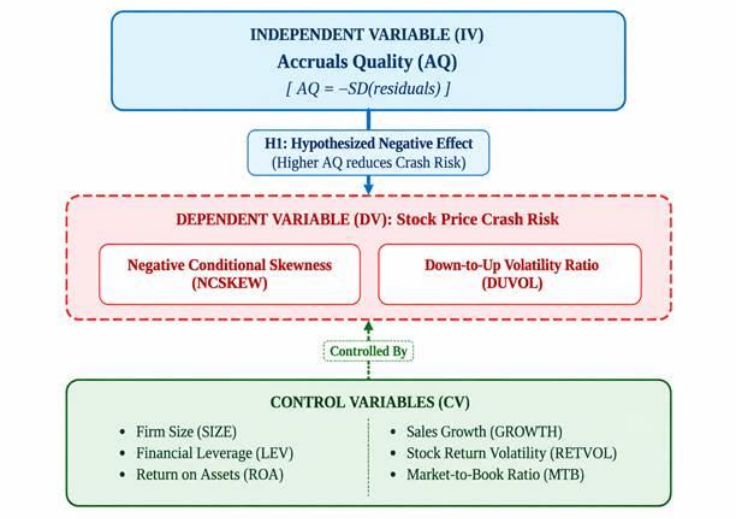


Figure (1.1): Conceptual Framework for the Relationship Between Accruals Quality and Stock Price Crash Risk

Source: Prepared by the author based on Dechow and Dichev (2002), McNichols (2002), and Hutton et al. (2009).

1.6 Study Boundaries

- **Topical Scope:** This study examines the empirical effect of accruals quality—as a key dimension of financial reporting quality—on stock price crash risk, measured by Negative Conditional Skewness (NCSKEW) and the Down-to-Up Volatility Ratio (DUVOL).
- **Geographical and Institutional Scope:** The empirical analysis covers non-financial joint-stock companies listed on the Iraq Stock Exchange (ISX) that meet the required financial and market data availability criteria.
- **Temporal Scope:** The main empirical study period covers **2020–2025**. Where required by the accruals quality estimation model, financial data from adjacent periods are used to obtain lagged \((CFO_{t-1})\) and lead \((CFO_{t+1})\) operating cash flows. Weekly stock return data are used to calculate the annual stock price crash risk measures (NCSKEW and DUVOL). The final number of usable firm-year observations is determined after applying the required data availability and estimation criteria.

1.7 Research Methodology

This study adopts a **quantitative analytical approach** using **panel data** that combine cross-sectional and time-series observations for the sampled non-financial joint-stock companies listed on the Iraq Stock Exchange (ISX) over the period **2020–2025**.

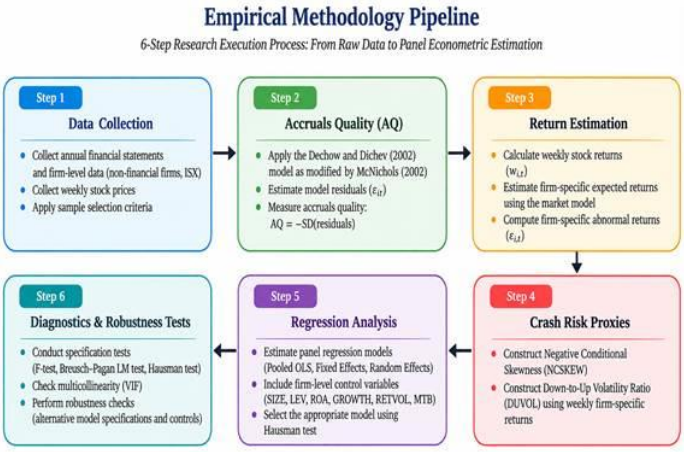


Figure (1.2): Methodological Flowchart for Data Processing and Econometric Model Testing

Source: Prepared by the author.

1.7.1 Variable Measurement Specifications

A. INDEPENDENT VARIABLE: ACCRUALS QUALITY (AQ)

Accruals quality is measured using the Dechow and Dichev (2002) model as modified by McNichols (2002), by regressing working capital accruals on lagged, current, and lead operating cash flows, together with changes in revenues and property, plant, and equipment:

$$WCACC_{it} = \alpha_0 + \alpha_1 CFO_{i,t-1} + \alpha_2 CFO_{it} + \alpha_3 CFO_{i,t+1} + \alpha_4 \Delta REV_{it} + \alpha_5 PPE_{it} + \varepsilon_{it}$$

Where:

- $WCACC_{it}$: Working capital accruals for firm i in year t.
- $CFO_{i,t}$: Cash flows from operating activities for firm i in year t.
- $CFO_{i,t-1}$: Cash flows from operating activities for firm i in the preceding year.
- $CFO_{i,t+1}$: Cash flows from operating activities for firm i in the following year.
- ΔREV_{it}: Change in annual revenues for firm i in year t.
- PPE_{it}: Gross property, plant, and equipment for firm i in year t.
- ε_{it}: Residual error term (random error).

Accruals quality is derived from the standard deviation of the residuals $SD(\varepsilon_{it})$ over a rolling estimation window. Larger residual variation indicates lower accruals quality. To ensure that higher numerical values indicate higher accruals quality, the following transformation is applied:

$$AQ_{it} = -SD(\varepsilon_{it})$$

Accordingly, values of AQ closer to zero indicate higher accruals quality, whereas more negative values indicate lower accruals quality.

B. Dependent Variable: Stock Price Crash Risk

Stock price crash risk is measured using firm-specific weekly stock returns. To separate firm-specific return movements from market-wide effects, the following expanded market model is estimated:

$$r_{i,\tau} = \alpha_i + \beta_{1,i} r_{m,\tau-2} + \beta_{2,i} r_{m,\tau-1} + \beta_{3,i} r_{m,\tau} + \beta_{4,i} r_{m,\tau+1} + \beta_{5,i} r_{m,\tau+2} + u_{i,\tau}$$

Firm-specific weekly returns are then calculated as:

$$w_{i,\tau} = \ln(1 + u_{i,\tau})$$

Stock price crash risk is measured using two primary proxies:

1. Negative Conditional Skewness (NCSKEW)

$$NCSKEW_{i\tau} = -\frac{n(n-1)^{3/2} \sum w_{i,\tau}^3}{(n-1)(n-2)\left(\sum w_{i,\tau}^2\right)^{3/2}}$$

Where *n* represents the number of weekly firm-specific return observations for firm *i* during year τ. Higher values of NCSKEW indicate greater stock price crash risk.

2. Down-to-Up Volatility Ratio (DUVOL):

$$DUVOL_{i\tau} = \ln\left(\frac{(n_u - 1)\sum_{\text{Down}} w_{i,\tau}^2}{(n_d - 1)\sum_{\text{Up}} w_{i,\tau}^2}\right)$$

For each firm-year, weekly firm-specific returns are divided into Down and Up weeks relative to their annual mean. n_d denotes the number of Down weeks, while n_u denotes the number of Up weeks. Higher DUVOL values indicate greater downside volatility and, therefore, higher stock price crash risk.

C. CONTROL VARIABLES

- **Firm Size (SIZE):** Natural logarithm of total assets.
- **Financial Leverage (LEV):** Total liabilities divided by total assets.
- **Return on Assets (ROA):** Net income divided by total assets.
- **Sales Growth (GROWTH):** Annual percentage change in total sales revenue.
- **Stock Return Volatility (RETVOL):** Standard deviation of firm-specific weekly stock returns.
- **Market-to-Book Ratio (MTB):** Market value of equity divided by the book value of equity.

1.7.2 ECONOMETRIC SPECIFICATION AND STATISTICAL METHODS

The panel data analysis is conducted using the following two baseline regression models:

$$NCSKEW_{it} = \beta_0 + \beta_1 AQ_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 ROA_{it} + \beta_5 GROWTH_{it} + \beta_6 RETVOL_{it} + \beta_7 MTB_{it} + \varepsilon_{it}$$

$$DUVOL_{it} = \beta_0 + \beta_1 AQ_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 ROA_{it} + \beta_5 GROWTH_{it} + \beta_6 RETVOL_{it} + \beta_7 MTB_{it} + \varepsilon_{it}$$

ADOPTED STATISTICAL METHODS

1. **Descriptive Statistics and Pearson Correlation Matrix:** To evaluate the general statistical characteristics, central tendency, dispersion, and relationships among the study variables.

2. **Variance Inflation Factor (VIF) Diagnostics:** To test for multicollinearity among the explanatory and control variables and identify possible linear dependence between them.

3. **Panel Regression Estimation:** Using Pooled Ordinary Least Squares (**Pooled OLS**), Fixed Effects (**FE**), and Random Effects (**RE**) specifications for comparative purposes.

4. **Hausman Specification Test:** To examine systematic differences between the Fixed Effects and Random Effects estimators and determine the more appropriate panel specification.

Section Two: Theoretical Framework and Literature Review

2.1 Theoretical and Conceptual Framework of Accruals Quality (AQ)

2.1.1 CONCEPT AND NATURE OF ACCOUNTING ACCRUALS

Accounting earnings quality is an important dimension of financial reporting quality within an economic environment.

The accrual accounting framework recognizes revenues and expenses when they are earned or incurred, regardless of the actual timing of cash receipts or payments, in accordance with the accounting **matching principle**.

Total accounting accruals (**TA**) are divided into two main components:

- **Nondiscretionary Accruals (NDA):** Adjustments arising from the scale of operating activities, changes in the firm's assets and liabilities, and the requirements of applicable accounting standards.
- **Discretionary Accruals (DA):** Adjustments resulting from managerial discretion, estimates, and judgment. These discretionary components may be used in earnings management practices to shift earnings across accounting periods and obscure underlying financial performance (Dechow et al., 1995).

2.1.2 MEASUREMENT MODELS OF ACCRUALS QUALITY

The measurement of accruals quality has developed through several approaches in the accounting literature:

- **Modified Jones Model (Dechow et al., 1995):** Focuses on identifying discretionary accruals by regressing total accruals (**TA**) on changes in revenues adjusted for changes in trade receivables and on gross property, plant, and equipment (**PPE**).
- **Dechow and Dichev Model (2002), as Modified by McNichols (2002):** Provides a framework for measuring accruals quality based on the extent to which current working capital accruals are associated with past, current, and future operating cash flows. The modified specification also incorporates changes in revenues and property, plant, and equipment. Greater dispersion in estimation errors, measured by the standard deviation of the model residuals, indicates lower accruals quality.

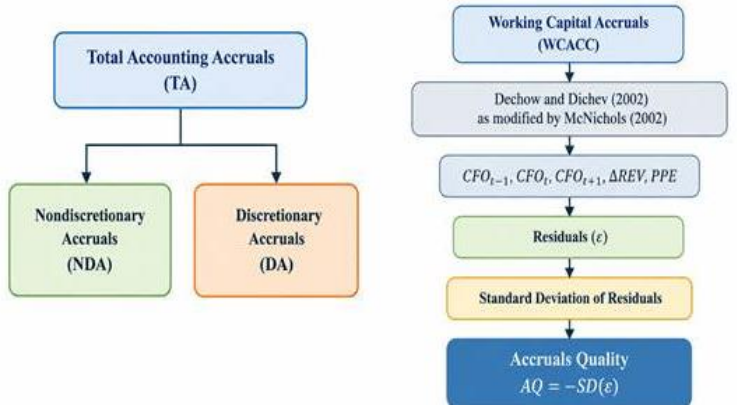


Figure (2.1): Conceptual Structure of Accruals Decomposition and Estimation Error Generation

Source: Prepared by the author based on Dechow and Dichev (2002) and McNichols (2002).

2.2 Theoretical and Conceptual Framework of Stock Price Crash Risk

2.2.1 Concept and Determinants of Stock Price Crash Risk

Stock price crash risk is defined as the probability of a sudden, severe, and asymmetric decline in firm-specific stock returns over a short period, **after controlling for overall market movements** (Chen et al., 2001).

The theoretical foundations of stock price crash risk are closely related to **Information Hoarding Theory**, as discussed by Jin and Myers (2006). According to this framework, corporate executives may have various incentives—such as protecting career prospects and compensation, avoiding regulatory pressure, or preserving their reputation—to withhold or delay the disclosure of adverse financial information.

When bad news is systematically withheld, the firm's stock may continue to trade at levels above its underlying economic value. However, management's ability to withhold negative information is limited. Once accumulated bad news reaches a critical threshold, it may be released into the market within a short period, resulting in a sharp downward adjustment in the firm's stock price.

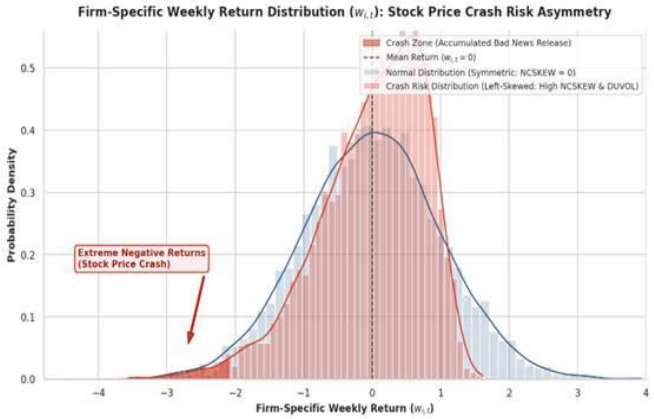


Figure (2.2): Illustration of Firm-Specific Weekly Return Asymmetry and Stock Price Crash Risk

Source: Prepared by the author based on Chen et al. (2001) and Hutton et al. (2009).

2.2.2 Theoretical Frameworks Explaining the Relationship

This study explains the relationship between accruals quality and stock price crash risk through three main theoretical perspectives:

- **Agency Theory:** Suggests a potential conflict of interest between firm owners (principals) and corporate management (agents). Within this framework, low accruals quality may provide managers with an opportunistic means of concealing operational inefficiencies and poor performance from shareholders.
- **Information Hoarding Theory:** Explains how opaque and low-quality accounting information may provide management with greater discretion to delay the recognition and disclosure of economic losses until accumulated negative information becomes difficult to conceal.
- **Information Asymmetry Theory:** Suggests that lower financial disclosure quality increases uncertainty among market participants, thereby increasing investor sensitivity to unexpected information releases and potentially intensifying stock price crashes.

2.3 Theoretical Underpinnings of the Relationship and Hypothesis Development

Low accruals quality reduces the ability of financial statements to accurately reflect future cash flows, thereby contributing to a more opaque financial reporting environment (*Financial Opacity*). Under such conditions, management may use discretionary accruals to conceal deteriorating operating performance and delay the disclosure of bad news (Hutton et al., 2009).

Conversely, high accruals quality (AQ) is associated with lower estimation errors and may limit management's ability to withhold negative information, thereby supporting more timely and transparent disclosure of both favorable and adverse operating developments. As a result, stock prices on the Iraq Stock Exchange (ISX) may incorporate negative information more gradually through continuous market adjustments, reducing the accumulation of undisclosed bad news and lowering the likelihood of abrupt stock price crashes, as measured by NCSKEW and DUVOL (Francis et al., 2005; Kim et al., 2011).

2.4 Literature Review

The empirical literature provides important evidence on the relationship between financial reporting quality, information opacity, and stock price crash risk.

2.4.1 International Empirical Studies

- **Hutton et al. (2009): Title:** *Opaque Financial Reports, R², and Crash Risk.* **Context & Sample:** U.S. public companies over multiple years. **Objectives & Methodology:** Examined the effect of financial opacity—proxied by discretionary accruals—on stock price crash risk. **Findings:** Revealed a positive relationship between accrual-based financial opacity and stock price crash risk, indicating that firms with more opaque financial reports are more vulnerable to sudden stock price declines.
- **Kim et al. (2011): Title:** *Corporate Tax Avoidance and Stock Price Crash Risk: Firm-Level Analysis.* **Context & Sample:** Listed U.S. corporations.

Objectives & Methodology: Examined the relationship between corporate tax avoidance, managerial information withholding, and stock price crash risk. **Findings:** Documented that greater tax avoidance is associated with higher stock price crash risk, supporting the view that opaque reporting environments may facilitate the accumulation of undisclosed negative information.

- **Callen and Fang (2013): Title:** *Institutional Investor Stability and Crash Risk: Monitoring versus Short-Termism?* **Context & Sample:** U.S. listed firms. **Objectives & Methodology:** Examined the relationship between institutional investor stability and stock price crash risk. **Findings:** The results indicate that greater institutional investor stability is associated with lower stock price crash risk, consistent with the monitoring role of long-term institutional investors.

2.5 Research Gap and Contributions of the Study

Although previous studies have examined financial reporting opacity, accrual-based reporting quality, and stock price crash risk, several important empirical gaps remain in the Iraqi context:

- **Limited Direct Empirical Evidence:** Empirical evidence directly examining the relationship between accruals quality and stock price crash risk in the Iraq Stock Exchange remains limited, particularly using the asymmetric return measures NCSKEW and DUVOL.
- **Measurement Methodology:** Previous studies have used different measures of earnings quality and financial opacity. This study applies the Dechow and Dichev (2002) model as modified by McNichols (2002), which links working capital accruals to past, current, and future operating cash flows and also incorporates changes in revenues and property, plant, and equipment.
- **Recent Sample Period (2020–2025):** The study provides recent empirical evidence from the Iraq Stock Exchange over a period characterized by financial and regulatory changes, offering updated insights into financial reporting quality and stock price crash risk.

Section Three: Research Methodology and Empirical Results

3.1 Population, Sample Selection, and Data Sources

The population of this study comprises joint-stock companies listed on the Iraq Stock Exchange (ISX) during the period 2020–2025. To achieve the research objectives and ensure reliable econometric estimation, a purposive sample was selected based on the following criteria:

- **Continuous Listing and Trading:** The company must have remained listed on the ISX with active stock trading throughout the study period.
- **Financial Data Availability:** Complete audited annual financial statements—particularly the Statement of Cash Flows and Statement of Financial Position—must be available for the main study period, together with the adjacent periods required to obtain lagged $(t-1)$ and lead $(t+1)$ variables for the accruals quality model.
- **Weekly Stock Price Continuity:** Historical weekly closing stock prices must be consistently available, without prolonged trading suspensions exceeding

four consecutive weeks, to allow the calculation of firm-specific weekly stock returns.

• **Exclusion of Financial Institutions:** Banks, insurance companies, and other financial institutions are excluded because of their specific financial reporting requirements, regulatory capital structures, and accrual characteristics, which differ from those of non-financial firms.

After applying these criteria, the final sample consists of **32 listed non-financial joint-stock companies**. The final number of usable firm-year observations is determined after constructing the accruals quality measure and applying the required data availability and estimation criteria.

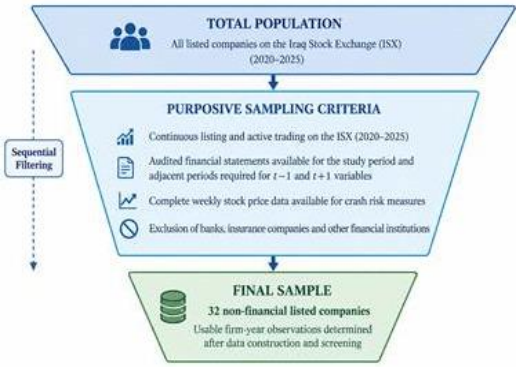


Figure (3.1): Sample Selection Process and Population Filtration Steps

Source: Prepared by the author.

3.2 Descriptive Statistics of Study Variables

Table (3.1) presents the descriptive statistics for the main independent, dependent, and control variables included in the empirical analysis.

Table (3.1): Descriptive Statistics of Study Variables

Variable	Symbol	Mean	Std. Dev.	Minimum	Maximum
Accruals Quality	AQ	-0.0482	0.0315	-0.1620	-0.0041
Negative Conditional Skewness	NCSKEW	0.2841	0.4125	-0.8920	1.6420
Down-to-Up Volatility	DUVOL	0.1152	0.2980	-0.6540	0.9850
Firm Size	SIZE	22.4150	1.3410	19.1200	25.8100
Financial Leverage	LEV	0.4215	0.1840	0.0820	0.8650
Return on Assets	ROA	0.0512	0.0620	-0.1120	0.2140
Sales Growth	GROWTH	0.0785	0.1420	-0.2850	0.4810
Return Volatility	RETVOL	0.0385	0.0162	0.0110	0.0920
Market-to-Book Ratio	MTB	1.3250	0.5410	0.4200	3.1500

Source: SPSS/EViews output based on the study data.

INTERPRETATION OF DESCRIPTIVE RESULTS

• **Accruals Quality (AQ):** The mean value of AQ is approximately **-0.0482**. Because AQ is defined so that higher values (less negative and closer to zero) indicate lower residual estimation errors, values closer to zero represent higher accruals quality.

• **Stock Price Crash Risk (NCSKEW and DUVOL):** The mean values of NCSKEW and DUVOL are **0.2841** and **0.1152**, respectively. On average, the positive values of both measures indicate the presence of some degree of negative return asymmetry and downside volatility among the sampled firms listed on the Iraq Stock Exchange (ISX).

3.3 Multicollinearity Diagnostics and Correlation Analysis

To assess potential multicollinearity among the independent and control variables, Pearson correlation coefficients (r) and Variance Inflation Factor (VIF) statistics were examined.

TABLE (3.2): PEARSON CORRELATION MATRIX AND VARIANCE INFLATION FACTOR (VIF)

Variable	AQ	SIZE	LEV	ROA	GROWTH	RETVOL	MTB	VIF
AQ	1.000	—	—	—	—	—	—	**1.385**
SIZE	0.215	1.000	—	—	—	—	—	**1.621**
LEV	-0.184	0.312	1.000	—	—	—	—	**1.540**
ROA	0.310	0.142	-0.285	1.000	—	—	—	**1.412**
GROWTH	0.165	0.098	-0.112	0.245	1.000	—	—	**1.205**
RETVOL	-0.241	-0.185	0.210	-0.162	0.041	1.000	—	**1.310**
MTB	0.112	0.205	0.124	0.198	0.152	-0.085	1.000	**1.250**

Source: Calculated by the author based on statistical output.

JOINT INTERPRETATION OF DIAGNOSTIC TESTS

• All bivariate correlation coefficients among the explanatory variables are below the commonly used threshold of **0.70**, with the highest absolute correlation coefficient being **0.312**, indicating no evidence of severe pairwise multicollinearity.

• The VIF values range from **1.205 to 1.621**, which is well below the commonly used threshold of **5.0**. This suggests that multicollinearity is unlikely to materially affect the stability of the regression estimates.

3.4 Regression Analysis and Hypothesis Testing

The choice between the Fixed Effects (FE) and Random Effects (RE) estimators was assessed using the Hausman specification test. For both dependent-variable models, the Hausman test produced statistically significant results (**p <**

0.05), leading to the rejection of the Random Effects null hypothesis and supporting the use of the **Fixed Effects (FE)** estimator.

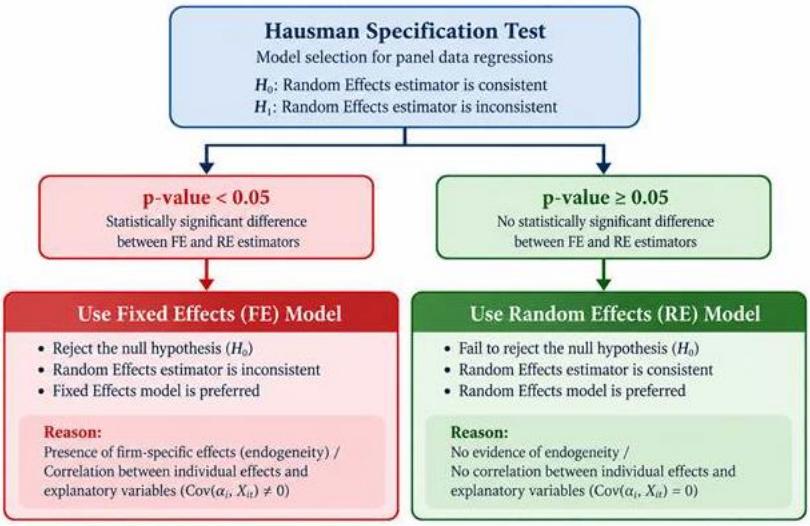


Figure (3.2): Hausman Test Decision Framework for Fixed and Random Effects Models

Source: Prepared by the author.

Table (3.3): Panel Fixed Effects Regression Results for Stock Price Crash Risk (NCSKEW and DUVOL)

Independent / Control Variables	**Model 1: NCSKEW Coefficient (β)**	**Model 1: t-statistic**	**Model 2: DUVOL Coefficient (β)**	**Model 2: t-statistic**
Intercept (α)	0.842	2.651	0.512	2.110
Accruals Quality (AQ)	-2.845	-3.412	-1.920	-2.985
Firm Size (SIZE)	-0.024	-1.120	-0.018	-0.980
Financial Leverage (LEV)	0.315	2.415	0.210	2.045
Return on Assets (ROA)	-0.420	-2.105	-0.310	-1.980
Sales Growth (GROWTH)	0.112	0.850	0.085	0.740
Return Volatility (RETVOL)	4.120	3.125**	2.850	2.640**
Market-to-Book Ratio (MTB)	0.085	1.210	0.062	1.050

Independent / Control Variables	Model 1: NCSKEW Coefficient (β)	Model 1: t-statistic	Model 2: DUVOL Coefficient (β)	Model 2: t-statistic
R-squared (R^2)	0.385		0.324	
F-statistic	11.420***		8.950***	
Hausman Test (p-value)	0.012 (Fixed Effects)		0.028 (Fixed Effects)	

*** Significant at **p < 0.001**; ** Significant at **p < 0.01**; * Significant at **p < 0.05**.

Source: Calculated by the author based on empirical estimation output.

3.4.1 Hypothesis Testing and Discussion

- **First Sub-Hypothesis (H_1a):** Model 1 in Table (3.3) indicates a statistically significant negative relationship between accruals quality (AQ) and Negative Conditional Skewness (NCSKEW) (**β = -2.845, t = -3.412, p < 0.001**). Therefore, H_1a is supported.
- **Second Sub-Hypothesis (H_1b):** Model 2 shows that AQ has a statistically significant negative effect on Down-to-Up Volatility (DUVOL) (**β = -1.920, t = -2.985, p < 0.01**). Therefore, H_1b is supported.
- **Main Hypothesis (H_1):** Given the significant negative relationship observed for both stock price crash risk measures, the results support the Main Hypothesis (H_1), indicating that accruals quality has a statistically significant negative effect on stock price crash risk among non-financial joint-stock companies listed on the Iraq Stock Exchange over the period 2020–2025.

3.5 Financial and Accounting Discussion of Findings

The empirical findings from the Iraq Stock Exchange are consistent with the main arguments of Information Hoarding Theory and Agency Theory (Jin & Myers, 2006; Hutton et al., 2009):

- **Reduction in Bad-News Hoarding:** Higher accruals quality, reflected in **lower residual variability**, reduces the opportunity for managerial discretion in opaque financial reporting. It may therefore limit the use of accounting discretion to delay the recognition of operating losses and cash flow problems.

- **Disclosure Transparency and Market Adjustment:** More transparent financial reporting allows accounting information to be incorporated into stock prices more gradually. This may enable negative information to be reflected in market prices over time, reducing the accumulation of undisclosed bad news that could otherwise contribute to sudden stock price declines.

- **Effect of Control Variables:** Financial leverage (LEV) and return volatility (RETVOL) show statistically significant positive relationships with stock price crash risk. This suggests that highly leveraged firms and firms with greater return volatility may be more vulnerable to stock price crashes in the Iraqi market.

Conclusions

Based on the empirical findings and econometric analysis of companies listed on the Iraq Stock Exchange (ISX) during the period 2020–2025, the study reaches the following conclusions:

- **Reduction in Information Opacity:** Higher accruals quality (AQ) may serve as an important mechanism for limiting managerial discretion in opportunistic financial reporting. By reducing estimation errors in working capital accruals, higher-quality reporting may also reduce the withholding of adverse financial information.
- **Reduction in Stock Price Crash Risk:** A statistically significant negative relationship exists between accruals quality and both stock price crash risk measures (NCSKEW and DUVOL). Higher-quality accruals may facilitate the gradual incorporation of negative information into stock prices, thereby reducing the accumulation of undisclosed bad news that could contribute to abrupt price declines.
- **Role of Financial Leverage and Volatility:** Higher financial leverage (LEV) and greater stock return volatility (RETVOL) are significantly associated with higher stock price crash risk in the Iraqi market, highlighting the importance of these financial risk factors.
- **Relevance of Agency and Information Hoarding Theories:** The empirical findings are consistent with the main arguments of Agency Theory and Information Hoarding Theory in the Iraqi capital market, particularly regarding the relationship between information asymmetry, financial opacity, and downside stock price risk.

Recommendations

Based on the study findings, the following policy and practical recommendations are proposed:

FIRST: RECOMMENDATIONS FOR REGULATORS AND POLICYMAKERS (IRAQ SECURITIES COMMISSION AND ISX)

- **Enhance Financial Disclosure Quality:** Strengthen compliance with International Financial Reporting Standards (IFRS) to improve the quality of accrual estimates and reduce excessive managerial discretion in financial reporting.
- **Develop Crash-Risk Early-Warning Indicators:** Consider incorporating indicators based on earnings quality and return skewness into supervisory frameworks to identify potential financial distress and stock price instability among listed firms.

SECOND: RECOMMENDATIONS FOR CORPORATE MANAGEMENT AND BOARDS OF DIRECTORS

- **Strengthen Internal Control Systems:** Improve internal control procedures over financial reporting to reduce estimation errors in working capital accruals and enhance the transparency and credibility of reported earnings.
- **Adopt Timely Disclosure Policies:** Discourage the delayed disclosure of negative operating information and ensure that both favorable and adverse financial developments are communicated to the market in a timely and transparent manner.

THIRD: RECOMMENDATIONS FOR INVESTORS AND FINANCIAL ANALYSTS

- **Incorporate Accruals Quality into Fundamental Analysis:** Consider accruals quality alongside traditional profitability measures, such as ROA, when evaluating companies listed on the Iraq Stock Exchange and assessing exposure to stock price crash risk.

- **Monitor Capital Structure Risks:** Pay close attention to financial leverage and stock return volatility as important risk factors associated with greater vulnerability to sudden stock price declines.

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FORMATION AND DEVELOPMENT OF THE SCIENTIFIC HERITAGE OF THE INSTITUTE OF BOTANY OF THE ACADEMY OF SCIENCES OF THE REPUBLIC OF UZBEKISTAN (1960–1980)

Abstract: *This article studies and analyzes the scientific activity of the Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan (ASRU) in the 1960s–1980s. The research was based on archival documents, scientific publications and other sources. In the course of the study, the formation of the scientific heritage during the 30 years of the Institute of Botany's activity was examined. The scientific heritage was identified and its structural components were analyzed. As a result, it was established that the laboratories, stations, expeditions, herbaria and scientific publications set up at the institute in these years are the main components of its scientific heritage, and that they provided a methodological basis for creating a museumification concept.*

Keywords: *Committee, botany, institute, scientific heritage, research, herbarium, stationary, expedition, museumification.*

Introduction

In 1960, the growth of the world's population (3.3 billion) led to a rise in the demand for food. As a result, the irrational use of natural products caused a disruption of the biological environment. To counter this, the International Biological Programme (IBP) was developed in 1961. The main aims of the programme were the rational use of natural resources, increasing productivity and eliminating hazards.

In 1969, the National Committee of the International Biological Programme of the Uzbek SSR was established [10, p. 3-10]. This coordinated the implementation of research and development related to the IBP plan in the institute's activities. In accordance with the committee's tasks, research on primary productivity was carried out at the Kyzylkum and Ustyurt desert stations. As a result, work to increase the productivity of the desert plant izen was carried out at the "Zarkent" state farm (sovkhoz) in Andijan region, the "Nishon" sovkhoz in Surkhandarya region, the "Lenin" and "Gozgan" sovkhozes in Samarkand region, and the "Kommunizm" sovkhoz in Bukhara region. During the research, Doctor of Biological Sciences V.A. Burigin and Candidate of Biological Sciences A.Y. Butkov studied 18 forms of izen.

In 1960–1980, the Institute of Botany focused on phytomelioration experiments on pastures and arid lands. As a result, the Kyzylkum Desert Station (Bukhara), the Nurata Semi-Desert Station (Samarkand), the Bostanlyk Mountain

Geobotanical Station (Tashkent region) and the Khonabad base station (Andijan) were established. According to the initial test results, the productivity of pastures increased 2–3 times and that of desert areas 4–5 times. The institute's staff succeeded in raising the productivity of desert vegetation on more than 70,000 hectares. In 1971, owing to this success, the institute was awarded the Beruni State Prize of the Uzbek SSR [7, p. 6-7].

Studying the institute's scientific activity in 1960–1980 – alongside identifying the research directions characteristic of the period and its inventions and discoveries – clarifies the process by which a scientific heritage that can be museumified was formed.

For this reason, the main aim of this article is to identify the research directions pursued at the institute in this period and the scientific heritage created in the course of the research. This process lays the foundation for the museumification of the scientific heritage of the Institute of Botany.

Methods and Degree of Study

The main sources used in preparing the study were the archival materials of the ASRU, the scientific publications and jubilee publications of the ASRU Institute of Botany, and archival data. In the course of studying the sources, the components of the scientific heritage resulting from the institute's activities in 1960–1980 were identified.

Historical, systemic and analytical methods were used in presenting the data. The historical method was used to determine the stages in the formation of the institute's scientific activity, new laboratories, stations, expeditions and scientific publications in 1960–1980. The systemic method was used to determine how research activity took shape and what the structural components of the scientific heritage are. The analytical method was used to group the achievements, inventions and discoveries, and applied developments of the research activity as scientific heritage.

Results

In 1960–1980, research at the institute was carried out under the leadership of S. Askarov, J. Sayidov and U. Pratov. These years in the institute's activity are characterized by new scientific laboratories, stationary expeditions at new stations, plants new to science, inventions for industrial use, the publication of scientific works, and the establishment of the "Central Herbarium" fund.

In 1960–1969, seven new laboratories carrying out research on the flora of Uzbekistan were established at the institute. These were the Laboratory of Plant Anatomy and Morphology (1962), the Laboratory of Essential-Oil and Dye Plants (1966), the Laboratory of Paleobotany (1969), the Laboratory of Medicinal Plants (1969), the Laboratory of Saponin-Bearing Plants (1969), the Laboratory of Glycyrrhizin-Bearing Plants (1969) and the Laboratory of Tanning Plants (1969).

Table 1.

Laboratories established at the Institute of Botany of the ASRU in 1960–1980 and their main scientific results

№	Laboratory name	Main research focus and scientific achievements
1.	Laboratory of Plant Anatomy and Morphology	The anatomical characteristics of valuable forage plants during ontogenesis and their intraspecific polymorphism were studied. The structure of the absorbing roots of desert subshrubs and the formation of their adaptive anatomical traits were determined.
2.	Laboratory of Essential-Oil and Dye Plants	More than 560 essential-oil plants, more than 200 aromatic-spice plants and more than 100 dye plants were identified. 22 species of essential-oil plants were tested under industrial conditions and recommended for use in the perfumery industry.
3.	Laboratory of Paleobotany	The Mesozoic and Cretaceous floras and the fossil woods of the Angren coal deposit were studied. Nearly 127 species belonging to 56 genera were identified for the Jurassic flora, and more than 120 species belonging to 80 genera in Southern Fergana. 9 genera and 45 species new to science were described.
4.	Laboratory of Medicinal Plants	The distribution of licorice over an area of more than 6,000 hectares in the Amu Darya, Syr Darya and Zarafshan valleys and its reserves of 35,200 tonnes were determined. Maps of medicinal plants were compiled and used in practice.
5.	Laboratory of Saponin-Bearing Plants	Nine species of saponin-bearing plants were studied and species promising for the national economy were identified. Perfoliate gypsophila (teshikbargli kachim) was successfully brought into cultivation in the Mirzachul.
6.	Laboratory of Glycyrrhizin-Bearing Plants	Methods for cultivating naked licorice (yalang‘och shirinmiya) on the fresh-water and saline soils of Uzbekistan were developed, and production volume increased ninefold.
7.	Laboratory of Tanning Plants	The tanning properties of yorongul were confirmed. Leather products treated with its extract were found to meet the requirements of the state standard.

According to the data in this table, it was precisely in these years that the institute achieved scientific results such as the creation of new plants, increased productivity, and the identification of plants suitable for industrial use.

In cooperation with the Ministry of Food Industry and the Ministry of Fruit and Vegetable Farming of the Uzbek SSR, Q.X. Xojimatov prepared recipes for 17 types of non-alcoholic beverages, which were introduced into production [9, p. 34]. These include the beverages “Rayxon”, “Toshkent”, “Paxtakor” and “Tog‘ guli” (Mountain Flower). As a result of scientific invention, recipes for the balms

“Samarqand” and “Samarqand ifori” (Fragrance of Samarkand) were developed. A red dye used in confectionery, non-alcoholic beverages and minced sausage meat was extracted from the hollyhock plant (gulxayri) and put into practice. As a result, large-scale cultivation of hollyhock was established at the “Kommunizm” sovkhoz in Jizzakh region [8, p. 52].

In 1966–1970, under the leadership of A.Y. Butkov, a stationary geobotanical study was carried out in the Chirchik-Angren water basin to determine the barley-grass and wheatgrass-type vegetation cover. The study succeeded in establishing results such as plant composition, root mass and the dynamics of seasonal productivity [5, p. 1].

In 1967, O.N. Bondarenko went on a business trip to Leningrad to study the herbarium of the Botanical Institute of the USSR Academy of Sciences. During this trip, which was planned to last four years, the scientist processed about 150 species. Herbarium specimens relating to Central Asia were extracted from the Mongolian, Chinese, Japanese and Caucasian sections of the Central Asian herbarium [4, p. 5-6].

In 1975–1985, Academician J.K. Saidov was awarded the USSR State Prize and the Bronze Medal of the USSR Exhibition of Achievements of the National Economy (VDNKh) for developing the scientific basis for the phytomelioration of desert pastures [3, p. 58].

In the formation of the institute’s scientific heritage in 1960–1980, scientific publications, identification keys, monographs and scientific collections are of importance. In 1963, a 10-volume “Key to the Plants of Central Asia” was prepared at the institute in cooperation with Tashkent State University. The preparation of the key drew on herbarium data from the Institute of Botany of the Academy of Sciences of the Uzbek SSR, TashSU, the Botanical Institute of the USSR Academy of Sciences (BIN) and the botanical institutes of Central Asia [1, p. 252].

Under the leadership of A. Vvedenskiy, and in cooperation with Tanya State University, the 10-volume “Identifier of the Flora of Uzbekistan” was compiled. It is a critical work on the flora of a large region. The TashSU herbaria were taken as the basis for compiling the work. Six volumes of the work were prepared in cooperation with the Academy of Sciences of the USSR (BIN AN SSSR) and the botanical institutes of the Central Asian republics (BINOV).

In 1965, the “Identifier of Higher Plants of Karakalpakstan” was compiled. The work included 87 families, 413 genera and 874 species of wild and cultivated plants.

In 1968, the institute’s staff were awarded the Abu Rayhon Beruni State Prize for the books “Flora of Uzbekistan” and “Botanical Materials of the Herbarium”.

In 1970–1971, the monographs “Физиология семян дикорастущих пустынных растений” (Seed Physiology of Wild Desert Plants) and “Газообмен и обмен веществ пустынных растений Кызылкума” (Gas Exchange and Metabolism of Desert Plants of the Kyzylkum) were published [7, p. 25].

In 1982, fundamental publications such as “Flora of Uzbekistan” and the “Key to the Plants of Central Asia” are among the important sources that make up

the institute's scientific heritage. These works not only carried out a scientific inventory of the flora of Uzbekistan but also served as a basis for preserving plant diversity, protecting rare species and forming biological collections [2, p. 177]. In 1982, Volume VI of the "Key to the Plants of Central Asia" was published. It includes 57 families, 568 genera and 4,029 species. This volume contains information on two genera new to science, 125 new species and 40 new combinations [1, p. 253].

From 1983 to 1985, scientists such as R.V. Kamelin, I.I. Malsev and I.G. Levich jointly organized an expedition to the Kugitang Range. The expedition collected a large volume of scientific material that would help in creating a grid mapping program for Surkhandarya region [9, p. 11].

In 1984, the urgency of Uzbekistan's ecological problems led botanists to create the "Red Book". It compiled a list of 163 rare, unique and endangered higher plants of various kinds [6, p. 1-2].

In 1987, in the history of the institute, the "Central Herbarium" fund was created through the merger of four large herbarium collections. It comprises the herbaria of the National Herbarium of Uzbekistan, the Herbarium of the Institute of Botany, the Institute of the Chemistry of Plant Substances and the Tashkent Museum of Nature. The earliest forms of the herbaria date back to 1835–1840. The herbaria come from Central Asia, North Africa, Russia, Korea, China and other regions. Among them is also a herbarium from 1900 collected by the botanist B. Fedchenko.

Discussion

As a result of the study, it was established that the research activity of the Institute of Botany of the ASRU developed in three directions.

First, the establishment of new laboratories and stations demonstrated the expansion of directions in scientific activity. The development of research on medicinal, essential-oil, saponin-bearing, glycyrrhizin-bearing and tanning plants led to their introduction into practice.

Second, the expansion of stationary studies and expeditions created the opportunity to conduct research in the natural environment. As a result, herbarium specimens, expedition documents and maps were formed. These are assessed as heritage that makes up the institute's scientific heritage.

Third, the research results were oriented toward practice, that is, toward agriculture and industry. This shows the expansion of applied directions such as determining the reserves of medicinal plants, bringing plant species into cultivation and applying them in industry.

Generalizing these three directions made it possible to determine the composition of the institute's scientific heritage and to divide it into groups.

Conclusion

The results of the study show that in 1960–1980 the institute's fundamental and applied activities developed together. The scientific heritage formed as a result of this activity can be classified into material, intellectual and practical components. This classification is a methodological basis for systematizing the scientific heritage

and creating the possibility of its museumification. Taking precisely these aspects into account, the results of the institute's scientific activity in these years are an important source for creating the scientific concept "Museumification of the Scientific Heritage of the Institute of Botany".

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SO‘X TUMANI LANDSHAFT GEOKIMYOVIY SHAROITINING SHAKLLANISHIDA IQLIMIY VA GIDROLOGIK OMILLARNING O‘RNI

Annotatsiya: *Mazkur tezisda So‘x tumani landshaft-geokimyoviy sharoitining shakllanishida iqlimiy va gidrologik omillarning o‘rni ilmiy jihatdan tahlil qilingan. Hududning orografik tuzilishi, atmosfera sirkulyatsiyasi, harorat va yog‘ingarchilikning balandlik bo‘yicha o‘zgarishi hamda So‘x daryosining gidrologik rejimi, suvining mineralizatsiyasi va ionli migratsiya jarayonlari o‘rtasidagi uzviy bog‘liqlik yoritib berilgan.*

Kalit so‘zlar: *Landshaft geokimyosi, orografiya, iqlimiy omillar, gidrologik rejim, So‘x daryosi, mineralizatsiya, ionli migratsiya.*

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THE ROLE OF CLIMATIC AND HYDROLOGICAL FACTORS IN THE FORMATION OF LANDSCAPE-GEOCHEMICAL CONDITIONS IN THE SOKH DISTRICT

Abstract: *This paper provides a scientific analysis of the role of climatic and hydrological factors in the formation of landscape-geochemical conditions in the Sokh district. It highlights the intricate relationship between the region's orographic structure, atmospheric circulation, altitudinal variations in temperature and precipitation, as well as the hydrological regime of the Sokh river, water mineralization, and ionic migration processes.*

Keywords: *Landscape geochemistry, orography, climatic factors, hydrological regime, Sokh river, mineralization, ionic migration.*

So‘x tumani landshaft-geokimyoviy sharoitining shakllanishi va uning hududiy tafovutlari murakkab tabiiy-geografik omillar majmuasi, xususan, hududning o‘ziga xos orografik tuzilishi, zamonaviy iqlim va gidrologik rejimning o‘zaro ta’siri ostida yuzaga keladi. Orografik jihatdan deyarli barcha tomonlari tog‘ tizmalari bilan o‘ralganligi havo oqimlarining erkin kirib kelishini cheklab, mahalliy geokimyoviy muhitning o‘ziga xos xususiyatlarini belgilaydi. Hozirgi vaqtda tog‘li hududlarning landshaft-geokimyoviy sharoitlarini o‘rganish, kimyoviy elementlarning migratsiyasi va to‘planish qonuniyatlarini aniqlash atrof-muhit barqarorligini ta'minlashning ustuvor yo‘nalishlaridan biridir [4, 7].

Farg‘ona viloyatining eksklav hududi bo‘lgan So‘x tumani, o‘zining murakkab orografik tuzilishi, balandlik mintaqalari va Oloy tizmasining shimoliy etaklarida joylashganligi bilan ajralib turadi [6, 9, 11]. O‘zbekistonlik olimlardan Q.V. Valiyev, Sh.S. G‘ulomov va boshqalarning tadqiqotlariga ko‘ra, tog‘li hududlardagi lito-geokimyoviy jarayonlar tabiiy omillar bilan birga antropogen bosim ta'sirida keskin o‘zgarishlarga uchraydi.

Hajman kichik bo‘lishiga qaramay, hududning mutlaq balandligi shimolda Sirdaryoning qayir usti terrasalari va So‘x konussimon yoyilmasining quyi qismlarida 380–400 m dan, janubda Oloy va Turkiston tog‘ tizmalarining suvayirg‘ich qismigacha qariyb 6000 m gacha keskin ko‘tarilib boradi [1, 13]. Relyef bunday vertikal bo‘yicha keskin o‘zgarishi iqlim elementlarining balandlik zonalari bo‘yicha taqsimlanishiga, natijada esa tuproq-o‘simlik qoplamining vertikal tabaqalanishiga olib keladi [12]. Havoning o‘rtacha yillik harorati yuqoriga ko‘tarilgan sari pasayib borsa, atmosfera yog‘inlarining miqdori aksincha keskin ortib boradi. Tog‘oldi tekisliklarida yog‘inlar miqdori 80–100 mm ni tashkil etsa, baland tog‘ qismlarida 1000–1200 mm gacha yetadi.

Hudud iqlimini shakllantirishda G‘arb va shimoldan kirib keluvchi havo massalari bilan bir qatorda mahalliy tog‘-vodiy sirkulyatsiyasi ham muhim o‘rin tutadi. Bu sirkulyatsiya jarayonlari kunduzi tog‘ga, kechasi esa vodiyga qarab esuvchi shamollar tarzida namoyon bo‘lib, landshaftlararo moddalarning migratsiyasiga ta’sir ko‘rsatadi [12].

So‘x tumani hududining asosiy gidrogeokimyoviy o‘qi bo‘lgan So‘x daryosi Oloy tizmasidagi 99 ta muzlik va qor suvlaridan oziqlanadi. Daryoning umumiy uzunligi 172 km, havza maydoni 3510 km², ko‘p yillik o‘rtacha suv sarfi 42 m³/s ni tashkil etadi. Yillik yog‘in miqdorining 71% qismi qor va 29% qismi yomg‘ir hissasiga to‘g‘ri kelishi yoz oylarida (iyul-avgust) suv sarfining keskin ortishini va geokimyoviy yuvilish jadallashishini ta’minlaydi [1]. Daryo suvining mineral tarkibi uning rejimiga bog‘liq holda o‘zgarib turadi: mejen davrida mineralashuv 1,3–2,2 g/l (sulfat-xloridli, kalsiy-magniyli) bo‘lsa, yozgi ko‘p suvli davrda 0,55–0,74 g/l (sulfat-gidrokarbonatli va kalsiy-magniyli) turiga o‘tadi [1, 4, 12].

Hududdagi landshaftlar shakllanishining o‘ziga xos jihatlari morfolitogen asosining tarkibi va pozitsion joylashuviga ko‘ra belgilanib, yuqoridan pastga tomon tog‘ va tog‘oldi landshaftlarining monolit va geterolit tiplari ajratiladi [3, 2, 5]. Farg‘ona viloyati va So‘x vohasi hududidan oqib o‘tuvchi suv havzalarida ionli migratsiya mexanik migratsiyaga nisbatan biroz ustunlik qiladi [8, 10]. Yer usti va yer osti oqimlari doimiy ionli migratsiyani hosil qiladi, bunda yer osti oqimining ahamiyati katta bo‘lsada, u bevosita tog‘ va tog‘oldi hududlarining yuqori qismlarida geokimyoviy rejimni to‘la belgilamaydi. So‘x tumanining landshaft-geokimyoviy holati tabiiy lito-geokimyoviy omillar va ortib borayotgan antropogen yuklamalar ta'sirida shakllanmoqda [7, 9, 11, 15, 16]. Elementlarning yuqori qismlardan quyi vodiylarga migratsiyasi va sug‘oriladigan yerlardagi tuproq degradatsiyasi hududda geoekologik monitoringni yo‘lga qo‘yishni taqozo etadi. Tuproq va suv resurslarini muhofaza qilish bo‘yicha ilmiy asoslangan meliorativ chora-tadbirlarni ishlab chiqish maqsadga muvofiqdir [14].

Xulosa qilib aytganda, So‘x tumani landshaft-geokimyoviy sharoitining hosil bo‘lishida iqlimiy va gidrologik omillar o‘zaro mutanosiblikda namoyon bo‘ladi. Iqlim omili harorat va yog‘inlar rejimi orqali migratsiya muhitini yaratib, vertikal zonal tabaqalanishni ta’minlasa, gidrologik omil elementlarning gipsometrik pastliklarga tomon ko‘chishi, tuzlar balansi va geokimyoviy oqimlar dinamikasini uzluksiz boshqarib turadi [15].

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SO‘X TUMANI LANDSHAFTLARIDA GEOKIMYOVIY MIGRATSIYA JARAYONI

Annotatsiya: *Mazkur tezisda So‘x tumani landshaftlarida kimyoviy elementlarning geokimyoviy migratsiyasi, tashqi va ichki migratsiya muhitining shakllanish xususiyatlari hamda quyosh energiyasining transformatsiyasi tahlil qilingan [4]. Shuningdek, daryo va soyliklarning erozion faoliyati, flyuvoglyatsial, delyuvial, prolyuvial va allyuvial yotqiziqlarning rolisihamda makro- va mikroelementlarning geoekologik me’yorlari ilmiy asosda yoritib berilgan.*

Kalit so‘zlar: *Geokimyoviy migratsiya, migratsiya muhiti, quyosh energiyasi, suv migratsiyasi koeffitsiyenti, konussimon yoyilmalar, og‘ir metallar, geoekologik me’yorlar.*

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GEOCHEMICAL MIGRATION PROCESS IN THE LANDSCAPES OF SOKH DISTRICT

Abstract: *This thesis analyzes the geochemical migration of chemical elements in the landscapes of Sokh district, the formation features of external and internal migration environments, as well as the transformation of solar energy [4]. Furthermore, the erosional activity of rivers and streams, the role of fluvioglacial, deluvial, proluvial, and alluvial deposits, alongside the geoecological standards of macro- and microelements, are scientifically elucidated.*

Keywords: *Geochemical migration, migration environment, solar energy, water migration coefficient, alluvial fans (cone-shaped deposits), heavy metals, geoecological standards.*

Landshaftlarda kimyoviy elementlarning migratsiyalanishi bevosita migratsiya muhitiga bog‘liq bo‘lib, u tashqi va ichki muhit majmuasidan tashkil topadi. Tashqi muhit muayyan landshaftlardagi tabiiy-geografik sharoit bilan belgilanib, turli tabaqadagi landshaftlarning pozitsion joylashuvi va relyefning kontrastliligi elementlarning bir tomonlama lateral (gorizontal) oqim yo‘nalishini hosil qiladi [7, 9]. Tashqi muhitning shakllanishida iqlimiy omillar, xususan, quyosh radiatsiyasi hal qiluvchi ahamiyat kasb etadi. N.K.Chertko ta’kidlaganidek, quyosh energiyasi ta’sirida bevosita va bilvosita tarzda barcha gipergenez jarayonlari yuzaga kelib, migratsiya jarayonlarining asosiy manbasi bo‘lib xizmat qiladi [9].

Quyosh energiyasi yer yuzasiga yetib kelgach transformatsiyalanib, migratsiya muhitida mexanik va kimyoviy energiyaga aylanadi [11].

Geokimyoviy landshaftlar uchun tuproq o‘ziga xos geokimyoviy muhitni hosil qilib, barcha migratsiya omillari tufayli olib kelingan kimyoviy elementlarni o‘zida to‘playdi. Tuproqning migratsiya muhiti o‘simliklar uchun muhim ahamiyatga ega bo‘lib, o‘simliklar suv oqimi orqali, ya’ni suvda erigan moddalarni biologik energiya hisobiga o‘zlashtirib oladi [14]. Elementlarning geokimyoviy migratsiyasiga sarflangan energiyaning miqdori turli landshaft zonalarida turlicha bo‘ladi: masalan, tundra landshaftlarida o‘simlik biomassasining hosil bo‘lishi uchun yiliga 2.5 kal/sm kv, nam tropik o‘rmonlarda 2000 kal/sm kv gacha, mo‘tadil kengliklar o‘rmonlarida esa 100-400 kal/sm kv energiya sarflanadi. Migratsiya jarayonlarining faolligi haroratning ortib borishi bilan uzviy bog‘liq bo‘lib, yilning issiq oylarida optimal sharoit yuzaga keladi [15].

Adir va past tog‘ mintaqalarida quruq dasht va chalacho‘l landshaftlari ustunlik qilsa, o‘rta va yuqori tog‘ mintaqalarida tog‘-o‘tloq, archazor va subalp landshaftlari shakllangan. A.I. Perelman va B.B. Polinov ta'limotiga ko‘ra, tog‘li landshaftlarda elementlarning lateral va radial migratsiyasi jadalligi bilan ajralib turadi [15, 17]. Yuqori tog‘ qismlaridan yuvilib tushgan kimyoviy birikmalar quyi qismlardagi akkumulyatsiya zonalarga (daryo vodiylari va tekisliklarga) kelib o‘rnashadi 14, 16].

Geokimyoviy migratsiya muhitini hosil qilishda suvning o‘rni beqiyosdir. Gidrogenez jarayonlari nurash hududlarida jinslarni eritib, ularning migratsiyasini ta’minlaydi. B.B.Polinov (1955) bo‘yicha suv migratsiyasi koeffitsiyenti quyidagi formula orqali ifodalanadi [17]:

$$K_x = \frac{C_x \cdot 100}{M \cdot n_x}$$

Kx — suv migratsiyasi koeffitsiyenti;
Cx — elementning suvli konsentratsiyasi;
M — suvning umumiy mineralashuvi;
nx — elementning tog‘ jinsidagi yoki tuproqdagi foiz miqdori).

So‘x tumanida landshaftlarning hosil bo‘lishida daryo va soyliklarning geologik faoliyati muhim o‘rin tutadi. Tog‘oldi zonasidagi erozion faoliyat va adirlarni kesib o‘tish jarayonida yonlama hamda chuqurlama erozion shakllar hosil bo‘lib, yuvilgan jinslar daryo bo‘ylab yotqizilishi natijasida konussimon yoyilmalar vujudga kelgan [1, 12, 13]. So‘x daryosining suv yig‘ish havzasida geokimyoviy migratsiya yo‘lagi bo‘ylab tadqiqotlar olib borilib, landshaftlar dinamikasida energetik jarayonlarning geokimyoviy jarayonlarga va aksincha, geokimyoviy jarayonlarning landshaftlarga ta’siri muhimligi aniqlandi [3, 5]. So‘x tumani landshaftlaridagi geokimyoviy rejim genetik jihatdan flyuvoglyatsial, delyuvial,

prolyuvial va allyuvial yotqiziqlar bilan bog‘liq bo‘lib, yuqoridan pastga tomon lateral oqimni yuzaga keltiradi.

So‘x daryosi hududning yagona asosiy suv arteriyasi bo‘lib, uning kimyoviy tarkibi tog‘ jinslarini yuvib kelishi hisobiga shakllanadi. Mineralizatsiya darajasi yuqori oqimda past (0.2–0.4 g/l) bo‘lsa, quyi qismlarga tomon o‘zlashtirilgan hududlar va qaynoq buloqlar ta'sirida 0.8–1.2 g/l gacha ortadi. Suv tarkibidagi gidrokarbonat-kalsiy va sulfat birikmalarining ustunligi hududning lito-geokimyoviy xususiyatlari bilan uzviy bog‘liqdir.

Geoekologik vaziyatni barqaror saqlash uchun kimyoviy elementlarning kontsentratsiyasi ruxsat etilgan me’yorlardan (REM) oshmasligi lozim. Mineral o‘g‘itlar, jumladan superfosfat tarkibida xrom, kobalt, mis, qo‘rg‘oshin, nikel, vanadiy, rux kabi og‘ir metallarning tabiiy birikmalari to‘planishi mumkin. Tuproq tarkibidagi bunday elementlarning o‘simliklar tomonidan o‘zlashtirilishi nosog‘lom ekologik muhitni keltirib chiqaradi [4]. Farg‘ona vodiysining So‘x tumani paragenetik landshaftlarida Cl, S, B, Br, I, Ca, Na, Mg, Sr, Zn, Mo, Fe kabi makro- va mikroelementlarning migratsion jarayonlari o‘rganildi. Bunda makroelementlar (Cl, S, Ca, Na, Mg) tabiiy landshaftlarda yuqori konsentratsiyada uchratsa, mikroelementlar va og‘ir metallar kam konsentratsiyada uchrasada, antropogen omillar ta’sirida ekologik xavf tug‘dirishi mumkin [13].

Adir va quyi qismlarda tarqalgan bo‘z tuproqlar hamda yuqori mintaqalardagi qo‘ng‘ir va tog‘-o‘tloq tuproqlarining o‘rganilishi shuni ko‘rsatdiki, hududda sug‘orish dehqonchiligi ta'sirida ikkilamchi sho‘rlanish jarayonlari yuzaga kelmoqda [10]. Sug‘oriladigan yerlardagi tuproq namunalarining tahlillari natriy, xlorid va sulfat anionlarining miqdori tabiiy me'yordan 1.4–1.8 barobar yuqori ekanligini ko‘rsatdi. Bu esa akkumulyatsiya zonalarida biogeokimyoviy anomaliyalar shakllanayotganidan dalolat beradi.

Xulosa qilib aytganda, So‘x tumani landshaftlarida moddalarning o‘zgarishida tabiiy va antropogen omillarning ta’siri katta. Mineral o‘g‘itlarni yillar davomida qo‘llash hamda So‘x daryosining doimiy oqimi natijasida kelib chiquvchi geokimyoviy oqimlar tuproq tarkibining shakllanishi, unumdorligi va hudurning geoekologik holatini belgilovchi asosiy omil hisoblanadi [2].

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USING DATA ANALYTICS METHODS TO ASSESS THE PROFESSIONAL COMPETENCIES OF MID-LEVEL MEDICAL AND PHARMACEUTICAL PERSONNEL

Abstract. *This article examines the theoretical and methodological foundations for using Data Analytics methods to assess the professional competencies of mid-level medical and pharmaceutical personnel. It explores the possibilities of integrating electronic health records, learning management systems, certification databases, patient feedback, IoT sensors, and 360-degree assessment data within a unified analytical framework. The study employs systematic literature review, comparative analysis, content analysis, and scenario-based expert assessment. It distinguishes the roles of descriptive, diagnostic, predictive, and prescriptive analytics in competency management. The results show that, despite the growing number of data sources, their integration and conversion into management decisions remain insufficient. To overcome the condition of "data richness—knowledge poverty," an analytical model consisting of a digital competency profile, data-quality control, and a prescriptive recommendation mechanism is proposed.*

Keywords: *Data Analytics, Big Data, professional competency, mid-level medical personnel, pharmaceutical personnel, EHR, LMS, descriptive analytics, predictive analytics, prescriptive analytics, digital profile.*

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O'RTA BOSHQA TIBBIYOT VA FARMATSEVTIKA XODIMLARNING KASBIY KOMPETENTLIKLARINI BAHOLASH UCHUN MA'LUMOTLARNI TAHLIL QILISH USULLARIDAN FOYDALANISH

Annotatsiya. *Maqolada o'rta tibbiyot va farmatsevtika xodimlarining kasbiy kompetensiyalarini baholashda Data Analytics usullaridan foydalanishning nazariy va uslubiy asoslari tadqiq etilgan. Elektron tibbiy yozuvlar, ta'limni boshqarish tizimlari, attestatsiya bazasi, bemorlar fikri, IoT sensorlari va 360 darajali baholash ma'lumotlarini yagona analitik konturda birlashtirish imkoniyatlari ko'rib chiqilgan. Tadqiqotda tizimli adabiyotlar tahlili, qiyosiy tahlil, kontent-tahlil va ssenariyli ekspert baholash usullaridan foydalanilgan. Deskriptiv,*

diagnostik, prognozli va preskriptiv tahlilning kompetensiya boshqaruvidagi vazifalari ajratilgan. Natijalar ma'lumot manbalari ko'payayotganiga qaramay, ularning o'zaro integratsiyasi va boshqaruv qaroriga aylanishi yetarli emasligini ko'rsatdi. "Ma'lumot boyligi –bilim qashshoqligi" holatini bartaraf etish uchun raqamli kompetensiya profili, ma'lumotlar sifati nazorati va preskriptiv tavsiya mexanizmidan iborat analitik model taklif etildi.

Kalit so'zlar: *Data Analytics, Big Data, kasbiy kompetensiya, o'rta tibbiyot xodimlari, farmatsevtika xodimlari, EHR, LMS, deskriptiv tahlil, prognozli tahlil, preskriptiv tahlil, raqamli profil.*

INTRODUCTION

The digitalization of Uzbekistan's healthcare system is changing not only clinical processes but also methods of managing human-resource capacity. Electronic health records, laboratory information systems, LMS platforms, mobile applications, and sensors generate large volumes of data. However, the use of these data to objectively assess an employee's professional competency, identify competency gaps, and develop an appropriate training decision has not yet become systematic.

The Volume, Velocity, and Variety dimensions defined by Laney explain the scale, rate of update, and diversity of formats of modern medical data. The value of medical data lies not in their volume but in their ability to improve clinical and management decisions. From this perspective, competency assessment requires a transition from merely collecting data to producing analytical knowledge.1

Traditional certification systems rely on periodic and often static assessment. Data Analytics makes it possible to integrate an employee's learning activity, clinical indicators, service quality, certifications, and peer feedback over time. This creates the conditions for interpreting competency as a dynamic profile rather than a one-time score.

The purpose of the study is to identify the functional capabilities of Data Analytics methods in assessing the competencies of mid-level medical and pharmaceutical personnel and to propose an integrated analytical model. Its objectives are to classify data sources, delimit the functions of descriptive, diagnostic, predictive, and prescriptive analytics, analyze existing scientific approaches, and develop an implementation mechanism and assessment indicators suited to the conditions of Uzbekistan.

LITERATURE REVIEW

One of the earliest theoretical foundations of the Big Data concept is Laney's 3V model. The author explains data-management challenges through the dimensions of volume, velocity, and variety. For healthcare, the criteria of Veracity and Value were later added to this model. Even a large volume of incomplete or erroneous data cannot support useful decisions.2

[1]Laney D. 3D Data Management: Controlling Data Volume, Velocity, and Variety. META Group Research Note, 2001. Pages cited: 1-4.
[2]Laney D., 2001. The 3V model: Volume, Velocity, and Variety. Pages cited: 1-4.

W. Raghupathi and V. Raghupathi describe a Big Data Analytics architecture for healthcare and the relationship among data sources, analytical platforms, and practical outcomes. They identify clinical decision support, disease detection, population health management, cost control, and operational efficiency as the principal areas of application. By adapting this approach to human-resource management, the relationship between clinical outcomes and an employee's learning history can be analyzed.3

Provost and Fawcett explain the analytical process through the stages of defining the problem, understanding the data, modeling, and translating results into decisions. For medical competency assessment, this approach means that the management question must be stated clearly before an algorithm is selected: whether to describe the employee's current status, identify the cause of a gap, predict a future need, or recommend a practical intervention.4

Siemens defines Learning Analytics as the measurement, collection, analysis, and reporting of data about learners and their contexts for the purpose of understanding and optimizing learning and the environments in which it occurs. This definition provides a methodological basis for transforming LMS data-such as test results, module-completion time, repeated attempts, and learning activity—into competency indicators.5

Obermeyer and Emanuel emphasize that machine learning can improve clinical prediction and risk stratification, but bias in the data and an incorrectly specified objective function can amplify erroneous decisions. Their article supports the principle that AI outputs in employee competency assessment should not be treated as absolute truth, models should be explainable and human oversight should be retained.6

The literature review shows that healthcare analytics is primarily focused on patient risk and clinical outcomes, whereas Learning Analytics focuses on educational activity. Integrating these two streams makes it possible to view clinical outcomes, learning activity, and professional assessment within a unified competency profile. The research gap lies precisely in the insufficient development of this integration for mid-level medical and pharmaceutical personnel.

RESEARCH METHODOLOGY

The study was conducted using a conceptual-analytical design. The primary materials comprised five core sources on Big Data, Data Science, Learning Analytics, and machine learning in medicine, together with a regulatory document on Uzbekistan's digital development. The sources were subjected to content analysis according to author, research object, analytical task, type of data used, and practical limitations.

[3]Raghupathi W., Raghupathi V. Big Data Analytics in Healthcare: Promise and Potential. Health Information Science and Systems, 2014, 2:3. Pages cited: 1-10.
[4]Provost F., Fawcett T. Data Science for Business. O'Reilly Media, 2013. Pages cited: 45-70.
[5]Siemens G. Learning Analytics: Envisioning a Research Discipline and a Domain of Practice. LAK'12, 2012. Pages cited: 4-8.
6Obermeyer Z., Emanuel E.J. Predicting the Future — Big Data, Machine Learning, and Clinical Medicine. NEJM, 2016, 375. Pages cited: 1216-1219.

The analysis was structured at four levels. Descriptive analytics answers the question “What happened?”, diagnostic analytics, “Why did it happen?”, predictive analytics, “What may happen?”, and prescriptive analytics, “What action should be taken?” For each level, the data source, method, and management outcome were specified.

The 2026 coverage indicators and implementation levels of analytics types contained in the initial source material were treated not as official statistics but as the author’s scenario-based expert estimates. They are used to demonstrate the operating logic of the conceptual model. During empirical validation, these values must be recalculated using institutional data.

The study has several limitations: there is no unified national competency database, the level of integration between EHR and LMS platforms differs across institutions, and attributing clinical outcomes solely to employee competency may create a causal error. The results were therefore interpreted at the level of conceptual development and pilot-project planning.

ANALYSIS AND RESULTS

Data Sources for Competency Assessment

Comparison of data sources shows that building a competency profile solely on certification results is insufficient. The coverage values in Table 1 represent the study’s estimates for 2026.

Data source	**Data type**	**Update frequency**	**2026 coverage***	**Assessment capability**[7]
EHR	Clinical indicators and medical records	Real time	68%	High
LMS	Learning activity and test results	Real time	74%	High
Certification database	Qualification level and certificates	Once every five years	100%	Medium
Patient feedback	Communication and service quality	After each visit	62%	Medium
Wearables and IoT	Activity and stress indicators	Continuous	38%	Additional
360° assessment	Soft skills and team assessment	Quarterly	45%	High

Although the certification database has broad coverage, its update cycle is long. EHR and LMS platforms provide timely data, but their coverage and interoperability are limited. This condition may be described as “data richness—knowledge poverty”: information exists across different systems, but without a unified identifier, competency classifier, and analytical model, it is not converted into management knowledge.

[7]Author’s scenario-based expert forecast.

Functional Differences Among the Levels of Data Analytics

Level of analysis	Primary question	Method for medical competency	Management outcome
Descriptive	What happened?	Mean, median, distribution, dashboard	Current competency profile
Diagnostic	Why did it happen?	Correlation, clustering, association	Causes of gaps and groups
Predictive	What may happen?	Classification, regression, time-series model	Future needs and risks
Prescriptive	What should be done?	Recommendation and optimization	Decision on module, timing, and resources

Adapted by the author to medical competency management on the basis of the research classification.8

Descriptive analytics presents the current state of competency but does not explain its causes or future needs. Diagnostic analytics identifies relationships among LMS activity, certification scores, and clinical indicators. It must be remembered that correlation does not imply causation.

Predictive analytics estimates which competency gap may emerge for an employee and when it may occur. Potential model features include length of service, position, specialty, certification status, test scores, learning history, and clinical indicators. Model quality should be evaluated not only by accuracy but also by precision, recall, F1 score, ROC-AUC, and fairness across groups.

Prescriptive analytics converts a forecast into a practical decision by identifying which module should be recommended, in what format, when, and for what duration. Where resources are constrained, the recommendation algorithm also accounts for instructor workload, platform capacity, budget, and continuity of service.

Integrated Analytical Model

The analysis yields a five-stage model: (1) collecting data and linking them through a unique employee identifier, (2) checking data quality, (3) building a dynamic competency profile, (4) forecasting needs and generating recommendations, and (5) monitoring results using pedagogical, clinical, and economic indicators. The model's principal distinction is that it does not directly convert clinical data into a conclusion that "the employee performed poorly", instead, it controls for working conditions, patient complexity, and team-level factors.

DISCUSSION

The results show that the healthcare analytics architecture proposed by Raghupathi and Raghupathi can be extended to the management of personnel competencies. In this framework, the EHR reflects clinical outcomes, the LMS reflects the learning process, certification reflects formal qualifications, and patient and peer feedback reflects communicative competency. No single source provides

[8]Provost F., Fawcett T., 2013. An approach to translating analytical tasks into management decisions. Pages cited: 45-70.

a complete assessment, triangulation reduces the likelihood of erroneous conclusions.9

The benefit of Data Analytics is determined not by collecting more data but by producing timely and explainable decisions. Descriptive dashboards may become widespread, but management value increases at the predictive and prescriptive stages. At the same time, a more complex model is not always a better model: when data quality is poor, an algorithm merely automates error.

From ethical and legal perspectives, employee monitoring must not become a punitive instrument. The purpose of a digital profile should be to identify development needs and allocate resources fairly. Employees should be informed about which data are used, how recommendations are generated, and how they may challenge the outcome.

In Uzbekistan, implementation should begin with a pilot stage: a unified competency dictionary should be developed, a minimum data set for EHR and LMS systems should be established, retrospective analysis should be conducted in several institutions, and predictive recommendations should then be compared with the expert judgments of educators and managers. System-wide expansion is recommended only after validation.10

CONCLUSIONS AND RECOMMENDATIONS

Data Analytics enables the competency assessment of mid-level medical and pharmaceutical personnel to move from a static certification score to a dynamic, multi-source, and predictive profile. EHR, LMS, certification data, patient feedback, IoT, and 360-degree assessment complement one another, but their value depends on integration and data quality.

Descriptive analytics characterizes the current state, diagnostic analytics identifies the causes of gaps, predictive analytics estimates future needs, and prescriptive analytics produces practical training and resource decisions. System effectiveness should be assessed not only through model accuracy but also through competency growth, course completion, time savings, unit cost, and fairness.

Practical recommendations include creating a unified competency classifier, introducing a unique digital employee identifier, establishing an EHR-LMS data-exchange standard, conducting audits of data quality and algorithmic fairness, applying recommendations under human oversight, and reassessing the 2026 scenario indicators using actual institutional data.

The proposed model provides a theoretical and methodological basis for transforming professional development from reactive course planning into a continuous, evidence-based, and economically managed human-capital development system.

[9]Raghupathi W., Raghupathi V., 2014. Healthcare analytics architecture. Pages cited: 1-10.
[10]Decree No. PF-60 of the President of the Republic of Uzbekistan dated 28 January 2022, Annex 1, objectives and provisions concerning healthcare digitalization. The electronic document has no stable page numbering.

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TEMIR YO‘L ORQALI O‘ZBEKISTONNING MAVJUD TRANZIT IMKONIYATLARINI YANADA OSHIRISH VA DENGIZ YO‘LIGA CHIQISH BORASIDAGI ISTIQBOL REJALARI

Annotatsiya: *Mazkur maqolada mustaqillik yillarida O‘zbekistonning mavjud tranzit imkoniyatlarini temir yo‘l orqali yanada yaxshilash, tashishlar samaradorligini oshirish, tashishlar bilan bog‘liq bo‘lgan vaqt sarfi va harajatlarni qisqartirish bo‘yicha amalga oshirilgan ishlar hamda istiqbol loyihalar haqida tahliliy ma’lumotlar keltirilgan.*

Kalit so‘zlar: *TRASEKA, Tajan-Saraxs-Mashxad temir yo‘li, Yevroosiyo temir yo‘l tizimi, Xitoy-Qirg‘iziston-O‘zbekiston temir yo‘li, Transafg‘on temiryo‘li.*

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PROSPECTIVE PLANS FOR FURTHER INCREASING UZBEKISTAN'S EXISTING TRANSIT OPPORTUNITIES AND ACCESS TO SEA ROUTES VIA RAILWAY

Abstract: *This article provides analytical information on the work carried out during the years of independence to further improve Uzbekistan's existing transit capabilities via the railway, increase transportation efficiency, reduce time and costs associated with transportation, and outline promising projects.*

Keywords: *TRACECA, Tajan-Sarakhs-Mashhad railway, Eurasian railway system, China-Kyrgyzstan-Uzbekistan railway, Trans-Afghan railway.*

O‘zbekiston Markaziy Osiyo mintaqasidagi dengiz transportiga to‘g‘ridan-to‘g‘ri kirish imkoniga ega bo‘lmagan davlatlar bilan barcha chegaralarini bo‘lishib, nafaqat dunyodagi dengizlar, balki dengiz yo‘llariga chiqish imkoniyatiga ega bo‘lmagan davlatlar bilan chegaradosh ikki davlatdan biridir. Bu o‘z navbatida, dengiz yo‘llariga chiqish uchun O‘zbekistonning tashqi savdo yuklari biror bandargohga yetib borishi yoki bu bandargohlardan yetib kelishi uchun kamida ikki davlat hududidan tranzit tarzda o‘tishi eksport yuklari narxiga o‘z ta’sirini ko‘rsatmay qolmasligini anglatadi.

Bugungi kunda geografik joylashuvning ana shu xususiyatlaridan kelib chiqib, mamlakat hududi orqali tashiladigan tranzit yuklar hajmini oshirish, texnik

jihatdan jahon talablariga javob beradigan samarali infratuzilmani yaratish transport tizimining dolzarb masalasi hisoblanadi.

1991 yilga qadar O‘zbekiston SSR transportning birorta turi –avtomobil yo‘llari, temir yo‘llar, havo transporti orqali janubiy, g‘arbiy va sharqiy xalqaro transport yo‘laklariga chiqish imkoniyatiga ega emas, faqat shimoliy yo‘nalish mavjud edi. Yaqin davrgacha ham mamlakatimizning transport-tranzit imkoniyatlarini amalga oshirishda katta tanlovlar bo‘lmagan. O‘zbekiston xorij davlatlari bilan o‘zaro iqtisodiy aloqalarini uchun asosan uchta dengiz porti orqali amalga oshirishi mumkin edi. Bular Ilichevsk porti orqali Qora dengizga, Sankt-Peterburg orqali Boltiq dengiziga va Vladivostok orqali Uzoq Sharq portlariga chiqish imkoniyati edi. Ushbu portlarga respublikadan mos ravishda 3 ming, 4 ming 300 va 8 ming kilometr masofani bosib o‘tish yuk tashish narxini sezilarli darajada oshirardi. Ushbu yo‘llar orqali kamida ikkita davlat hududini bosib o‘tishga to‘g‘ri kelar edi [10].

Mamlakatimiz Markaziy Osiyoda muhim geostrategik o‘ringa ega bo‘lib, uning hududidan qadimdan Buyuk Ipak yo‘li o‘tgan, ko‘plab savdo yo‘llari tutashgan va dunyo xalqlari madaniyatlarining o‘zaro boyish jarayoni jadal kechgan. Bugungi kunda ham bu yerda Sharqdan G‘arbga, Janubdan Shimolga olib boruvchi transport magistrallari kesishadi. Tashishlar samaradorligini rivojlantirish maqsadida xalqaro tashuvlarda o‘z o‘rnimizni saqlab qolish vazifasi biz uchun dolzarb bo‘lishi kerak [20].

“Hozirgi vaqtda, - deb ta’kidlaydi O‘zbekiston Respublikasi Prezidenti Shavkat Mirziyoyev, - dengiz portlariga to‘g‘ridan to‘g‘ri chiqish imkoniyatiga ega bo‘lmagan mamlakatlar, mintaqalarning transport-tranzit xarajatlari juda yuqori bo‘lib, ular eksport qilinayotgan tovarlar qiymatining 70-89 foiziga yetadi”. Bu holat mamlakatimizning iqtisodiy aloqalarini rivojlantirish imkoniyatlarini cheklamoqda, bizni tranzit yuklarimiz o‘tadigan mamlakatlarga qaram qilib qo‘ymoqda [14].

O‘zbekistonning xalqaro yo‘l loyihalaridagi transport siyosati uning geografik imkoniyatlaridan kelib tashkil qilinadi. Bu borada ikki omil asosiy bo‘lib, ulardan biri – to‘g‘ridan-to‘g‘ri dengiz portlariga chiqa olmaslik, ikkinchisi – g‘arb va sharq savdo yo‘llari kesishadigan hudud markazida joylashganligi sababli qator yo‘l loyihalarini O‘zbekiston ishtirokisiz bajarishning imkoni yo‘qligidir.

Shunday loyihalardan biri TRASEKA yo‘lagi hisoblanadi. 1993-yil Bryussel shahrida bo‘lib o‘tgan konferensiyaga ko‘ra, Markaziy Osiyo va Kavkaz mamlakatlarining o‘zaro transport tizimini rivojlantirish uchun dastlabki harakatlar boshlandi. Loyihadan ko‘zlangan asosiy maqsad Rossiya va Eronni chetlab o‘tadigan yo‘nalish tashkil qilishdan iborat bo‘lib, barcha yuklar Kaspiy va Qora dengiz orqali o‘tishi rejalashtirilgan.

1996-yilda Turkmaniston va Eron o‘rtasida temir yo‘llarni bog‘lash bo‘yicha kelishuvga erishildi. Uzunligi 308 kilometrni tashkil qiluvchi “Tajan-Saraxs-Mashxad” temir yo‘li Markaziy Osiyo davlatlarini Eron va Turkiya orqali

Yevropaga chiqishga imkon yaratadi. Bu yo‘nalishga Yevroosiyo maqomi berildi.

Mazkur yo‘nalishning o‘ziga xos xususiyati Transsib yo‘nalishidan 1500 kilometr

masofaga qisqaligidadir. Yuklar Xitoyning Lyangan portidan Berlingacha 20-30 kun ichida yetib borsa, mazkur shimoliy yo‘l orqali 11 kungacha qisqaradi.

Tojikistondan tashqari Markaziy Osiyoning barcha davlatlari temir yo‘llar qurgan yoki qurmoqda, ularni qurishdan maqsad qo‘shnilarini ortda qoldirishdir. Qo‘shni davlatlar orqali yuk tashishning tranzit qiyinchiliklari tufayli O‘zbekistonda yangi temir yo‘llar qurildi, bu esa ichki yuk tashishda ma’lum mamlakatlar orqali tranzitni chetlab o‘tish imkonini beradi. Bunda Toshg‘uzor-Boysun-Qumqo‘rg‘on temir yo‘l liniyasining qurilishi katta rol o‘ynadi. Ushbu yangi yo‘llar O‘zbekistonning iqtisodiy rivojlanishiga ijobiy ta’sir ko‘rsatadi [14].

Ayni vaqtda Toshg‘uzor-Boysun-Qumqo‘rg‘on temir yo‘l yo‘lagi qurilishi juda katta strategik ahamiyatga ham ega bo‘lgan edi. Masalan, O‘zbekistondan tashiladigan yuklar Fors ko‘rfazigacha eng qisqa yo‘l – O‘zbekistonning Xo‘jadavlat bekatidan Seraxs orqali Turkmanistondan tranzit sifatida o‘tish – Eronning Bandar-Abbos portigacha 2909 kilometrni, shu yo‘l orqali Chobahor portigacha esa 3762 kilometrni tashkil etardi. Yangi loyiha amalga oshirilganidan so‘ng esa Chobahor portigacha bo‘lgan masofa 1592 kilometrgacha, Bandar-Abbos portigacha bo‘lgan masofa esa 694 kilometrgacha qisqardi. Qolaversa, ushbu bandargoh orqali Hindiston, Pokiston, Saudiya Arabistoni va Afrika mamlakatlari bilan savdo aloqalarini amalga oshirish mumkin.

Iqtisodiy globallashuv jarayonida mazkur magistralning ishga tushirilishi qo‘shni davlatlar bilan o‘zaro iqtisodiy hamkorlik aloqalarini jadallashtirish hamda kelgusida Afg‘oniston va Eron orqali Fors ko‘rfazi bandargohlariga chiqish uchun katta imkon berdi. Transafg‘on yo‘lagini rivojlantirish, Toshg‘uzor-Boysun-Qumqo‘rg‘on temir yo‘l yo‘nalishida tashuv samaradorligini yanada oshirish maqsadida hamda ushbu yo‘lning mantiqiy davomi sifatida “Hayraton-Mozori Sharif temir yo‘l qurilishini amalga oshirish to‘g‘risida”gi 2009 yil 20 noyabrda O‘zbekiston Respublikasi Vazirlar Mahkamasining qarori e’lon qilindi. 2010 yil 22 yanvardan Afg‘onistonda 75 kilometrlik “Hayraton-Mozori Sharif” temir yo‘l qurilishi boshlandi va 4 noyabr sanasida qurilish ishlari yakunlandi. Ushbu loyiha uchqun 129 million AQSh dollari sarflandi. Ushbu temir yo‘l Afg‘oniston xalqi uchun mamlakatdagi ilk magistral bo‘lsa, o‘zbek mutaxassislari uchun xorijiy davlatdagi dastlabki tajriba hisoblanadi. “Hayraton-Mozori Sharif” temir yo‘lining barpo etilishi O‘zbekiston va Afg‘oniston o‘rtasidagi tashuv xizmatlarida ortiqcha sarflanayotgan mablag‘larni tejash imkonini berdi. Bundan tashqari, Afg‘onistonga turli davlatlar tomonidan yuboriladigan gumanitar yordamlarining yanada ortishiga sharoit yaratib berdi. “Transafg‘on” transport yo‘lagining yana bir ahamiyatli jihati shundaki, uning O‘zbekiston hududidan rivojlantirilishi, qo‘shni mamlakatlar iqtisodiyotining yuksalishiga ijobiy ta’sir qilish bilan birga, mamlakatimizning mana shu temir yo‘l yordamida g‘arbda Eronning dengiz porti orqali Osiyo va Yevropa davlatlari bilan, sharqda esa to‘g‘ridan-to‘g‘ri Hind okeaniga chiqib, Janubiy va Janubi-Sharqiy Osiyo mamlakatlari bilan iqtisodiy va siyosiy aloqalarni olib borishda katta ahamiyat kasb etadi.

Janubiy Osiyo va Yevropa davlatlari o‘rtasida Markaziy Osiyo orqali yuklarni tashish vaqtini hamda narxini sezilarli darajada kamaytiradigan loyiha esa “Mozori-Sharif – Qobul - Peshavor” temir yo‘lining qurilishidir. Shuningdek, yangi transafg‘on temir yo‘li - Pokistonning “Korachi”, “Qosim” va “Gvadar” dengiz portlariga chiqadi hamda Janubiy Osiyo temir yo‘l tizimini Markaziy Osiyo va Yevroosiyo temir yo‘l tizimlari bilan bog‘laydi (1-rasm).



1-rasm. Mozori-Sharif-Qobul-Peshovar temir yo‘li loyihasi.

Mazkur rasm internet ma’lumotlaridan olingan.[11]

2021-yil fevral oyida Toshkentda O‘zbekiston, Afg‘oniston va Pokiston “Termiz - Mozori-Sharif - Kobul – Peshovar” temir yo‘lini qurish bo‘yicha yo‘l xaritasini imzolagan. Afg‘oniston hududida 2022-yil 18-iyulda Transafg‘on temir yo‘lining yo‘nalishini aniqlash va loyihaning texnik-iqtisodiy asoslarini ishlab chiqish bo‘yicha ekspeditsiya ishlari boshlandi. U 573 km uzunlikdagi va yiliga 20 million tonnagacha yuk tashish salohiyatiga ega magistral qurishni nazarda tutadi. Yangi transport yo‘lagi Yevropa Ittifoqi, Rossiya, O‘zbekiston, Afg‘oniston, Pokiston, Hindiston va Janubi-Sharqiy Osiyo davlatlarini bog‘lashi kerak. Temir yo‘l qurilishi kamida 5 yil davom etishi kutilmoqda.

2023-yil avgust oyida prezident Afg‘oniston orqali o‘tadigan temir yo‘l Janubiy Osiyoga “eng yaxshi, arzon va xavfsiz yo‘l” bo‘lishini ta’kidlagan.

“Tasavvur qiling, bu ikki temir yo‘l qurilsa, iqtisodiyotimiz naqadar barqaror bo‘ladi. Hech kimga qaram bo‘lmaymiz. Mana shu ikkita katta temir yo‘l qurilsa, biz ham [tranzit] tarifi orqali manfaat ko‘radigan mamlakatga aylanamiz,” – deya qayd etgan prezident Shavkat Mirziyoyev [17].

Transafg‘on temiryo‘li Termizdan Afg‘onistonning Naybobod, Maydanshahr va Logar shaharlari orqali Pokiston bilan chegaradagi Xarlachigacha o‘tkaziladi. Mamlakatimizning Eron va Qora dengiz portlariga chiqish imkoniyati mavjud bo‘lishiga qaramay, O‘zbekiston uchun dengizga eng qisqa yo‘l Transafg‘on

[11] https://kavkazgeoclub.ru/content/put-na-indostan-transafganskiy-koridor?utm_medium=organic&utm_source=yandexsmartcamera

koridori hisoblanadi, u Pokistondagi Karachi portlariga olib boradi. Transport vazirligi prognozlariga ko‘ra, temiryo‘l qurilishining birinchi bosqichida yiliga 3 mln tonnacha yuk tashish mumkin bo‘ladi. 2035−2040-yillarga kelib bu ko‘rsatkich 15−20 mln. tonnaga yetishi mumkin.

Bugungi kunda O‘zbekistondan Karachi portlarigacha multimodal yo‘lak orqali avtomobil transportida yuk yetkazib berish 35−40 kun vaqt oladi.

O‘zbekiston - Afg‘oniston - Pokiston temiryo‘lini Termiz - Naybabod - Maydanshahr - Logar - Xarlachi yo‘nalishi bo‘yicha o‘tkazish rejalashtirilgan.

“Naybabod stansiyasi Hayraton va Mazori-Sharif o‘rtasida joylashgan. Naybaboddan yo‘nalish sharqqa buriladi, Logar va Xarlachidan o‘tib, Pokiston temiryo‘l tarmog‘iga tutashtiriladi. Pokiston tomonida Xarlachini Ko‘hot bilan bog‘lovchi 143 km.lik uchastka bor. Hozir Pokiston ushbu uchastkada qurilishni boshlagan. U yakunlangandan so‘ng Peshovar, Laxor, Islomobodga yaqin bo‘lamiz. Keyin yo‘l Multon shahriga — yirik o‘rta markazga, u yerdan esa Korachiga olib boradi. Pokiston hozir ushbu yo‘nalishlarda o‘z temir yo‘l infratuzilmasini modernizatsiya qilmoqda” (Transport vaziri o‘rinbosari J.Choriyev) [18].(2-rasm).



2-rasm. “Trans-afg‘on” temir yo‘l liniyasining yakuniy loyihasi.

Mamlakatimiz hududida yagona temir yo‘l tizimini tashkil qilish masalasini yakunlash, Xitoydan Markaziy Osiyo orqali Yevropagacha yetib borishi rejalashtirilgan xalqaro temir yo‘l koridorini yaratish, shuningdek, Farg‘ona vodiysini ijtimoiy-iqtisodiy jihatdan rivojlantirish, aholi uchun qulay shart-sharoitlarni yaratish maqsadida 2013 yil 18 iyunda qabul qilingan O‘zbekiston Respublikasi Prezidentining qaroriga asosan dengiz sathidan 2 ming 200 metr balandlikda joylashgan, Qamchiq dovoni orqali o‘tadigan 123,2 kilometr uzunlikda

bo‘lgan yangi temir yo‘l loyihasi va uning eng muhim qismi bo‘lgan uzunligi 19,2 kilometrlik tunnel qurilishi boshlandi. Quruvchilar ushbu vazifani belgilangan muddatidan 4 oy oldin –jami 32 oy ichida qurib bitkazdilar. Ushbu loyihaning amalga oshirilishi natijasida mamlakatimizda yagona temir yo‘l tarmog‘i vujudga keldi. 2016 yilning 27 avgust sanasida Angren-Pop temir yo‘l yo‘nalishida “Toshkent-Andijon” yo‘lovchi poezdining birinchi qatnovi amalga oshirildi. Angren-Pop temir yo‘li qurilishi natijasida, Farg‘ona vodiysi hamda mamlakatimiz boshqa viloyatlari orasida temir yo‘llar orqali bog‘liqlik yuzaga keldi.

Bundan tashqari, yuqorida aytib o‘tilganidek, O‘zbekiston hududida qadimdan mavjud bo‘lgan xalqaro savdo yo‘laklari bugungi kunda asosan, shimolga yo‘naltirilgani yanada yirik muammolardan biri edi. Bu esa, janubiy hududlarda transport yo‘laklarining rivojlanmay qolishi, ushbu yo‘nalish bo‘ylab manfaatdorlik hissasi sezilarli darajada kamayib ketishiga olib kelardi. 2022 yil 15-16 sentyabr sanalarida Shanxay Hamkorlik Tashkilotining Samarqand sammit o‘tkazildi. Ushbu sammit doirasida tashkilotga a’zo davlatlarning xalqaro iqtisodiy tarmoqlari, transport va tranzit yo‘laklarini o‘zaro manfaat asosida birlashtirishga qaratilgan yana bir muhim hujjat Xitoy-Qirg‘iziston-O‘zbekiston temir yo‘li qurilishi loyihasi bo‘yicha uch tomonlama hamkorlik bitimi imzolandi. Mazkur temir yo‘l qurilishi loyihasining amalga oshirilishi mamlakatlar o‘rtasida yagona transport tarmog‘ini yaratishda muhim omil bo‘ladi. Xitoydan O‘zbekiston orqali Yevropaning bir qator davlatlariga va Janubiy koridor bo‘ylab Fors ko‘rfazi davlatlariga tashuvlarni amalga oshirish esa o‘z navbatida, Janubiy-Sharqiy Osiyo, O‘rta Osiyo va Yevropa mintaqalarini o‘zaro bog‘lash imkonini beradi. O‘zbekistonning tranzit salohiyatini yanada oshirib, savdo geografiyasini kengaytiradi [10].

Bizning fikrimizcha, yuk tashishni optimallashtirish maqsadida O‘zbekiston Afg‘oniston va Xitoy kabi janubiy va sharqiy qo‘shnilari bilan muqobil va samarali yo‘nalishlarni shakllantirishi kerak. Avval Xitoyning Qirg‘iziston orqali O‘zbekiston bilan bog‘lanishi maqsadga muvofiqdir. Bu borada muhim strategik loyiha - yangi elektrlashtirilgan “Angren-Pop” temir yo‘lining o‘rni katta. Yangi temir yo‘l O‘zbekistonning Tojikiston bilan shimoliy chegarasi bo‘ylab o‘tadi va Xitoyni O‘zbekiston orqali Yevropa davlatlari bilan bog‘laydi. 1997-yilda uch tomonlama memorandum imzolandi va Xitoy-Qirg‘iziston-O‘zbekiston temir yo‘lini qurish uchun yo‘lni yotqizishning mumkin bo‘lgan variantlari o‘rganila boshlandi. Bugungi kunda ushbu yo‘lakning muhimligini quyidagi faktlar orqali ko‘rsata olamiz [20]:

- Suvaysh kanali orqali dengiz orqali yuklarni yetkazib berish 30-40 kun;
- Qozog‘iston bo‘ylab tashish Kaspiy dengizi bo‘ylab ikkita qayta yuklash bilan amalga oshiriladi: 1) Qozog‘iston hududida dengiz transportida; 2) Ozarbayjon hududida dengizdan temir yo‘lga o‘tish va Qozog‘istonning “Do‘stlik” va “Xorgos” chegara stansiyalarining o‘tkazuvchanlik qobiliyati oshib ketmoqda;
- Rossiyaning Yevropa Ittifoqi bilan iqtisodiy munosabatlari zaiflashgani sababli Rossiya orqali yuk tashish barqaror emas [20].

Hindiston bugungi kunda dunyodagi ikkinchi yirik eksportchi ekanligini hisobga olsak, bu yo‘nalish bizning temir yo‘limiz uchun foydali bo‘lib, Yevropaga va ortga qo‘shimcha tranzit yuklarini yetkazib beradi. Lekin bunda geografik, siyosiy va texnik omillar hisobga olinishi kerak [13].

“Xitoy-Qirg‘iziston-O‘zbekiston” temir yo‘lining barpo etilishi davlatlarning savdo-tranzit imkoniyatlaridan to‘liq foydalanish, o‘zaro hamkorlikni kuchaytirish, savdo aloqalarini kengaytirish va yangi bozorlarga chiqishda juda muhim omil bo‘lib xizmat qiladi. Ta’kidlash joizki, ushbu loyihani amalga oshirish deyarli 20 yildan ortiq davr mobaynida rejalashtirilayotgan bo‘lib, yakuniy qarorga kelinmayotgan edi. Dastlabki hisob-kitoblarga ko‘ra, temir yo‘l qurilganidan so‘ng bu yo‘nalishlardan o‘tadigan yuklar miqdori 5 million tonnadan 10 million tonnagacha yetishi kutilmoqda. Mazkur loyiha amalga oshadigan bo‘lsa, “Transsibir” magistrali (Rossiya orqali) hamda “G‘arbiy Xitoy – G‘arbiy Yevropa” magistraliga (Qozog‘iston va Rossiya orqali) raqobatchi transport yo‘lagiga aylanadi. Qolaversa, ushbu temir yo‘l Sariq dengizi bandargohlarigacha bo‘lgan masofani 1100 kilometrgacha qisqartiradi. Shuningdek, mazkur magistral orqali Pokistonning Korachi dengiziga chiqish imkoniyati paydo bo‘ladi.

Istiqbol loyiha bo‘lgan Xitoyni Markaziy Osiyo davlatlari bilan bog‘laydigan temiryo‘l tarmog‘ini qurish loyihasining amalga oshirilishi Xitoydan Qirg‘iziston orqali O‘zbekistonga, so‘ngra Turkmaniston, Eron va Turkiyaga chiqish imkonini beradi.

Mazkur xalqaro transport yo‘lagi qurilishi “Qashqar – Torugart – Makmal – Jalolobod - Andijon” yo‘nalishining kombinatsiyalangan varianti bo‘yicha amalga oshiriladi. Xitoy - Qirg‘iziston - O‘zbekiston temiryo‘lining uzunligi 486 km.ni tashkil etadi, shundan taxminan 312 km Qirg‘iziston Respublikasi hududidan o‘tadi, u yerda 18 ta temiryo‘l stansiyasi qurilishi rejalashtirilgan, bundan tashqari, tog‘li relyefni hisobga olgan holda, 81 ta ko‘prik qurish va uzunligi 120 km dan ortiq bo‘lgan 41 ta tunnelni burg‘ilash talab etiladi. Mazkur temir yo‘lning 40 % tunnel va ko‘priklar orqali o‘tib, 2030 yilda qurilishi yakunlanishi rejalashtirilgan. (3-rasm).



3-rasm. Xitoy – Qirg‘iziston – O‘zbekiston temir yo‘li loyihasi.

Mazkur rasm internet ma’lumotlaridan olingan.[12]

Loyiha doirasida Qirg‘iziston hududida umumiy uzunligi 37 kilometrdan ortiq bo‘lgan uchta yirik tunnel qurilishi rejalashtirilgan:

- “Norin (Jaman-Davan)” 1-tunneli — 12,5 km;
- “Koshtoba (Kazarman)” tunneli — 13,2 km;
- Farg‘ona tog‘ tunneli — 12,2 km [22].

Uzunligi 12 km bo‘lgan tunnellardan biri Jalolobod viloyatining Suzoq tumanidan Tog‘uz-Torov tumanigacha davom etadi. Norin va Jalolobod viloyatlarida yana ikkita yirik tunnel quriladi [22].

Loyihada 46 ta ko‘prik (120 km) va 27 ta tunnel qurish ko‘zda tutilgan bo‘lib, bu butun trassaning 39,3 foizini tashkil qiladi.

Shuningdek, 20 ta temiryo‘l stansiyasi (ikkita istiqbolli), jumladan, 2 ta chegara stansiyasi, 1 ta qayta yuklash stansiyasi, 4 ta oraliq stansiya va 13 ta razyezd qurilishi rejalashtirilmoqda [22]. Loyihani ishga tushirish marosimi 2024-yil 27-dekabr kuni Jalolobod shahrida bo‘lib o‘tgan [19].

Hozirgi kunda O‘zbekiston temiryo‘lchilari oldiga “yo‘lovchi va yuk tashish hajmini oshirish bilan bir qatorda, hududlarning iqtisodiy salohiyatini yanada rivojlantirish, mineral resurslarni kompleks o‘zlashtirish, tarmoq korxonalari uchun mutaxassislar tayyorlash, iqtisodiyot tarmoqlari va aholining ko‘mir mahsulotlariga bo‘lgan doimiy o‘sib borayotgan talabini qondirishga qaratilgan investitsiya loyihalarini amalga oshirish” kabi vazifalar qo‘yilgan. “tranzit salohiyatini yanada rivojlantirish va mamlakat milliy iqtisodiyoti tarkibida transport sektori ulushini oshirish... transport infratuzilmasiga zamonaviy texnologiyalar va xorijiy investitsiyalarni jalb etish”, “Sharq-G‘arb” loyihasi doirasida Qirg‘iziston va O‘zbekiston orqali o‘tadigan Xitoydan boshlanib, so‘ngra Janubiy va Sharqiy

[12] https://www.gazeta.uz/ru/2024/12/21/uzb-kg-china/?utm_medium=organic&utm_source=yandexsmartcamera

Yevropaga, Yaqin Sharq mamlakatlariga va O‘rta yer dengizi portiga chiqadigan yangi qurilgan Boku-Tbilisi-Kars temir yo‘l magistrali orqali yangi transport yo‘laklarini shakllantirish [14].

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GEOGRAFIYA TA’LIMIDA YOSH MUTAXASSISLARNING KASBIY SHAKLLANISHIDA MENTORLIK FAOLIYATINING PEDAGOGIK AHAMIYATI

Annotatsiya. *Mazkur maqolada geografiya fanidan faoliyat boshlayotgan yosh mutaxassislarning kasbiy shakllanishi va pedagogik faoliyatga moslashuvida mentorlik faoliyatining o‘rni va ahamiyati keng tahlil qilinadi. Tadqiqot davomida tajribali pedagoglarning metodik yordami, kasbiy tajribani uzatish mexanizmlari, pedagogik kuzatuv va tahlil jarayonlarining yosh o‘qituvchilar kompetensiyalarini rivojlantirishdagi roli yoritilgan. Geografiya fanining kartografik vositalar bilan ishlash, tabiiy va ijtimoiy-geografik jarayonlarni tushuntirish, amaliy mashg‘ulotlar va dala tadqiqotlarini tashkil etish kabi o‘ziga xos xususiyatlari mentorlik faoliyatining dolzarbligini yanada oshirishi asoslab berilgan. Shuningdek, zamonaviy pedagogik texnologiyalar va axborot-kommunikatsiya vositalarini geografiya ta’limiga integratsiya qilishda mentorning yo‘naltiruvchi roli ochib berilgan.*

Kalit so‘zlar: *geografiya ta’limi, mentorlik faoliyati, yosh pedagog, kasbiy kompetensiya, metodik yordam, pedagogik mahorat, interaktiv metodlar, geografik tafakkur, ekologik madaniyat, innovatsion texnologiyalar.*

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THE PEDAGOGICAL IMPORTANCE OF MENTORING IN THE PROFESSIONAL DEVELOPMENT OF YOUNG SPECIALISTS IN THE FIELD OF GEOGRAPHICAL EDUCATION

Abstract. This article comprehensively analyzes the role and importance of mentoring in the professional formation and adaptation of young specialists in geography to pedagogical activity. The study highlights the role of methodological assistance from experienced teachers, mechanisms for transferring professional

experience, and pedagogical observation and analysis processes in developing the competencies of young teachers. It is argued that the specific features of geography, such as working with cartographic tools, explaining natural and socio-geographic processes, organizing practical exercises and field research, further increase the relevance of mentoring. It also reveals the guiding role of the mentor in integrating modern pedagogical technologies and information and communication technologies into geography education.

Keywords: *geographical education, mentoring, young teacher, professional competence, methodological support, pedagogical skills, interactive methods, geographical thinking, ecological culture, innovative technologies.*

Kirish. Bugungi kunda ta’lim tizimini modernizatsiya qilish, o‘qitish sifatini oshirish va xalqaro standartlarga moslashtirish davlat siyosatining ustuvor yo‘nalishlaridan biri hisoblanadi. Ta’lim sohasida amalga oshirilayotgan islohotlar o‘qituvchilarning kasbiy salohiyatini rivojlantirish, yosh mutaxassislarni qo‘llab-quvvatlash va pedagogik faoliyatning samaradorligini oshirishga qaratilgan.

Geografiya fani umumta’lim tizimida alohida ahamiyatga ega bo‘lib, u o‘quvchilarda tabiat va jamiyat o‘rtasidagi murakkab munosabatlarni anglash, ekologik tafakkurni rivojlantirish, hududiy tahlil qilish ko‘nikmalarini shakllantirish hamda global ekologik muammolarni tushunishga xizmat qiladi. Geografiya darslari orqali o‘quvchilar nafaqat nazariy bilimlarni egallaydilar, balki xaritalar, atlaslar, statistik ma’lumotlar va zamonaviy geoinformatsion texnologiyalar bilan ishlash ko‘nikmalarini ham rivojlantiradilar.

Biroq yosh pedagoglarning kasbiy faoliyatning dastlabki bosqichida duch keladigan muammolari kam emas. Darsni rejalashtirish, pedagogik texnologiyalarni tanlash, o‘quvchilar bilan samarali muloqot o‘rnatish, baholash mezonlarini to‘g‘ri qo‘llash va tarbiyaviy ishlarni tashkil etish ulardan katta mas’uliyat va tajriba talab qiladi. Shu sababli yosh mutaxassislarni qo‘llab-quvvatlashning samarali mexanizmlaridan biri sifatida mentorlik faoliyati alohida ahamiyat kasb etadi.

Mentorlik tizimining pedagogik mohiyati. Mentorlik tizimi tajribali pedagog va yosh mutaxassis o‘rtasidagi maqsadli, tizimli va uzluksiz hamkorlikni ifodalaydi. Uning asosiy vazifasi pedagogik tajribani uzatish, kasbiy rivojlanishni qo‘llab-quvvatlash va yosh mutaxassisni mustaqil pedagogik faoliyatga tayyorlashdan iborat.

Mentor nafaqat bilim beruvchi, balki maslahatchi, yo‘naltiruvchi va motivator sifatida ham faoliyat olib boradi. Yosh pedagog esa ushbu hamkorlik jarayonida nazariy bilimlarini amaliyot bilan uyg‘unlashtirish, dars jarayonidagi muammolarni tahlil qilish va mustaqil yechim topish imkoniyatiga ega bo‘ladi.

Pedagogik nuqtai nazardan mentorlik tizimi quyidagi vazifalarni bajaradi:

- yosh pedagoglarning kasbiy moslashuvini tezlashtirish;
- metodik tayyorgarlik darajasini oshirish;
- pedagogik kompetensiyalarni rivojlantirish;
- innovatsion faoliyatga tayyorlash;
- kasbiy motivatsiyani shakllantirish;

- pedagogik refleksiya va tahliliy fikrlashni rivojlantirish.

Geografiya fanining o‘ziga xosligi va mentorlik zarurati

Geografiya fani tabiiy va ijtimoiy jarayonlarni o‘rganishga qaratilgan integrallashgan fan hisoblanadi. Ushbu fan biologiya, geologiya, ekologiya, iqtisodiyot, demografiya va tarix kabi ko‘plab fanlar bilan uzviy bog‘liqdir.

Geografiya ta’limining asosiy xususiyatlaridan biri uning ko‘rgazmalilik va amaliyotga yo‘naltirilganligidir. Xaritalar, atlaslar, globuslar, diagrammalar, aerokosmik suratlar va statistik ma’lumotlar geografiya darslarining ajralmas qismi hisoblanadi.

Yosh pedagoglar ko‘pincha quyidagi qiyinchiliklarga duch keladilar:

- xaritalar bilan ishlash metodikasini to‘liq egallamaslik;
- mavzuni amaliy misollar bilan boyitishda qiyinchiliklarga duch kelish;
- geografik jarayonlarni sodda va tushunarli tarzda tushuntira olmaslik;
- dala amaliyotlari va ekskursiyalarni tashkil etish tajribasining yetarli emasligi;
- zamonaviy raqamli texnologiyalardan foydalanish ko‘nikmalarining sustligi.

Ana shunday vaziyatlarda mentorning tajribasi va amaliy tavsiyalari yosh pedagogning kasbiy rivojlanishida muhim omil bo‘lib xizmat qiladi.

Darslarni rejalashtirish va tashkil etishda mentorning roli

Geografiya darsining samaradorligi avvalo uning to‘g‘ri rejalashtirilishiga bog‘liq. Mentor yosh o‘qituvchiga taqvim-mavzu rejasini tuzish, dars maqsadlarini aniqlash, o‘quv natijalarini belgilash va baholash mezonlarini ishlab chiqishda yordam beradi.

Shuningdek, mentor quyidagi yo‘nalishlarda metodik ko‘mak ko‘rsatadi:

- darsning kirish, asosiy va yakuniy qismlarini samarali tashkil etish;
- o‘quvchilarning faolligini oshiruvchi metodlarni tanlash;
- differensial va individual yondashuvlarni qo‘llash;
- nbaholashning zamonaviy usullaridan foydalanish;
- kompetensiyaviy yondashuv asosida dars tashkil etish.

Kartografik vositalardan foydalanishda mentorning ahamiyati

Geografiya fanining eng muhim xususiyatlaridan biri kartografik savodxonlikni shakllantirish hisoblanadi. Xaritalar bilan ishlash o‘quvchilarda fazoviy tafakkurni rivojlantiradi va geografik hodisalarni chuqurroq tushunishga yordam beradi.

Mentor yosh pedagogga:

- xarita turlarini tanlash;
- shartli belgilarni izohlash;
- geografik koordinatalarni aniqlash;
- masshtab bilan ishlash;
- hududiy tahlil usullarini qo‘llash;
- tematik xaritalardan foydalanish metodikasini o‘rgatadi.

Natijada yosh o‘qituvchi kartografik materiallarni darsning samarali vositasiga aylantira oladi.

Dala amaliyotlari va ekskursiyalarni tashkil etish. *Geografiya ta’limining muhim tarkibiy qismi dala tadqiqotlari va ekskursiyalar hisoblanadi. Bunday mashg‘ulotlar o‘quvchilarning nazariy bilimlarini mustahkamlash, kuzatuvchanligini rivojlantirish va tabiatga ongli munosabatni shakllantirishga xizmat qiladi.*

Ekskursiyalarni tashkil etishda mentor yosh pedagogga:

- tadqiqot maqsadini aniqlash;
- kuzatuv dasturini ishlab chiqish;
- xavfsizlik qoidalariga rioya qilish;
- dala kundaliklarini yuritish;
- natijalarni tahlil qilish va umumlashtirish bo‘yicha tavsiyalar beradi.

Zamonaviy pedagogik texnologiyalar va raqamli vositalar

Bugungi raqamli davr geografiya ta’limiga yangi imkoniyatlarni olib kirmoqda. Elektron xaritalar, virtual laboratoriyalar, sun’iy yo‘ldosh tasvirlari va interaktiv platformalar o‘quv jarayonini yanada qiziqarli va samarali tashkil etish imkonini beradi.

Mentor yosh pedagogga quyidagi vositalardan foydalanishni o‘rgatadi:

- raqamli xaritalar;
- geografik axborot tizimlari;
- virtual ekskursiyalar;
- multimedia taqdimotlari;
- videodarslar;
- onlayn test va baholash platformalari.

Bu esa o‘quvchilarning fan bo‘yicha motivatsiyasini oshiradi va ta’lim sifati yaxshilanishiga xizmat qiladi.

Dars kuzatuvi va metodik tahlil. *Mentorlik faoliyatining eng samarali shakllaridan biri dars kuzatuvi hisoblanadi. Dars kuzatuvi davomida mentor yosh pedagogning metodik yondashuvi, vaqt taqsimoti, baholash usullari va sinf bilan ishlash ko‘nikmalarini tahlil qiladi.*

Kuzatuv natijalari asosida:

- mavjud kamchiliklar aniqlanadi;
- ularni bartaraf etish bo‘yicha tavsiyalar ishlab chiqiladi;
- pedagogik mahoratni oshirish strategiyasi belgilanadi.

Bu esa yosh pedagogning o‘z ustida ishlashiga va kasbiy rivojlanishiga xizmat qiladi.

Mentorlik tizimining ta’lim sifatiga ta’siri. *Mentorlik tizimi nafaqat yosh pedagoglarning rivojlanishiga, balki butun ta’lim tizimi samaradorligiga ham ijobiy ta’sir ko‘rsatadi. Tajribali pedagog rahbarligida faoliyat yuritayotgan yosh mutaxassislar darslarni yanada sifatli tashkil etadilar, innovatsion metodlarni faol qo‘llaydilar va o‘quvchilarning fan bo‘yicha natijalarini yaxshilaydilar.*

- geografik tafakkur rivojlanadi;
- ekologik madaniyat shakllanadi;
- mustaqil fikrlash ko‘nikmalari rivojlanadi;
- ta’lim sifati va samaradorligi ortadi.

Xulosa

Xulosa qilib aytganda, geografiya ta’limida yosh mutaxassislarning kasbiy shakllanishida mentorlik faoliyati muhim pedagogik vosita hisoblanadi. Mentorning metodik yordami va amaliy tajribasi yosh pedagoglarning kasbiy moslashuvini tezlashtiradi, pedagogik kompetensiyalarini rivojlantiradi va ularning ijodiy salohiyatini yuzaga chiqaradi.

Geografiya fanining o‘ziga xos amaliy yo‘nalganligi mentorlik tizimining ahamiyatini yanada kuchaytiradi. Xaritalar bilan ishlash, dala tadqiqotlari, ekskursiyalar va zamonaviy texnologiyalarni qo‘llash jarayonida tajribali pedagogning yo‘l-yo‘riqlari yosh mutaxassisning professional rivojlanishida muhim omil bo‘lib xizmat qiladi.

Shu sababli geografiya ta’limida mentorlik tizimini takomillashtirish, uni institutsional darajada qo‘llab-quvvatlash va amaliyotga keng joriy etish ta’lim sifatini oshirishning muhim shartlaridan biri hisoblanadi.

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CREATING AN INTERACTIVE WEB MAP FOR THE LOWER AMU DARYA STATE BIOSPHERE RESERVE BASED ON THE GOOGLE EARTH ENGINE PLATFORM

Abstract. *This article describes the methodology for monitoring the ecological state of the Lower Amu Darya State Biosphere Reserve and creating an interactive web map based on the Google Earth Engine (GEE) platform. The study analysed spatial-dynamic changes in land cover, vegetation status, and water bodies based on Sentinel-2 satellite images. Using the Google Earth Engine platform allows for rapid processing of large-scale remote sensing data, visualisation of ecological processes, and creation of web-cartographic resources that support decision-making.*

Keywords: *Google Earth Engine, web map, remote sensing, Sentinel-2, environmental monitoring, biosphere reserve.*

Introduction. In recent years, the intensification of environmental problems on a global scale, in particular climate change, depletion of water resources, increased desertification processes and reduction of biodiversity, creates the need for continuous and systematic monitoring of protected natural areas [3].

In this process, the Google Earth Engine has emerged as one of the largest and most advanced geoinformation tools at the global scale. By integrating a multi-year archive of satellite imagery, powerful cloud-based computational resources, and code-driven analytical capabilities, the platform has elevated environmental monitoring to a new level. Google Earth Engine enables the rapid analysis and visualisation of large volumes of spatial data without local technical limitations [6].

The primary objective of this study is to assess the ecological condition of the Lower Amu Darya State Biosphere Reserve using the Google Earth Engine platform and Sentinel-2 satellite data, to identify key ecological processes through spectral indices, and to present the results in the form of an interactive web map.

Materials and methods. This study was conducted within the Lower Amu Darya State Biosphere Reserve, located in the northwestern part of the Republic of Uzbekistan, within the Republic of Karakalpakstan, and encompassing the lower reaches of the Amu Darya River. The territory of the Lower Amu Darya State Biosphere Reserve is predominantly characterised by lowland landscapes, with absolute elevations ranging on average between 70 and 90 meters above sea level.

The territory is characterised by a sharply continental climate, with extremely hot and arid summers and relatively cold winters. Annual precipitation is low and occurs predominantly during the winter and spring months [7].

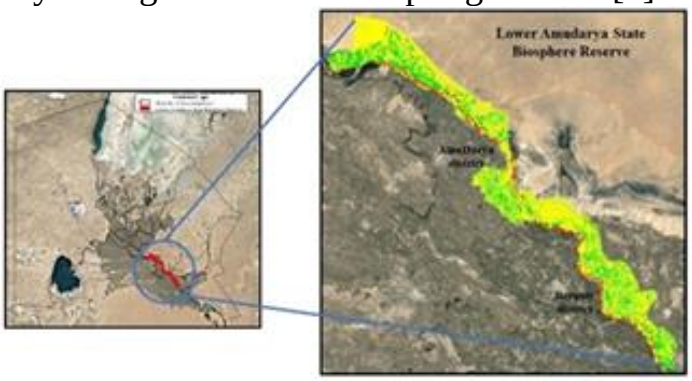


Figure 1. Lower Amu Darya State Biosphere Reserve.

Given the vast spatial extent of the Lower Amu Darya State Biosphere Reserve, comprehensive assessment of its ecological condition through conventional field-based observations alone remains limited. In this context, satellite remote sensing data provide an effective and scalable solution. In particular, high-resolution imagery from Sentinel-2 plays a crucial role in detecting and analysing spatial and temporal dynamics of vegetation cover, surface water bodies, and land cover changes [1].

Methodology. In this study, open-access and reliable remote sensing datasets available within the Google Earth Engine (GEE) platform were utilised. To ensure a comprehensive assessment of the ecological condition of the study area, satellite imagery operating in the optical spectral range was selected as the primary source of information.

Imagery acquired by the Sentinel-2 mission served as the principal dataset. With a spatial resolution of 10–20 meters and a revisit cycle of approximately five days, Sentinel-2 enables continuous monitoring of vegetation dynamics, surface water bodies, and land cover changes in complex ecosystems such as the Lower Amu Darya State Biosphere Reserve [3]. For this research, imagery corresponding to the 2024 vegetation period was selected, allowing for the analysis of both seasonal and intra-annual variations. Only scenes with cloud cover below 10% were retained, thereby improving the accuracy and reliability of the results.

The administrative boundaries of the Lower Amu Darya State Biosphere Reserve were adopted as the study area. The boundaries were defined in vector (polygon) format and imported into the GEE environment [2]. After defining the ROI (Region of Interest), all satellite images were clipped strictly to the boundaries of the study area. This procedure reduced redundant data volume and significantly improved computational efficiency during subsequent processing steps.

Satellite imagery was retrieved from the Google Earth Engine archive, specifically from the Sentinel-2 *COPERNICUS/S2_SR_HARMONIZED* collection. This dataset consists of atmospherically corrected surface reflectance products, providing physically consistent spectral reflectance values from the Earth’s surface.

The imagery was filtered according to the following criteria:

- Spatial filtering based on the study area boundaries;
- Temporal filtering covering the period from March to October 2024;
- Cloud cover constraint (*CLOUDY_PIXEL_PERCENTAGE* < 10%).

This stage ensured high data quality and minimised potential errors in the calculation of spectral indices.

To assess the ecological condition of the territory, key spectral indices characterising vegetation and surface water were computed. Among them, the Normalised Difference Vegetation Index (NDVI) is widely applied for evaluating vegetation density and health status [4].

It was calculated using the following formula:

$$NDVI = \frac{(NIR - RED)}{(NIR + RED)}$$

where:

- *NIR* refers to the near-infrared band (Sentinel-2: B8);
- *RED* refers to the red spectral band (Sentinel-2: B4).

Higher NDVI values indicate dense and healthy vegetation, whereas low or negative values correspond to bare land, water surfaces, or degraded areas.

The NDWI (Normalised Difference Water Index) was used to identify water bodies and monitor moisture conditions. The index was calculated using the following formula:

$$NDWI = \frac{Green - NIR}{Green + NIR}$$

where:

- ***GREEN*** – green spectral band (B3),
- ***NIR*** – near-infrared band (B8).

Positive NDWI values indicate the presence of water bodies, while negative values correspond to dry areas.

The NDWI index enables the identification of open water bodies and the assessment of their spatial distribution. Using this index, river channels, reservoirs, seasonal lakes, and wetlands can be delineated, and their dynamic changes throughout the vegetation period can be analysed. A decline in NDWI values clearly reflects the reduction of water surfaces and highlights areas experiencing increasing water scarcity [5].

Spectral indices were calculated based on annual and seasonal mean values. This approach allowed for the assessment of temporal dynamics of ecological processes. Using the statistical functions of Google Earth Engine, the monthly minimum, maximum, and mean values of NDVI and NDWI across the study area were determined, enabling an evaluation of ecological change trends.

Results and discussion. Using Sentinel-2 satellite imagery processed within the Google Earth Engine environment, the ecological condition of the Lower Amu Darya State Biosphere Reserve was comprehensively assessed. The calculated

spectral indices indicated a high degree of spatial variation in ecological processes across the reserve.

The results of NDVI and NDWI analyses revealed that ecological patterns are strongly influenced by the hydrological regime, topographic features, and soil conditions. In particular, vegetation cover in the low-lying areas along the Amu Darya River remained relatively stable, while regions with limited water availability showed intensified processes of ecological degradation.

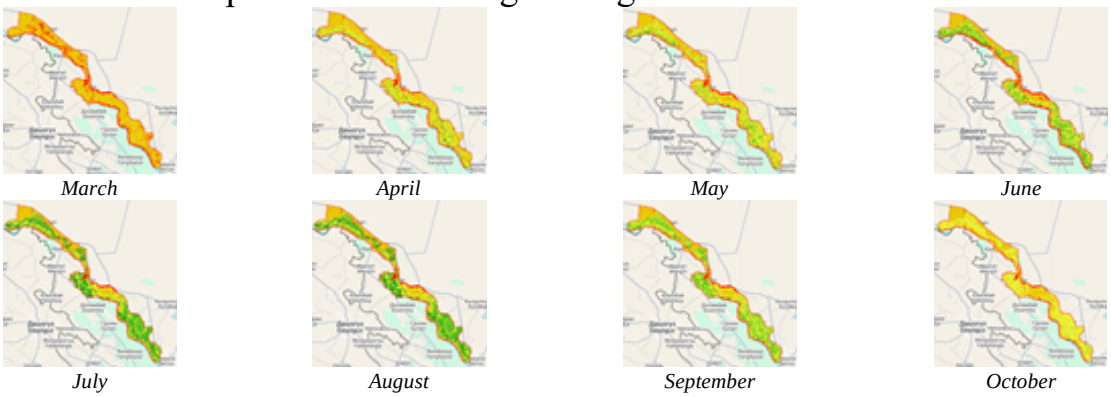


Figure 3. Monthly changes in NDVI vegetation cover in 2024 (in the GEE platform window).

The seasonal dynamics of the NDVI index throughout 2024 were clearly observed. In March, vegetation was not yet fully developed, resulting in low NDVI values. During April and May, the spring growth phase commenced, and NDVI values increased rapidly. From June to July, vegetation reached its peak development stage, with the index attaining its highest values. Starting in August, reduced moisture availability led to a slight decline in NDVI. In September and October, vegetation weakened, and NDVI values fell to moderate and low levels.

Overall, the NDVI dynamics were found to be directly linked to the seasonal climatic conditions and the hydrological regime of the region [6].

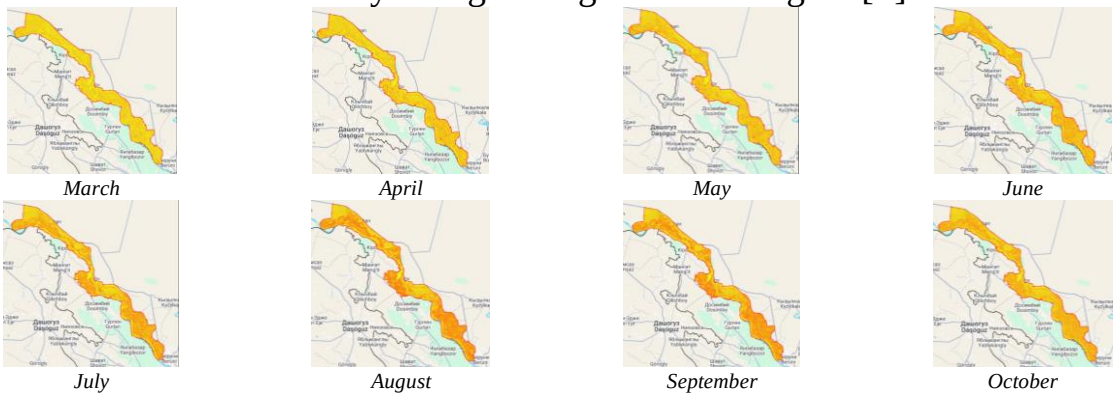


Figure 4. Monthly changes in NDWI vegetation cover in 2024 (in the GEE platform window)

Temporal variations in NDVI (time-series) provide valuable functional information on crop productivity and can be used to identify and highlight anomalies in growth patterns. NDVI enables the detection of areas with reduced productivity caused by disease, natural disasters, or other stress factors during the vegetation season [11].

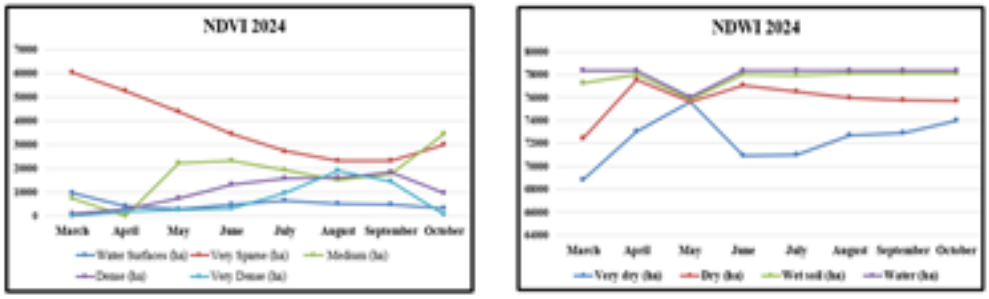


Figure 5. Monthly changes in NDVI and NDWI indices in 2024.

The 2024 data indicate a predominance of arid conditions across the study area. Throughout the year, the majority of the territory fell under the “very dry” category, reflecting the region’s climatic characteristics, including high summer temperatures and intensive evapotranspiration processes.

During the spring months (March–April), soil moisture remained relatively stable; however, starting in May, the proportion of very dry areas increased. In the summer months (June–August), drought conditions persisted, with dry and very dry areas dominating the landscape. At the same time, slight increases in moist soil were observed in certain locations around mid-summer, likely due to irrigation or localised water accumulation.

At the beginning of autumn (September), a relative increase in moist soils was noted, attributed to lower temperatures and reduced evaporation. Nevertheless, by October, dry conditions once again prevailed.

Overall, while seasonal variations in soil moisture were observed in 2024, dry and very dry lands consistently constituted the largest proportion of the territory.

The analysis demonstrates that during the spring months, an increase in NDWI values (indicating higher surface and soil moisture availability) leads to a corresponding rise in NDVI. This pattern reflects the transition of vegetation into an active growth phase, characterised by intensified photosynthetic activity and rapid biomass accumulation. Enhanced precipitation and improved soil moisture conditions in spring create favourable environmental settings for vegetation development. During the summer season, vegetation typically reaches its peak growth stage, and NDVI records its highest values. In certain areas, NDWI remains relatively stable due to irrigation practices or the persistence of moisture in the soil profile. In irrigated landscapes in particular, the positive correlation between NDWI and NDVI becomes more pronounced, as artificial water supply sustains vegetation vigour despite elevated temperatures and increased evapotranspiration rates. In autumn, declining precipitation and intensified evapotranspiration processes result in reduced moisture availability, reflected by decreasing NDWI values. Consequently, NDVI also declines, indicating a reduction in vegetation density and biomass. This seasonal pattern corresponds to the phenological transition toward the end of the growing period. Overall, NDWI represents one of the principal natural drivers of vegetation dynamics and exhibits a positive correlation with NDVI.

Discussion of the results obtained based on the web map. The developed web map was created using the Google Earth Engine (GEE) platform, where NDVI

(Normalised Difference Vegetation Index) and NDWI (Normalised Difference Water Index) were calculated and classified on a monthly basis from March to October using Google Earth Engine and Sentinel-2 satellite imagery [7].

The web application provides an interactive interface that enables users to visualise monthly index values, examine their classification by thematic classes, and assess the spatial distribution of each class in terms of area (hectares).



Figure 6. Interactive web map of the Lower Amu Darya State Biosphere Reserve. (https://ee-alishernuratdinov.projects.earthengine.app/view/lower-amu-darya-state-biosphere-reserve-web-maps)

This web application allows the user to view index values for each month in map format, analyse them based on classification, and statistically evaluate changes in the territorial area.

The NDVI index is divided into 5 classes to assess the state of vegetation in the reserve. This classification serves to identify zones of very low, low, medium, high and very high vegetation. In March 2024, NDVI indicators are observed mainly in the low and medium classes, which indicates that the vegetation has not yet fully developed. Starting from April, vegetation becomes active and the area of the high classes begins to expand. In May, June and July, NDVI approaches maximum values, and the high and very high classes occupy a large part of the reserve territory. Starting from August, vegetation decreases and the area of the high classes decreases. In September and October, the proportion of the low and medium classes increases, which indicates the end of the vegetation period. The web map calculates each class area separately and shows the dynamics of change from month to month.

The NDWI index was classified into four categories to assess the water and moisture regime of the study area: very low moisture, low moisture, moderate moisture, and high moisture zones. In March 2024, NDWI values were generally at a moderate level, with higher moisture conditions observed in certain low-lying areas [6]. In April and May, due to spring runoff and increased moisture availability, the spatial extent of high-moisture classes expanded. Beginning in June, rising air temperatures led to a reduction in moisture availability, and NDWI values exhibited a declining trend. In July and August, the area covered by low-moisture classes increased, reflecting typical summer arid conditions. In September and October, moisture conditions partially recovered, resulting in a renewed expansion of moderate and high-moisture classes. The interactive web map provides a colour-coded visualisation of the spatial distribution of NDVI and NDWI for each month, while area statistics for each class are automatically calculated.

In general, the created web map allows:

- ✓ remote ecological monitoring of the area,
- ✓ rapid assessment of vegetation and moisture changes,

- ✓ use as a visual analysis tool for scientific research and dissertation work,
- ✓ creation of a database for making management decisions.

Thus, the developed NDVI–NDWI web map is an effective, modern and interactive monitoring tool for displaying the seasonal ecological dynamics of the area.

Suggestions and recommendations. Based on the results of this study, a set of recommendations has been developed to enhance ecological monitoring within the Quyi Amudaryo davlat biosfera rezervati, to provide a scientific basis for nature conservation measures, and to promote the practical implementation of modern geoinformation technologies.

First, it is essential to establish a continuous and systematic ecological monitoring framework within the biosphere reserve. This system should be organised on the basis of Google Earth Engine and supported by Sentinel-2 satellite imagery to ensure regular observation of vegetation cover, water bodies, and land cover dynamics.

Second, in assessing vegetation conditions and water regimes, it is recommended not to rely solely on NDVI and NDWI, but also to incorporate additional spectral indices such as Soil-Adjusted Vegetation Index (SAVI), Enhanced Vegetation Index (EVI), Normalised Difference Salinity Index (NDSI), and Land Surface Temperature (LST).

Third, to improve the reliability of remote sensing results, systematic validation through field observations and laboratory analyses is necessary. Comparing in situ measurements of soil salinity, vegetation condition, and water quality with satellite-derived data would significantly enhance the accuracy and credibility of monitoring outcomes.

Fourth, the developed interactive web map should be integrated into the operational activities of organisations responsible for managing the biosphere reserve, as well as ecological inspection authorities and research institutions.

Fifth, for future studies, it is advisable to integrate artificial intelligence and machine learning algorithms—such as Random Forest and change detection models—into the Google Earth Engine environment to enable automated identification of ecological processes.

Conclusion. This study developed a modern web-cartographic approach for assessing and monitoring the ecological condition of the Lower Amu Darya State Biosphere Reserve using the capabilities of the Google Earth Engine platform. A complete technological workflow for remote sensing data processing was implemented, covering all stages from delineation of the study area to the calculation of spectral indices and the visualisation of results in the form of an interactive web map.

Sentinel-2 satellite imagery was selected as the primary data source. Its high spatial resolution and regular revisit frequency enabled dynamic monitoring of ecological processes within the complex ecosystem of the biosphere reserve. The spatial and temporal variability of the NDVI index, which characterises vegetation cover conditions, proved to be a significant indicator for identifying degradation

and regeneration processes in tugai forests. Furthermore, the NDWI results clearly reflected reductions in water body extent and changes in the moisture regime.

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AUTIZM SPEKTRI BUZILISHI BO'LGAN BOLALAR BILAN BADIIY-IJODIY FAOLIYATNI TASHKIL ETISHNING ZAMONAVIY PEDAGOGIK ASOSLARI

Annotatsiya: *Mazkur maqolada autizm spektri buzilishi bo'lgan bolalar uchun rivojlantiruvchi ta'lim muhitini tashkil etishning pedagogik ahamiyati yoritilgan. Ta'lim makonini strukturaviy va vizual jihatdan to'g'ri tashkil etish, individual yondashuv hamda san'at va ijodiy faoliyatga asoslangan metodlarning bolalarning ijtimoiylashuvi, muloqot ko'nikmalari, mustaqilligi va hissiy rivojlanishiga ijobiy ta'siri tahlil qilingan. Shuningdek, pedagog va ota-onalar hamkorligining autizm spektri buzilishi bo'lgan bolalarni inklyuziv ta'lim muhitiga muvaffaqiyatli moslashtirishdagi o'rni asoslab berilgan.*

Kalit so'zlar: *Autizm spektri buzilishi, inklyuziv ta'lim, rivojlantiruvchi ta'lim muhiti, pedagogik yondashuv, san'at terapiyasi, ijodiy faoliyat, vizual qo'llab-quvvatlash, ijtimoiylashuv, kommunikativ ko'nikmalar, individual yondashuv.*

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MODERN PEDAGOGICAL FOUNDATIONS FOR ORGANIZING ARTISTIC-CREATIVE ACTIVITIES WITH CHILDREN WITH AUTISM SPECTRUM DISORDER

Abstract*: This article highlights the pedagogical importance of creating a developmental learning environment for children with Autism Spectrum Disorder (ASD). It analyzes the positive impact of a well-structured and visually organized educational environment, an individualized approach, and art- and creativity-based teaching methods on children's socialization, communication skills, independence, and emotional development. The article also emphasizes the role of collaboration between teachers and parents in facilitating the successful adaptation of children with ASD to an inclusive educational environment.*

Keywords: *Autism Spectrum Disorder (ASD), inclusive education, developmental learning environment, pedagogical approach, art therapy, creative activities, visual support, socialization, communication skills, individualized approach.*

Bugungi kunda autizm spektri buzilishiga ega bolalar sonining ortib borayotgani inklyuziv ta'lim tizimi oldiga yangi vazifalarni qo'ymoqda. Bunday bolalarni ta'lim jarayoniga muvaffaqiyatli jalb etishda maxsus tashkil etilgan rivojlantiruvchi muhit va pedagogik metodlarning o'rni alohida ahamiyat kasb etadi.

Ruhiy kasalliklar va kasalliklarning xalqaro tasnifi autizm spektri buzilishlarini keng ko'lamli g'ayritabiiy xatti-harakatlar va ijtimoiy o'zaro ta'sir va muloqotdagi qiyinchiliklar, shuningdek, jiddiy cheklangan qiziqishlar va tez-tez takrorlanadigan xatti-harakatlar sifatida belgilaydi.

- Autizm spektrining buzilishlariga quyidagilar kiradi:
- autizm (Kanner sindromi);
- Asperger sindromi;
- bolalikdagi parchalanish buzilishi;
- rivojlanishning o'ziga xos bo'lmagan buzilishi.

Maxsus ehtiyojli bolalar bilan ishlash bo'yicha keng tajribaga asoslanib, shuni ta'kidlash kerakki, autizmga chalingan barcha bolalarda muloqot va ijtimoiy ko'nikmalar buzilgan. Ular dinamik ravishda o'zgarib turadigan muhit bilan faol munosabatlarni rivojlantirishda affektiv muammolar va qiyinchiliklarga duch kelishadi, bu esa ularning atrofdagi dunyoda izchillikni va stereotipik xatti-harakatlarni saqlashga e'tibor qaratishlarini belgilaydi.

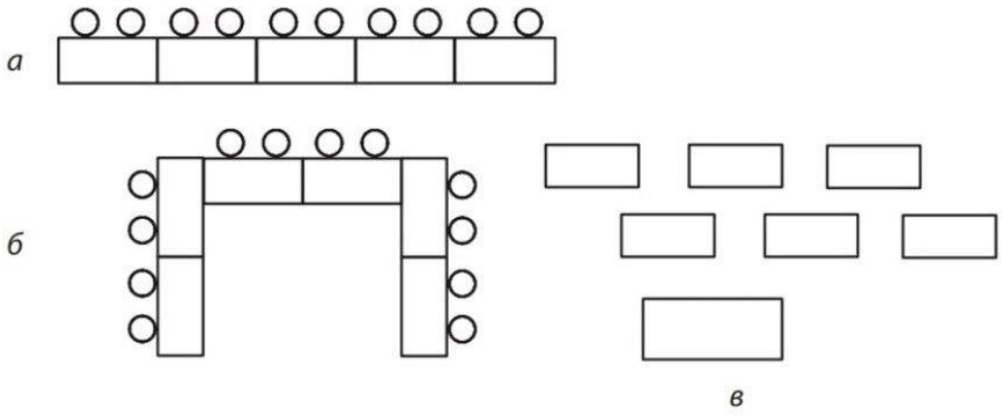
Amaliy kuzatuvlar shuni ko’rsatadiki, autizm spektri buzilishi bo’lgan har bir bolaning rivojlanish xususiyatlari o’ziga xos va takrorlanmasdir. Bu shuni anglatadiki, har qanday bola bilan muloqotda bo'lganingizda, o'zingizni sinab ko'rishingiz va ijodiy jarayonni kuzatishingiz, munosabatlarga "makon" va erkinlikni kiritishingiz kerak. Bola bilan birga bo'ling, ularni kuzating va ular bilan ongli makonda ishtirok eting.

Makon - bu individual o'quv muhitini tashkil etish imkonini beruvchi komponentlardir. Ta’lim Makoni bolaning individual xususiyatlarini hisobga olgan holda o’quv muhitini samarali tashkil etishga xizmat qiladi. Shu nuqtai nazardan, mebel va o'quv materiallarini qanday joylashtirish muhim, toki bola o'z ish joyini, san'at buyumlari qayerda ekanligini, qo'llarini yuvish va rasm chizish uchun suvni qayerdan olish kerakligini va hokazolarni aniqlay bilsin. Bu bolalarga har bir atrof-muhit makonining boshlanishi va oxiri borligini tushunishga yordam beradi. Shuning uchun, boshidanoq bolaga sinf xonasini mustaqil ravishda o'rganish imkoniyatini berish juda muhimdir.

Fazoviy tuzilish darajasi bolaning o'zini o'zi boshqarish darajasiga bog'liq, ammo uning kognitiv rivojlanishiga bog'liq emas. O'quvchilar mustaqil bo'lib borgan sari, fazoviy tuzilish darajasi asta-sekin pasayadi.

Aniq vizual va moddiy chegaralarga e'tibor berish darkor: xonadagi yoki sinf xonasidagi mebellar (kitob javonlari, javonlar, stollar, gilamlar, to'siqlar) turli maqsadlar uchun bir nechta zonalarni belgilash uchun joylashtirilishi kerak. Chegaralarni vizual ravishda belgilash uchun turli xil rangli pol qoplamalari yoki rangli pol lentasidan foydalanish mumkin. Pedagogik jarayonda maktabgacha yoshdagi bolalar va boshlang'ich maktab o'quvchilari bilan sinf odatda xona ikkita zonaga ajratiladi: birinchi zona, gilam bilan qoplangan, dars boshlanadigan joy, "umumiy doira". Bu zonada hikoya yoki ertak tinglanadi va dars mavzusiga oid turli xil sensorli materiallar bilan o'ynaladi. Ikkinchi zonada esa stollarda ishlashga o'tiladi, u yerda aslida badiiy va ijodiy vazifalar bajariladi.

Ish stoli. Nogiron bolalar bilan san'at darslari uchun ish joyini tashkil qilish standart sinfda qiyin bo'lishi mumkin. Ijodiy mashg'ulotlar uchun stollarni bolalar va o'qituvchi o'rtasidagi, shuningdek, bir-biri bilan o'zaro aloqani osonlashtirish uchun turli usullar bilan joylashtirish mumkin, chunki ijodiy yo'lni boshlagan ko'plab bolalarga ota-ona yoki o'qituvchi hamrohlik qiladi. Shuning uchun har bir bolaga standart sinfdagiga qaraganda ikki baravar ko'proq joy ajratilishi kerak (1-rasm).

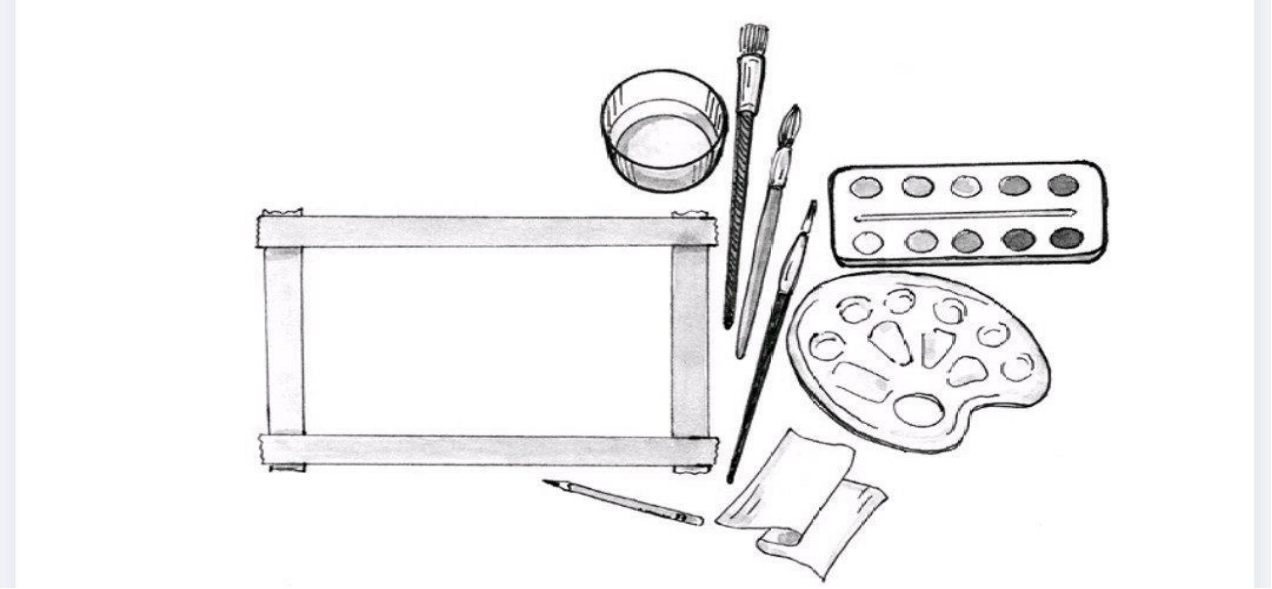


1-rasm. Guruh mashg'ulotlari uchun ish maydonini tashkil qilish variantlari: a) 6-8 ta parta yoki stol yonma-yon qo'yilib, bitta umumiy stol hosil qiladi. Darslarda naqsh va bezaklarsiz qalin mato bilan qoplangan uchta oddiy katlanadigan ovqatlanish stolidan foydalaniladi;

b) stollar yarim doira yoki U shaklida joylashtirilgan, shunda siz har bir tarbiyalanuvchi (o’quvchi)ni ko'rishingiz mumkin va ularning o'zlari ham siz, ham bir-birlari bilan ko'z aloqasini o'rnatadilar;

d) stollar shaxmat taxtasi shaklida joylashtirilgan. Bu tartib repetitor bola bilan ishlayotganda juda qulay, chunki bu repetitorning orqasida o'tirgan o'quvchining ko'rinishini to'sib qo'yishining oldini oladi.

Mashg'ulot uchun tayyorlangan materiallar joylangan alohida stol bolaga ishlash uchun qulay bo'lishi kerak, u tegishli balandlikdagi stulda o'tirib qo'yilishi kerak. Mashg'ulot boshlanishidan oldin, stolni moyli mato bilan yoping, iloji bo'lsa naqshsiz, shunda bola ish yuzasini bo'yoq, yelim yoki boshqa materiallar bilan bo'yashdan qo'rqmaydi. Qog'oz varag'i asosiy, markaziy o'rinni egallashi kerak. Varaq stoldan sirg'alib ketmasligi uchun uni butun perimetri bo'ylab qog'oz lenta bilan mahkamlang. Bola ishlaydigan materiallar (qalamlar, markerlar, rangli qalamlar va boshqalar) bolaning dominant qo'lining yon tomoniga qo'yiladi (masalan, agar dominant qo'l o'ngda bo'lsa). Agar siz bo'yoqlar bilan ishlayotgan bo'lsangiz, unda ustiga bo'yoqlar qo'yilgan palitra ham shu yerga qo'yilishi kerak. Palitraning yonida bir stakan suv va latta qo’yilishi lozim (2-rasm)



.

2-rasm. Ish joyini tashkil etish sxemasi

Barcha narsalar stolga qo'yilgandan so'ng, bolaga nima qayerga ketishini tushuntirish muhimdir. Bu o'zini tuta bilish va mustaqillikni rivojlantirishga yordam beradi.

Autizm spektri buzilishlari (ASB) bo'lgan bolalarga ularning o'ziga xos xususiyatlari va ehtiyojlarini tushunishga asoslangan ta'limni o'rgatishda tuzilgan, ta'lim va rivojlanish muhiti muhim rol o'ynaydi. Gap shunchaki "QAYERDA?" va "QACHON?" masalasi emas; gap bolalar motivatsiya, tushunish, interaktiv va mustaqil bo'lishni o'rganadigan psixologik va pedagogik muhitni yaratish haqida.

Dars jarayonini qanday tuzish kerak? Albatta, har bir bolaning qobiliyatlarini - darsda 30 daqiqa o'tirish, ma'lumotni o'zlashtirish, o'qituvchi bilan muloqot qilish va boshqa bolalar bilan bog'lanish qobiliyatini hisobga olish zarur. Pedagogik jarayonda dastur haftasiga ikki marta o'qitiladi. Har bir dars 1 soat 20 daqiqa davom etadi va o'rtasida qisqa tanaffus bilan ikkita 40 daqiqalik qismdan iborat. Bu vaqt bolalarning ijodiy faoliyatga tayyorlanishi uchun yetarli.

Dars o'yinli dam olish texnikasi, motorli plastika, o'simlik va hayvonot dunyosi eksponatlarini tomosha qilish, rasmlarning reproduksiyalari, taqdimotlar va videolar, musiqa tinglash va haqiqiy vizual faoliyatlarni o'z ichiga oladi (ba'zi hollarda modellashtirish va turli xil sensorli materiallar bilan ishlash qo'shimcha sifatida qo'shilishi mumkin).

Mato, qum, tabiiy materiallar va boshqalar, kollaj yasash va boshqalar). Har bir darsdan oldin pedagog ularga ishning asosiy qoidalarini eslatib turishi kerak. Bu o'quvchilarga o'z-o'zini tashkil etishga yordam beradi. Qoidalar o'rnatilishi, yozilishi yoki chizilishi (tasavvur qilinishi) kerak. Ular ko'p bo'lmasligi kerak va ma'lum bir vaqt oralig'i uchun tegishli bo'lishi kerak. Qoidalar qisqa iboralar bilan shakllantirilishi lozim, ularning har biri bolalar tomonidan tushunilishi va albatta qoidalarni ular bilan muhokama qilish kerak.

O'quvchilar bilan birgalikdagi badiiy va ijodiy faoliyat jarayonida usullar xarakterli kombinatsiyada qo'llaniladi. Usullar o'qituvchi yoki ota-ona tomonidan

belgilanadi.
bir qator omillarni hisobga olgan holda belgilashlar:

ta'limning maqsad va vazifalari;
bolalarning yoshi va individual xususiyatlari;
o'qituvchining o'ziga xos tayyorgarligi va mahorati;
o'quvchilar va ularning ota-onalarining ijodiy qobiliyatlarini rivojlantirish darajasi; ularning munosabatlarining tabiati va boshqalar.

Pedagogik dasturni metodologik amalga oshirish faqat san'atning salohiyatiga tayanadi, asosan ta'lim jarayonining barcha ishtirokchilari o'rtasida ijodkorlik va muloqot orqali bolaning shaxsiyatini umumiy rivojlantirishga qaratilgan. O'qituvchilar, o'quvchilar va ota-onalar o'rtasida badiiy va ijodiy faoliyatni tashkil etish usullari tizimi yagona maqsadga yo'naltirilgan va bu usullar bir-birini to'ldiradi.

Biz bilamizki, vizual faoliyatning asosiy vazifasi bolalarga biron bir narsa va hodisani tasvirlashni o'rgatish emas, balki uni bolalarga xos bo'lgan muammolarni yengish yoki yengillashtirishga qaratilgan muhim pedagogik vosita sifatida optimal ravishda qo'llashdir.

Yana bir muhim jihat - o'ziga ishonish va birgalikda ijod qilish jarayonidan zavqlanish. Bolaning yuzidagi sof zavqni ko'rish ming so'zga arziydi. Barcha bolalarga bu zavqni his qildirishga intilish kerak. "ASB bilan og'rigan bolalarning hissiy-ijodiy rivojlanishi: muammolari, metodologiya va diagnostika" Nogironligi bo’lgan bolalar qilayotgan ishlaridan zavqlanganda eng yaxshi va samarali tarzda o'rganadilar. Autizmli bolalar ham bundan mustasno emas. Ko'pgina autistik bolalar jamiyat tomonidan belgilangan standartlarga javob bera olmasligi mumkin. Rasm chizishni o'rganish ushbu cheklovlarni yengib o'tish va bir vaqtning o'zida san'at asarlarini yaratish, o'z ishlaridan zavqlanish imkoniyatini beradi.

Foydali natijalarga erishishga imkon beradigan katta va kichik maqsadli harakatlarni bajarish qobiliyatini rivojlantirishga, motor qobiliyatlariga alohida e'tibor qaratish kerak.

Autizmli bolalar uchun ta'lim faoliyatini qat'iy ko'rsatmalarga muvofiq tuzish muhimligiga qaramay, ba'zan faoliyatning belgilangan shaklini o'zgartirish, vazifalarning murakkabligini asta-sekin oshirish va yangi o'qitish usullarini joriy etish foydali bo'ladi. Biroq, bu juda ehtiyotkorlik bilan amalga oshirilishi kerak, bu bolaga o'zgarishlarga moslashish uchun vaqt beradi.

Faoliyatni rag'batlantirish uchun, ayniqsa darslarning boshida, shuningdek, sog'ligi yomonlashgan va qiyin vazifalar bajarilgan davrlarda, bolaning eng qimmatli qiziqishlaridan (ularni oldindan aniqlash va his qilish lozim) foydalanish kerak. Biroq, bu faoliyat bolaning yuqori qiziqishini uyg'otadigan tasvirlar bilan ishlash bilan cheklanishi kerak degani emas: har qanday ta'lim jarayonida bo'lgani kabi, oddiy, elementar harakatlarning qat'iy ketma-ketligi juda muhimdir.

Hayotiy ko'nikmalar. San'at orqali autizmli bolalar turli xil asosiy hayotiy ko'nikmalarni, xususan, muloqot va ijtimoiylashuvni rivojlantirishlari mumkin. Har bir insonning bu ko'nikmalarni o'zlashtirish qobiliyati har xil bo'lsa-da, ular autizmli bolalarni "normal" dunyoda hayotga tayyorlashda juda muhimdir.

San'at o'zining asl mohiyatida ma'no yaratish va ifoda etish, shaxsiy o'sishni rag'batlantirish haqida. U shakl va aqliy tasvirlarimizni aks ettirish vositasini taqdim etadi, deb ta'kidlash mumkin. Ehtimol, barchamizda muloqotga, taassurotlarimizni belgilash va shakl berish uchun ifoda shakllarini izlashga, mavjudligimizda haqiqiylik tuyg'usini olishga ichki ehtiyoj bordir.

O'z-o'zini bilish. O'z-o'zini bilish har bir inson hayotining ajralmas qismidir. San'at autizmga chalingan har qanday bolaga bu muhim jarayonda yordam berishi mumkin. Ijodiy ishning quvonchi o'ziga, o'z qobiliyatlari va salohiyatiga ishonchni rivojlantirishga yordam beradi. O'z-o'zini bilish har qanday odamga foydali ta'sir ko'rsatadi, chunki o'zini anglash orqali boshqalar ularni qanday qabul qilishini tushunish va dunyodagi o'rnini topish mumkin. Boshqacha qilib aytganda, o'z-o'zini tushunish autizmga chalingan bolalar uchun hayotga moslashishga yordam beradi.

Xulosa qilib aytganda, autizm spektri buzilishi bo'lgan bolalar bilan ishlashda ularning individual rivojlanish xususiyatlari, qiziqishlari va ehtiyojlarini hisobga olgan holda tashkil etilgan ta'lim muhiti muhim ahamiyat kasb etadi. Strukturaviy va vizual jihatdan aniq tashkil etilgan makon, puxta rejalashtirilgan mashg'ulotlar hamda izchil pedagogik yondashuv bolalarning mustaqilligi, o'zini o'zi boshqarish ko'nikmalari va ijtimoiy moslashuvini rivojlantirishga xizmat qiladi.

San'at va ijodiy faoliyat esa autizm spektri buzilishi bo'lgan bolalarning hissiy holatini barqarorlashtirish, muloqot va ijtimoiy ko'nikmalarini rivojlantirish, mayda motorikani takomillashtirish hamda o'z imkoniyatlarini namoyon etishlari uchun samarali pedagogik vosita hisoblanadi. Ijodiy jarayon davomida bolalar nafaqat yangi bilim va ko'nikmalarni egallaydilar, balki o'ziga bo'lgan ishonchni mustahkamlaydi, atrofdagilar bilan hamkorlik qilishni va o'z his-tuyg'ularini erkin ifodalashni ham o'rganadilar. Shu bois autizm spektri buzilishi bo'lgan bolalar bilan olib boriladigan pedagogik faoliyatda individual yondashuv, ota-onalar va mutaxassislarning hamkorligi hamda san'atga asoslangan rivojlantiruvchi metodlardan tizimli foydalanish ularning har tomonlama rivojlanishi va jamiyat hayotiga muvaffaqiyatli integratsiyalashuvining muhim omillaridan biri hisoblanadi.

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THE EFFECT OF PLANT DENSITY ON THE YIELD OF SWEET CORN

Annotation. *Sweet corn (Zea mays L. saccharata) is an important vegetable crop valued for its high nutritional quality, relatively short growing period, and increasing demand in fresh and processed food markets. Among the agronomic factors affecting sweet corn productivity, plant density plays a particularly important role because it determines the spatial distribution of plants and their access to light, water, mineral nutrients, and soil resources. This article examines the influence of plant density on the growth, yield formation, and quality characteristics of sweet corn. A literature-based analytical approach was used to evaluate the relationship between plant population and individual plant productivity. The analysis indicates that increasing plant density can enhance yield per unit area up to an optimum level; however, excessive density intensifies competition among plants and may reduce ear size, individual ear weight, kernel development, and marketable yield. Conversely, excessively low density can improve the development of individual plants but may result in inefficient utilization of the production area.*

Keywords: *sweet corn, Zea mays saccharata, plant density, plant population, yield, ear weight, ear size, crop productivity, vegetable maize, crop management.*

Introduction. Sweet corn (*Zea mays* L. saccharata) is an economically valuable vegetable crop cultivated for fresh consumption, processing, and various food products. Unlike grain maize, sweet corn is harvested at the milk stage, when the kernels contain high concentrations of soluble sugars and possess desirable sensory characteristics. The crop has a relatively short production cycle, which makes it suitable for intensive vegetable production and, in favorable climatic conditions, for repeated cropping systems.

The productivity of sweet corn depends on the interaction of genetic characteristics and environmental and agronomic factors. Cultivar selection, planting date, soil fertility, irrigation, mineral nutrition, weed control, and plant density all influence crop development and final yield.

Plant density is particularly important because it determines the number of plants occupying a given area. Increasing the number of plants per hectare can potentially increase total ear production per unit area. However, each plant has a limited amount of space and available resources. When plant density becomes excessive, competition for sunlight, water, nutrients, and root-zone space becomes stronger.

Materials and Methods. This study was prepared using a scientific literature-based analytical approach focusing on the relationship between sweet corn plant density and yield formation.

The principal factor considered was plant density, expressed as the number of plants per unit of cultivated area. Plant density can be modified through changes in row spacing and intra-row plant spacing.

The following growth and productivity indicators were considered for evaluating the effect of plant density:

- plant height;
- number of leaves per plant;
- leaf area;
- stem development;
- ear formation;
- ear length;
- ear diameter;
- number of kernels per ear;
- individual ear weight;
- proportion of marketable ears;
- total yield per unit area;
- marketable yield.

The theoretical relationship between plant density and yield can be represented as:

Total yield = plant population × average yield per plant.

This relationship demonstrates why increasing plant density does not automatically result in proportional yield increases. If plant population increases while the productivity of each plant declines substantially, total yield may eventually reach a plateau or decrease.

Discussion. Plant density strongly influences the spatial environment in which sweet corn plants develop. At low density, plants generally have greater access to sunlight and soil resources. Their leaves can occupy a larger spatial area, and individual plants may develop stronger stems and more extensive root systems.

As plant density increases, competition for available resources becomes stronger. Neighboring plants begin to intercept a greater proportion of available solar radiation, while their root systems occupy overlapping soil zones.

One of the most important consequences of dense planting is modification of the crop canopy. A sufficiently dense canopy can improve light interception at the field level, which may increase total photosynthetic productivity. However, excessive density can cause mutual shading, particularly within the lower and middle portions of the canopy.

The optimum density is therefore associated with a canopy structure capable of capturing available radiation efficiently without creating excessive competition among individual plants. **Table 1. General relationship between plant density and sweet corn productivity**

Plant density	Competition level	Individual plant development	Ear characteristics	Expected field productivity
Low	Low	Strong	Larger ears	Moderate
Moderate	Balanced	Good	Uniform, well-developed ears	High
High	Increased	Restricted	Smaller individual ears may occur	High to moderate
Excessively high	Very high	Strongly restricted	Reduced size and quality	May decline

Conclusion. Plant density is a major agronomic factor influencing the productivity and quality of sweet corn. Increasing plant population can improve the utilization of cultivated land and increase the number of ears per unit area. However, excessive density intensifies competition for light, water, nutrients, and soil space, which may reduce individual plant productivity and negatively affect ear size and marketability.

The highest plant population should therefore not automatically be considered the most productive option. An optimum density must provide an appropriate balance between the number of plants per hectare and the productivity of individual plants.

The response of sweet corn to plant density is influenced by cultivar characteristics, soil fertility, irrigation regime, planting date, climatic conditions, and the intended use of the harvested product. For this reason, locally adapted field experiments are necessary to determine the most suitable density for a particular production system. Optimizing plant density together with balanced fertilization, adequate irrigation, appropriate planting dates, and effective crop protection can improve resource-use efficiency and contribute to stable production of high-quality sweet corn.

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THE IMPORTANCE OF PLANTING TIME IN INCREASING ROOT MASS OF SWEET CORN

Annotation. *Sweet corn (Zea mays L. saccharata) is an important vegetable crop with high nutritional and economic value. The formation and development of the root system play a major role in determining plant growth, nutrient uptake, water utilization, resistance to environmental stresses, and final productivity. Planting time is one of the key agrotechnical factors influencing root development because it determines the temperature, moisture, and other environmental conditions during seed germination and subsequent plant growth. This article discusses the importance of planting time in increasing the root mass of sweet corn and explains the relationship between soil temperature, moisture availability, root growth, and plant development. Early planting under unfavorable soil temperature conditions may delay germination and restrict root development, while excessively late planting can expose plants to high temperatures and moisture deficiency.*

Keywords: *sweet corn, planting time, root mass, root system, soil temperature, soil moisture, plant growth, yield, agrotechnology.*

Introduction. Sweet corn is widely cultivated as a vegetable crop because of its pleasant taste, high carbohydrate content, vitamins, minerals, and relatively short growing period. The productivity and quality of sweet corn are determined by genetic characteristics as well as environmental and agrotechnical factors. Among these factors, planting time has a particularly important role because it affects the environmental conditions under which seeds germinate and plants establish their root and above-ground systems. The root system is the primary organ responsible for absorbing water and mineral nutrients from the soil. A well-developed root system provides plants with better access to soil moisture and nutrients and increases their ability to tolerate temporary environmental stresses. In sweet corn, intensive root development during the early stages of vegetation is especially important because it supports rapid leaf formation and subsequent accumulation of assimilates.

Materials and Methods. The study was based on an analysis of the biological characteristics of sweet corn and the influence of different planting periods on root development. The research approach considered the relationship between planting date, soil temperature, soil moisture, duration of seed germination, and accumulation of root biomass.

Sweet corn plants were considered under different planting periods corresponding to early spring, optimal spring, and relatively late planting

conditions. During the vegetation period, the development of the root system was evaluated at different plant growth stages.

The main indicators considered were:

- duration of seed germination;
- seedling emergence rate;
- root length;
- number of developed lateral roots;
- fresh root mass;
- dry root mass;
- root-to-shoot growth relationship;
- general plant vigor.

Root samples can be collected by carefully excavating individual plants together with the surrounding soil. The roots are washed with water to remove soil particles and then separated from the above-ground part. Fresh root mass is determined immediately after sampling. For determination of dry biomass, root samples are dried to a constant weight and subsequently weighed.

Soil temperature and moisture are important environmental indicators when evaluating the effect of planting time. The obtained observations are compared among planting periods to determine the conditions that contribute to intensive root formation.

Discussion. Effect of planting time on root development

Planting time has a direct influence on the initial development of sweet corn roots. Following sowing, the seed requires adequate moisture and temperature for rapid germination. The speed and uniformity of emergence subsequently determine the beginning of active root development.

When sweet corn is planted during a period with favorable soil temperature and sufficient moisture, the seed germinates more rapidly. Seedlings establish their primary roots quickly, followed by the formation of lateral and nodal roots. As the root system expands, the plant obtains access to a larger volume of soil, which improves water and nutrient uptake.

Planting too early can have the opposite effect. Low soil temperatures slow physiological processes associated with germination and root growth. Under such conditions, seedlings may emerge unevenly and remain weak for a longer period. Delayed root development can subsequently limit nutrient uptake and reduce the plant's ability to utilize favorable conditions later in the growing season.

Late planting can also negatively influence root biomass. Although warm soil promotes rapid germination, excessively high temperatures combined with reduced soil moisture may restrict root elongation and branching. In addition, high evaporative demand increases water consumption, creating conditions in which the young root system must develop under greater moisture stress.

Relationship between soil temperature and root mass

Soil temperature is one of the most important factors determining the early growth of sweet corn. The metabolic activity of germinating seeds and young roots

depends strongly on temperature. Under moderate and favorable temperatures, root cells actively divide and elongate, resulting in greater root length and biomass.

An appropriate planting period therefore provides a balance between temperature and moisture. This balance is more important than temperature alone because high temperatures cannot compensate for inadequate soil moisture.

The formation of a large root mass is generally associated with a greater capacity to absorb nutrients and water. Plants with stronger root systems are better able to maintain active leaf growth and photosynthetic activity. Consequently, the effect of planting date on root biomass may also indirectly influence the development of the above-ground plant and final ear formation.

Influence of soil moisture. Soil moisture is particularly important during the germination and early vegetative stages. Adequate moisture ensures the absorption of water by seeds and supports cell expansion during root growth.

Under irrigated conditions, maintaining appropriate soil moisture can reduce the negative effects of unfavorable weather conditions. However, excessive soil moisture may also limit root respiration by reducing soil aeration. Therefore, the most favorable conditions for root development are created when the soil contains sufficient moisture while maintaining adequate air exchange.

The interaction between planting date and irrigation is particularly important in repeated sweet corn production. Crops planted during warmer periods require more careful irrigation management because evaporation and plant water consumption increase.

Conclusion. Planting time is an important agrotechnical factor determining the formation and accumulation of root mass in sweet corn. The development of the root system depends strongly on the combination of soil temperature, moisture, aeration, and the duration of favorable growing conditions.

Planting under excessively cold conditions can delay germination and restrict early root development, whereas very late planting may expose plants to high temperatures and moisture stress. In contrast, planting during an agronomically favorable period promotes rapid emergence, active root elongation, formation of lateral and nodal roots, and accumulation of root biomass.

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TA’LIM INFRATUZILMASI RIVOJLANISHINING HUDUDIY IQTISODIY KO‘RSATKICHLARGA TA’SIRI

Annotatsiya. *Mazkur maqolada ta’lim infratuzilmasining rivojlanishi va uning hududiy iqtisodiy ko‘rsatkichlarga ta’siri iqtisodiy-geografik nuqtayi nazardan tahlil qilingan. Tadqiqotda ta’lim infratuzilmasi, xususan, umumiy o‘rta ta’lim muassasalarining moddiy-texnik bazasi, hududiy joylashuvi, ta’lim xizmatlaridan foydalanish imkoniyati, o‘quvchilar soni va maktablar tarmog‘ining rivojlanishi bilan hududning iqtisodiy salohiyati o‘rtasidagi o‘zaro bog‘liqlik yoritilgan. Ta’lim infratuzilmasining inson kapitalini shakllantirish, mehnat resurslarining malakasini oshirish, mehnat unumdorligini ta’minlash hamda ishlab chiqarish samaradorligini yaxshilashdagi ahamiyati konseptual jihatdan asoslangan. Shuningdek, ta’lim sohasiga yo‘naltirilgan investitsiyalarning uzoq muddatli istiqbolda bandlik, mehnat unumdorligi, hududiy iqtisodiy faollik va boshqa makroiqtisodiy ko‘rsatkichlarga ta’sir mexanizmlari ko‘rib chiqilgan. Tadqiqot natijalari ta’lim infratuzilmasini rivojlantirishni nafaqat ijtimoiy, balki hududiy iqtisodiy rivojlanishning muhim omili sifatida baholash zarurligini ko‘rsatadi.*

Kalit so‘zlar: *ta’lim infratuzilmasi, hududiy iqtisodiyot, iqtisodiy ko‘rsatkichlar, inson kapitali, mehnat unumdorligi, ishlab chiqarish samaradorligi, ta’lim xizmatlari, iqtisodiy rivojlanish, investitsiya, hududiy tafovutlar.*

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THE IMPACT OF EDUCATIONAL INFRASTRUCTURE DEVELOPMENT ON REGIONAL ECONOMIC INDICATORS

Abstract. *This article analyzes the development of educational infrastructure and its impact on regional economic indicators from an economic-geographic perspective. The study highlights the interrelationship between educational infrastructure—specifically the material-technical base of general secondary education institutions, their spatial distribution, accessibility of educational services, student enrollment, and the development of the school network—and the region's economic potential. It provides a conceptual rationale for the importance of educational infrastructure in shaping human capital, enhancing labor force skills, ensuring labor productivity, and improving production efficiency. Furthermore, the study examines the mechanisms through which investments in the education sector influence employment, labor productivity, regional economic activity, and other macroeconomic indicators in the long term. The research findings demonstrate the necessity of viewing the development of educational infrastructure not merely as a social issue, but as a crucial factor in regional economic development.*

Keywords: *educational infrastructure, regional economy, economic indicators, human capital, labor productivity, production efficiency, educational services, economic development, investment, regional disproportion*

Ta’lim infrastrukturasi zamonaviy iqtisodiy geografiya va ijtimoiy geografiya fanlarining asosiy kategoriyalaridan biri sifatida, hududiy rivojlanishning barcha bosqichlari va shakllarida muhim belgilovchi rol o‘ynaydi. Ushbu tushuncha nafaqat oddiy moddiy obyektlar yig‘indisi – maktab binolari, jihozlar, kutubxonalar, axborot-kommunikatsiya texnologiyalari, balki kengroq ma’noda inson kapitalining hududiy shakllanishi, mehnat bozori talablariga mos ta’lim sifati, jamiyatdagi ijtimoiy tenglik va ijtimoiy mobilitet darajasi, shuningdek, makroiqtisodiy barqarorlikning hududiy asosi sifatida baholanadi [4, 6]. Ta’lim infrastrukturasining mavjudligi va uning hududiy optimal joylashuvi demografik jarayonlarga, urbanizatsiya sur’atlariga, iqtisodiy faollik darajasiga va aholining ijtimoiy kayfiyatiga ham bevosita ta’sir ko‘rsatadi. Shu nuqtayi nazardan qaralganda, ta’lim infrastrukturasi zamonaviy iqtisodiy geografik tahlillarda faqat xizmatlar sohasi emas, balki hududiy tizimlar rivojlanishining strategik resursi sifatida o‘rganilishi zarur [1].

Har bir hududda ta’lim infrastrukturasi tizimi o‘zining shakllanishida tabiiy geografik, iqtisodiy-demografik va transport-logistik omillar bilan o‘zaro murakkab va ko‘p qirrali aloqadorlikka ega [5, 7]. Ayniqsa, maktablarning hududiy joylashuvi, ularga bo‘lgan kirishuvchanlik darajasi, o‘quvchilarning xavfsiz va qulay sharoitlarda ta’lim olishini ta’minlash imkoniyatlari bevosita hududdagi transport infrastrukturasining rivojlanganligi, aholining joylashuv zichligi, iqtisodiy imkoniyatlari hamda davlat siyosatining hududiy manzilliligi bilan bog‘liq. Aholi zich joylashgan shaharlar va sanoat zonalarida ta’lim obyektlarining soni ko‘proq, sifati yuqori va kirishuvchanlik darajasi yaxshi bo‘lsa-da, chekka, tog‘li yoki cho‘l mintaqalarda bu ko‘rsatkichlar past, nomutanosib va ehtiyojga javob bermaydigan holatda bo‘lishi mumkin. Bu esa iqtisodiy geografik nuqtayi nazardan hududlar

o‘rtasida ijtimoiy tengsizlik va rivojlanish tafovutlari yuzaga kelishiga sabab bo‘ladi [6, 8].

Ta’lim infrastrukturasi deganda, birinchi navbatda, ijtimoiy infrastrukturaning eng muhim tarmoqlaridan biri bo‘lgan ta’lim tizimining tarmoqlari va unga oid obyektlar majmui, ushbu obyektlarning hududiy joylashuvi, moddiy-texnik holati, aholi ehtiyojlarini qondirish imkoniyati va xizmat ko‘rsatish sifati tushuniladi [7, 9]. Ta’lim infrastrukturasi o‘z tarkibiga maktabgacha ta’lim muassasalari (bolalar bog‘chalari), umumiy o‘rta ta’lim maktablari, o‘rta maxsus va kasb-hunar ta’lim muassasalari, oliy ta’lim muassasalari, pedagogik kadrlar resurslari, ularning kasbiy malakasi va soni, shuningdek, axborot-kommunikatsiya texnologiyalari, kutubxonalar, ta’lim jarayonini samarali tashkil etishga xizmat qiluvchi texnik vositalar, laboratoriyalar, sport va madaniyat inshootlarini o‘z ichiga oladi. Bu obyektlarning mavjudligi va sifati bevosita aholining ma’naviy-ma’rifiy darajasini belgilovchi omil sifatida baholanishi bilan birga, ularning hududiy tashkil etilishi esa iqtisodiy geografik jihatdan ijtimoiy tenglik va hududiy rivojlanish muvozanatini ta’minlashda strategik ahamiyatga ega bo‘lgan indikator hisoblanadi [2, 6].

Ta’lim infrastrukturasining iqtisodiy samaradorligini aniqlovchi asosiy omillardan biri – bu tizimning hududiy joylashuvi va kirishuvchanlik darajasidir. Aholining ta’lim muassasalariga jismoniy yaqinligi, yo‘l infrastrukturasining holati, jamoat transporti imkoniyatlari, internet tarmog‘iga ulanish imkoniyati, mobil va raqamli platformalarga qulaylik darajasi – bularning barchasi hududiy taqsimotda mezogeografik o‘ziga xosliklarga ega bo‘lib, ayni vaqtda iqtisodiy tengsizliklar manbai sifatida ham ko‘riladi. Aytaylik, tog‘li va cho‘l zonalarda joylashgan hududlar uchun maktab yoki kollejga borish masofasi, mavsumiy yo‘llarning yaroqsizligi yoki transport vositalarining yetishmasligi, ijtimoiy xizmatlar sifati va yetib borish darajasi past bo‘lgan holatlarda bu infrastrukturaning amaldagi iqtisodiy samaradorligi sust bo‘lishi mumkin [1, 5, 7]. Shunday ekan, ta’lim infrastrukturasining makro va mezogeografik tahlili orqali har bir hududda xizmatlar sifati va ularga bo‘lgan ehtiyoj darajasining uyg‘unligini baholash muhim hisoblanadi.

Moddiy-texnik baza va kadrlar bilan ta’minlanganlik darajasi ham ta’lim infrastrukturasining samaradorligiga bevosita ta’sir qiluvchi omillardandir. O‘quv jihozlari, fan laboratoriyalari, zamonaviy texnologiyalar, interaktiv uskunalar bilan jihozlangan maktablar, o‘qituvchilarning malaka darajasi, ularning kasbiy tayyorgarligi va hududiy taqsimoti kabi ko‘rsatkichlarning barchasi o‘quvchilarning bilim sifati va ta’lim tizimining barqaror ishlashiga ta’sir etadi. Ayni paytda, ijtimoiy-iqtisodiy jihatdan sust rivojlangan, uzoq va chekka hududlardagi maktablarda o‘qituvchilar yetishmasligi, eski binolarda ta’lim berilishi, zamonaviy texnika va vositalarning yetarli emasligi iqtisodiy geografik jihatdan nomutanosibliklarning yaqqol ko‘rinishidir. Shunday hududlarda ta’lim sifati past bo‘lishi nafaqat mehnat bozori talablariga mos kelmaydigan kadrlarga olib keladi, balki hududiy raqobatbardoshlikni susaytiradi va demografik inqirozlarni kuchaytiruvchi omilga ham aylanishi mumkin [6, 8].

Ayni vaqtda, yirik shaharlar va iqtisodiy markazlarda joylashgan ta’lim muassasalari yuqori tezlikdagi internet, ilg‘or texnologiyalar va ilg‘or kadrlar bilan ta’minlangan bo‘lsa, chekka va oraliq hududlarda bu ko‘rsatkichlar juda past bo‘lishi mumkin. Bu esa “raqamli nomutanosiblik” fenomenini yuzaga keltirib, hududlar o‘rtasidagi iqtisodiy geografik tafovutlarni chuqurlashtiradi. Iqtisodiy va ijtimoiy geografiya fanida ta’lim infrastrukturasi ijtimoiy infrastrukturaning strategik tarmoqlaridan biri sifatida, muayyan hududning ijtimoiy-iqtisodiy rivojlanish sur’atlari, mehnat resurslarining qayta ishlab chiqarilishi, bilimga asoslangan iqtisodiyotga o‘tish jarayoni va hududiy taraqqiyotga xizmat qiluvchi kadrlar salohiyatini shakllantirishda hal qiluvchi rol o‘ynaydi.

Mazkur infrastrukturaning hududiy tahlili orqali iqtisodiy geografik muhitga mos holda, resurslar va imkoniyatlarning joylashuvi, ta’lim xizmatlariga kirishuvchanlik darajasi va aholining ta’limiy ehtiyojlariga ko‘rsatilayotgan javob samaradorligi aniqlanadi. Aynan mana shu tahliliy asosda har bir hududda mavjud resurslarning taqsimoti va ta’lim xizmatlarining muvofiqligini aniqlash, kelajakdagi hududiy rejalashtirish va infrastrukturaviy siyosatni shakllantirishda muhim manba bo‘lib xizmat qiladi [11].

1-jadval.

Ta’lim infrastrukturasining ishlab chiqarish samaradorligi va makroiqtisodiy ko‘rsatkichlarga ta’siri (konseptual tahlil asosida)

Ta’lim infrastrukturasi tarkibiy elementi	Inson kapitaliga ta’siri	Ishlab chiqarish samaradorligiga ta’siri	Makroiqtisodiy ko‘rsatkichlarga kutilayotgan ta’siri
Umumiy o‘rta ta’lim muassasalari	Asosiy bilim va ko‘nikmalar shakllanishi, o‘rta malakali mehnat resurslari bazasi	Mehnat unumdorligini oshiradi, ijtimoiy mehnat taqsimotiga yo‘naltiradi	Ishsizlikning kamayishi, demografik mobillikning oshishi
O‘rta maxsus va kasb-hunar ta’limi	Sanoat va xizmat ko‘rsatish sohalari uchun kasbiy kadrlar tayyorlash	Mahalliy ishlab chiqarishni ta’minlaydi, import o‘rnini bosuvchi salohiyat yaratadi	Iqtisodiy faollik oshadi, YAIMda sektorlar balanslashadi
Oliy ta’lim va ilmiy markazlar	Innovatsion tafakkur, ilmiy salohiyat, yuqori malakali kadrlar shakllanishi	Innovatsion iqtisodiyotga o‘tish, texnologik yangilanish	Innovatsion indeks ortadi, tashqi investitsiyalar ko‘payadi
Transport va kommunikatsion kirishuvchanlik	Ta’limga teng imkoniyatlar yaratiladi, resurslardan foydalanish imkoniyati kengayadi	Qamrov kengayadi, malakali ishchi kuchi taqsimoti yaxshilanadi	Hududlararo tengsizlik kamayadi, migratsiya muvozanatlanadi
Raqamli ta’lim texnologiyalari	Bilimga tezkor va sifatli kirish, zamonaviy ko‘nikmalar egallash	Yangi texnologiyalarni tez joriy qilish, raqamli ishlab chiqarishni rivojlantirish	Raqamli iqtisodiyot rivojlanadi, ish unumdorligi ortadi

Jadval Muallif tomonidan ijtimoiy infrastrukturaning tarkibiga kiruvchi ta’lim infrastrukturasining tarmoqlari va ularning vazifalari bayon etilgan.

Ta’lim infrastrukturasi bilan ishlab chiqarish tarmoqlari va iqtisodiy ixtisoslashuv o‘rtasidagi uzviy bog‘liqlik ham iqtisodiy geografiyaning muhim tahlil obyekti hisoblanadi. Ayni bir tuman yoki mintaqada sanoat, qishloq xo‘jaligi, turizm yoki xizmat ko‘rsatish sohalari yetakchi yo‘nalish bo‘lsa, bu hududdagi ta’lim muassasalari tarmog‘i ham, odatda, mazkur yo‘nalishlarga mos kasbiy ta’lim tizimi bilan boyitilgan bo‘ladi. Masalan, neft-gaz sanoati rivojlangan hududlarda texnikum va kollejlar ko‘proq texnik mutaxassislar tayyorlashga ixtisoslashgan bo‘lsa, qishloq xo‘jaligiga yo‘naltirilgan mintaqalarda agrar kollejlar va maktablar bilan uzviy bog‘liqlik shakllanadi. Bu holatda ta’lim infrastrukturasi mehnat bozoriga uzluksiz kadrlar oqimini ta’minlovchi tizimli mexanizm sifatida ko‘riladi. Iqtisodiy geografik nuqtai nazardan qaraganda, bu holat hududiy iqtisodiy tizimlarning barqaror ishlashini, mahalliy kadrlar salohiyatining ortishini va migratsion bosimning kamayishini ta’minlovchi ijtimoiy-iqtisodiy omil sifatida baholanadi.

Ilm-fan va texnologiya asosida shakllanayotgan zamonaviy iqtisodiyotda, ayniqsa oliy va o‘rta maxsus ta’lim muassasalari orqali amalga oshirilayotgan fundamental va amaliy tadqiqotlar, hududiy innovatsion klasterlarning shakllanishi, ilmiy markazlarning texnoparklar bilan integratsiyasi va startap loyihalarning qo‘llab-quvvatlanishi makroiqtisodiy daromadlarning ortishiga xizmat qiladi. Bu jarayonda ta’lim infrastrukturasi ilmiy izlanishlar uchun maydon, kadr va texnik imkoniyatlar yaratib, uni ishlab chiqarish tarmoqlari bilan bog‘lovchi ko‘prik vazifasini bajaradi [10]. Ayniqsa, regionlarda mavjud iqtisodiy ixtisoslashuvga mos ravishda yo‘naltirilgan kasbiy ta’lim tizimining isloh qilinishi, tadbirkorlik va muqobil iqtisodiyot tarmoqlari bilan uyg‘unlashuvi makroiqtisodiy rivojlanishning sifat jihatidan o‘zgarishiga sabab bo‘ladi. Bu esa barqaror iqtisodiy o‘sish, sanoatning zamonaviylashuvi va eksport salohiyatining ortishiga xizmat qiladi.

Ta’lim infrastrukturasi orqali jamiyatda ijtimoiy mobillikni kuchaytirish, iqtisodiy resurslardan foydalanish imkoniyatlarini kengaytirish va regional tengsizliklarni kamaytirish ham makroiqtisodiy samaradorlikni oshiradi. Ijtimoiy mobillik – bu fuqarolarning ta’lim olish orqali o‘z iqtisodiy va ijtimoiy holatini yaxshilashi, yuqori daromadli mehnat bozoriga kirishi, mahalliy iqtisodiy muhitda faol rol o‘ynashi bilan bevosita bog‘liq. Ta’lim infrastrukturasi yaxshi rivojlangan hududlarda aholining bandlik darajasi, daromadi va kasbiy malakasi yuqori bo‘lib, bu makroiqtisodiy ko‘rsatkichlarda namoyon bo‘ladi. Aksincha, infrastruktura yetishmaydigan yoki zaif hududlarda yoshlar orasida ishsizlik, migratsion intilishlar, iqtisodiy passivlik va ijtimoiy ajralish kuchayadi.

Bundan tashqari, ta’lim infrastrukturasi sektori hududiy nomutanosibliklar fonida ham alohida o‘rin tutadi. Ayni bir davlat ichidagi iqtisodiy geografik farqlarning chuqurlashuvi yoki aksincha, yumshatilishi ko‘p jihatdan ta’lim infrastrukturasining qamrov darajasi, sifati, innovatsiyalarga integratsiyalashuvi va kirishuvchanlik imkoniyatlari bilan belgilanadi. Masalan, Qashqadaryo viloyatining

tog‘li yoki cho‘l hududlaridagi maktablar soni, ularning jihozlanganlik holati, raqamli texnologiyalarga ulanish imkoniyati past bo‘lsa, bu yerda inson kapitali zaif shakllanadi va natijada hududning makroiqtisodiy ko‘rsatkichlari (ishsizlik darajasi, yalpi ichki mahsulot ulushi, sanoat ishlab chiqarishi hajmi) salbiy tomonga og‘adi [4, 10]. Aksincha, ta’lim infrastrukturasi rivojlangan, innovatsion pedagogik yondashuvlar qo‘llanilayotgan, ta’lim texnologiyalariga erkin kirish mumkin bo‘lgan hududlarda ijtimoiy-iqtisodiy faollik yuqori, makroiqtisodiy barqarorlik va ichki investitsion jozibadorlik kuchli bo‘ladi [2].

Shu sababli, iqtisodiy geografik tadqiqotlarda ta’lim infrastrukturasi hududiy siyosatning markaziy elementi sifatida baholanadi. Ta’lim infrastrukturasi tizimi o‘zining murakkab hududiy tuzilmasi va ko‘p omilli bog‘liqliklari bilan ajralib turadi. Xususan, iqtisodiy geografik nuqtayi nazardan, uning shakllanishi va rivojlanishiga bir vaqtning o‘zida tabiiy omillar (relyef, iqlim, suv resurslari, seysmik holat), ijtimoiy-demografik omillar (aholi zichligi, yosh tarkibi, etnik tarkib), iqtisodiy-ijtimoiy omillar (hududiy yalpi mahsulot, mehnat bozorining hajmi, aholi bandligi), shuningdek, texnogen va siyosiy omillar (hududiy boshqaruv siyosati, investitsiya oqimlari, davlat dasturlari) ta’sir qiladi [2, 6].

Ta’lim infrastrukturasining iqtisodiy geografik kategoriyalar bilan o‘zaro aloqadorligi uning ijtimoiy-iqtisodiy hududlar kesimidagi funksional va resurs taqsimoti orqali yaqqol namoyon bo‘ladi. Masalan, yirik sanoat markazlari yaqinida joylashgan hududlarda ta’lim infrastrukturasi, ayniqsa texnik va kasb-hunar yo‘nalishlari rivojlangan bo‘lib, bu iqtisodiy ixtisoslashuvning bevosita ta’siridir. Bunga javoban, uzoq cho‘l yoki tog‘li hududlarda maktablar soni, ta’lim sifati va moddiy-texnik ta’minoti past darajada bo‘lib, bu holat hududiy infrastrukturaviy nomutanosibliklarni yuzaga keltiradi. Shunday ekan, ta’lim infrastrukturasi iqtisodiy geografik kategoriyalar bilan o‘zaro aloqador holda o‘rganilganda, hududiy rivojlanishning ijtimoiy barqarorligini ta’minlovchi vosita sifatida ko‘riladi.

Umuman olganda, ta’lim infrastrukturasining mohiyati va iqtisodiy geografik kategoriyalar bilan uzviy aloqadorligi uni iqtisodiy tahlil, hududiy tashkil etish, infrastrukturaviy barqarorlik, ijtimoiy tenglik va hududiy rivojlanish tizimlarida strategik yo‘nalish sifatida o‘rganishni talab etadi. Bu esa nafaqat iqtisodiy geografiya fanining nazariy asoslarini boyitadi, balki amaliyotda ta’lim siyosatini shakllantirishda, hududiy rejalashtirishda va ijtimoiy infrastrukturalarni takomillashtirishda muhim metodologik vosita bo‘lib xizmat qiladi.

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QASHQADARYO VILOYATI UMUMTA’LIM MUASSASALARIDA QUYOSH PANELLARIDAN FOYDALANISHNING IQTISODIY-GEOGRAFIK TAHLILI

Annotatsiya. *Mazkur maqolada Qashqadaryo viloyati umumta’lim muassasalarida quyosh panellaridan foydalanish holati iqtisodiy-geografik nuqtai nazardan tahlil qilingan. Tadqiqotda maktablarning energetik infratuzilmasini rivojlantirishda muqobil energiya manbalarining o‘rni, quyosh panellarining hududlar kesimidagi taqsimlanishi hamda ularning umumiy quvvati baholangan. Quyosh panellarining samaradorligiga ta’sir etuvchi tabiiy va texnik omillar, jumladan geografik joylashuv, quyosh radiatsiyasi, panel quvvati va foydalanish sharoitlari yoritilgan. Shuningdek, quyosh energiyasidan foydalanish natijasida elektr energiyasi xarajatlarini kamaytirish, byudjet mablag‘larini tejash va qo‘shimcha iqtisodiy foyda olish imkoniyatlari tahlil etilgan. Tadqiqot natijalari hududlarda energetik infratuzilmani takomillashtirish, maktablarning energiya ta’minoti barqarorligini oshirish hamda ekologik toza energiya manbalaridan samarali foydalanish bo‘yicha ilmiy-amaliy tavsiyalar ishlab chiqishga xizmat qiladi.*

Kalit so‘zlar: *ta’lim infratuzilmasi, umumta’lim maktablari, quyosh panellari, muqobil energiya, energetik infratuzilma, qayta tiklanuvchi energiya manbalari, energiya samaradorligi, iqtisodiy-geografik tahlil, Qashqadaryo viloyati, hududiy rivojlanish.*

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ECONOMIC-GEOGRAPHICAL ANALYSIS OF THE USE OF SOLAR PANELS IN GENERAL EDUCATION INSTITUTIONS OF THE KASHKADARYA REGION

Abstract. *This article analyzes the use of solar panels in general education institutions of the Kashkadarya region from an economic-geographic perspective. The study evaluates the role of alternative energy sources in developing the schools' energy infrastructure, as well as the regional distribution and total capacity of the solar panels. It examines the natural and technical factors influencing solar panel efficiency—including geographical location, solar radiation, panel capacity, and operating conditions. Furthermore, the study analyzes the potential for reducing electricity costs, saving budget funds, and generating additional economic benefits through the use of solar energy. The research findings serve as a basis for developing scientific and practical recommendations to improve regional energy infrastructure, enhance the stability of school energy supplies, and ensure the efficient use of environmentally friendly energy sources.*

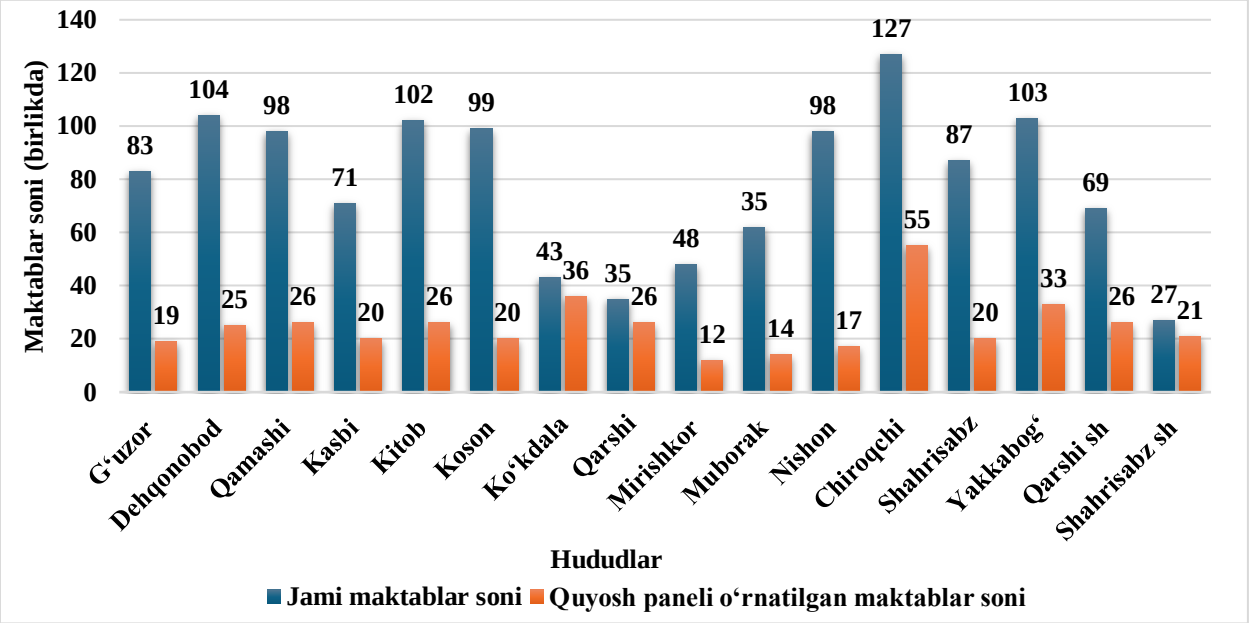
Keywords: *educational infrastructure, general education schools, solar panels, alternative energy, energy infrastructure, renewable energy sources, energy efficiency, economic-geographic analysis, Kashkadarya region, regional development.*

So‘nggi yillarda dunyo miqyosida qayta tiklanuvchi energiya manbalaridan samarali foydalanish ekologik barqarorlikni ta’minlash, energiya resurslarini tejash hamda iqtisodiy samaradorlikni oshirishning muhim yo‘nalishlaridan biri sifatida e’tirof etilmoqda. Ta’lim muassasalari ham ushbu jarayonlardan chetda qolmay, ularning energetik infratuzilmasini modernizatsiya qilishda muqobil energiya manbalarini keng joriy etish dolzarb masalaga aylanmoqda. Ayniqsa, quyosh energiyasidan foydalanish elektr energiyasi xarajatlarini kamaytirish, energiya ta’minotining uzluksizligini ta’minlash va ekologik toza ta’lim muhitini yaratishda muhim ahamiyat kasb etadi.

Qashqadaryo viloyati quyosh radiatsiyasi yuqori bo‘lgan hududlardan biri hisoblanib, bu yerda umumta’lim muassasalarida quyosh panellaridan foydalanish uchun qulay tabiiy sharoit mavjud. Shu sababli viloyat maktablarida quyosh panellarining joriy etilish darajasi, ularning hududlar kesimidagi taqsimlanishi, umumiy quvvati hamda samaradorligiga ta’sir etuvchi geografik va texnik omillarni tahlil qilish ta’lim infratuzilmasini rivojlantirish nuqtai nazaridan muhim ilmiy va amaliy ahamiyatga ega. Ushbu bo‘limda Qashqadaryo viloyati umumta’lim muassasalarida quyosh panellaridan foydalanish holati hamda uning energetik infratuzilmani takomillashtirishdagi o‘rni tahlil qilinadi.

Qashqadaryo viloyatida mavjud bo‘lgan 1256 ta maktabdan 396 tasida muqobil energiya manbai sifatida elektroenergiya ta’minotida quyosh panellaridan foydalanilmoqda (1-rasm). Ushbu maktablarga o‘rnatilgan quyosh panellarining umumiy quvvati 5013,7 kVt/s ga teng. Tumanlar kesimida quyosh panellari o‘rnatilgan maktablar soni va quvvati bir qancha tabiiy va texnik omillarga bog‘liq holda turlicha. Ya’ni, maktabning joylashgan geografik o‘rni, quyosh radiatsiyasining davomiyligi, o‘rnatilgan panel soni va hajmi, panelning samaradorligi – oddiy panellarda foydali ish koeffitsienti 20 % gacha, zamonaviy panellarda esa 25 % gacha bo‘lishi, panelning quyosh tushish burchagiga nisbatan

to‘g‘ri o‘rnatilganligi, havodagi chang va to‘zonlar natijasida hosil bo’ladigan quyosh nurining tarqoqlik darajasi kabi omillar ta’sir etadi.



1-rasm. Qashqadaryo viloyati ma’muriy hududlari kesimida Quyosh panellari o‘rnatilgan maktablar.

Chiroqchi tumanida 55 ta maktabda umumiy quvvati 351 kVt/s, Ko‘kdala tumanida 36 ta maktabda umumiy quvvati 501,3 kVt/s, Qamashi tumanida 26 ta maktabda quvvati 436 kVtni tashkil etsa, Kitob tumanida 26 ta maktabda quvvati 352 kVt/s ga teng. Qashqadaryo viloyati bo‘yicha 396 ta umumiy o‘rta ta’lim maktabida o‘rnatilgan quyosh panellarining umumiy quvvati 5013,7 kVt/s bo’lib, har bir maktabga hisoblaganda o‘rtacha 12,6 kVt/s to‘g‘ri keladi. Qamashi tumanida 17,8 kVt/s, Mirishkor tumanida 17 kVt/s, Qarshi shahrida 19 kVt/s, Chiroqchi tumanida 6 kVt/s, Muborak tumanida 9 kVt/s ni tashkil etadi [6, 7]. O‘rtacha har bir maktabga sarflanadigan elektroenergiya miqdori maktablardagi mavjud sig‘im ko‘rsatkichlaridan kelib chiqib turlicha hisoblanadi. Masalan, Qashqadaryoda har bir maktabga to‘g‘ri keladigan o‘quvchilar sonidan (535 nafar) kelib chiqib hisoblasak, 500-600 nafar o‘quvchi sig‘imiga ega bo‘lgan maktablar oyiga o‘rtacha 1500-2500 kVt/s elektroenergiya ehtiyojiga ega. Statistik ma’lumotlardan ma’lumki, quvvati 1 kVt bo‘lgan quyosh paneli bir yilda o‘rtacha 1700 kVt elektroenergiya ishlab chiqaradi. Viloyat bo‘yicha quyosh panellari o‘rnatilgan maktablarda o‘rtacha quvvat 12,7 kVt bo‘lib, yillik 21600 kVt soatga teng. Bu quvvatni oylar kesimiga hisoblaganimizda quyosh paneli o‘rnatilgan maktablarda elektroenergiyaga bo‘lgan ehtiyojning 75 % ini qoplab berishini bilish mumkun. Viloyatdagi ma’muriy hududlar kesimida quyosh panellari yordamida ishlab chiqarilgan elektroenergiya natijasida, umumiy o‘rta ta’lim maktablaridagi elektr uchun to‘lanadigan mablag‘ kamayadi, ortiqcha elektr energiyasi sotiladi va byudjet mablag‘lari tejaladi. Buning natijasida hududlar kesimida ushbu tarmoqdan tushgan iqtisodiy foyda miqdori kelib chiqadi [1, 3].

Quyosh panellaridan tushgan mablag‘ viloyat bo‘yicha 1 milliard 514 mln so‘mni tashkil etadi. Bu raqamni quyidagicha tahlil qilish mumkun. Qashqadaryo viloyati umumiy o‘rta ta’lim maktablariga ajratilgan mablag‘larning umumiy yillik qiymati har bir maktabga o‘rtacha 1 mlrd 194 mln so‘mni tashkil etadi. Demak, energetik infrastruktura elementi hisoblangan quyosh panellaridan tushadigan mablag‘ o‘rtacha viloyatdagi bitta maktabning davlat tomonidan ajratiladigan mablag‘ qiymatiga teng. Qashqadaryo viloyatida umumiy o‘rta ta’lim muassasalari infrastrukturasining iqtisodiy geografik tahlili shuni ko‘rsatadiki, maktablarning suv ta’minoti, isitish tizimi va moddiy-texnik bazasida hududiy nomutanosibliklar mavjud bo‘lib, ular bevosita tabiiy geografik sharoit, aholi zichligi, iqtisodiy faol zonalar joylashuvi hamda transport infrastrukturasi bilan chambarchas bog‘liqdir.

Tog‘li va cho‘l mintaqalarda joylashgan tumanlarda ta’lim muassasalari resurslarga yetarlicha ega emasligi, kommunikatsion tarmoqlarning sustligi va suv ta’minoti bilan bog‘liq muammolar o‘quv jarayonining samaradorligini pasaytirmoqda. Bunday hududlarda o‘quvchilarning sanitariya-gigiyena sharoitlari, isitish tizimining barqarorligi va energetik xavfsizligi zaif bo‘lib, bu holat inson kapitali sifatiga salbiy ta’sir ko‘rsatadi. Shu boisdan ta’lim infrastrukturasini iqtisodiy geografik yondashuv asosida takomillashtirish – ya’ni har bir tuman va aholi manzilgohining tabiiy-iqtisodiy imkoniyatlarini, demografik yuklamasini va hududiy transport tarmog‘ini chuqur tahlil etgan holda rejalashtirish zarur ilmiy va amaliy yo‘nalish sifatida namoyon bo‘lmoqda [2, 4].

Viloyat umumta’lim maktablarida muqobil energiya manbalaridan, xususan quyosh panellaridan foydalanish amaliyoti kengayib borayotgani kuzatiladi. Quyosh panellarining o‘rnatilishi elektr energiyasi xarajatlarini kamaytirish, energiya ta’minoti barqarorligini oshirish hamda ekologik jihatdan toza energiyadan foydalanish imkonini bermoqda. Kelgusida quyosh energiyasidan foydalanish ko‘lamini kengaytirish, energiya samaradorligini oshirish va maktablarning muhandislik-kommunikatsiya infratuzilmasini takomillashtirish ta’lim muassasalarining barqaror rivojlanishiga xizmat qiladi.

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QASHQADARYO VILOYATI UMUMTA’LIM MAKTABLARI INFRASTRUKTURASINING HUDUDIY RIVOJLANISH DARAJASINI IQTISODIY GEOGRAFIK RAYONLASHTIRISH ASOSIDA BAHOLASH

Annotatsiya. *Mazkur maqolada Qashqadaryo viloyati umumta’lim maktablari infratuzilmasining hududiy rivojlanish darajasi iqtisodiy-geografik rayonlashtirish asosida baholangan. Tadqiqotning asosiy maqsadi viloyat hududlarida umumta’lim maktablari infratuzilmasining shakllanishi va rivojlanishidagi hududiy tafovutlarni aniqlash, ularni kompleks baholash hamda rivojlanish xususiyatlariga ko‘ra hududiy guruhlashdan iborat. Tadqiqotda umumta’lim maktablari soni, o‘quvchilar kontingenti, maktablarning moddiy-texnik ta’minoti, aholi zichligi, demografik salohiyat, maktablarning hududiy joylashuvi va transport-kommunikatsiya sharoitlari kabi ko‘rsatkichlardan foydalanilgan. Mazkur mezonlar asosida viloyat hududi Kitob–Shahrisabz, Dehqonobod–Chiroqchi va Qarshi–Koson rayonlariga ajratilib, har bir hududning ta’lim infratuzilmasini shakllantirishga ta’sir etuvchi asosiy omillar aniqlangan. Tadqiqot natijalari maktablar tarmog‘ini takomillashtirish, yangi ta’lim obyektlarini hududiy ehtiyoj asosida joylashtirish hamda istiqboldagi demografik o‘zgarishlarni hisobga olgan holda ta’lim infratuzilmasini rejalashtirishga xizmat qiladi.*

Kalit so‘zlar: *Qashqadaryo viloyati, umumta’lim maktablari, ta’lim infratuzilmasi, hududiy rivojlanish, iqtisodiy-geografik rayonlashtirish, hududiy tafovut, maktablar zichligi, o‘quvchilar kontingenti, demografik salohiyat, hududiy rejalashtirish.*

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ASSESSING THE LEVEL OF TERRITORIAL DEVELOPMENT OF GENERAL EDUCATION SCHOOL INFRASTRUCTURE IN THE

QASHQADARYO REGION BASED ON ECONOMIC-GEOGRAPHIC REGIONALIZATION

Abstract. *This article evaluates the level of regional development of general education school infrastructure in the Kashkadarya region based on economic-geographical zoning. The study aims to identify regional disparities in the formation and development of school infrastructure, conduct a comprehensive assessment, and group territories according to their development characteristics. The study considers the number of schools, student population, material and technical facilities, population density, demographic potential, school location, and transport and communication conditions. Based on these indicators, the territory of Kashkadarya region was divided into three zones: Kitab–Shahrisabz, Dehqonabad–Chirakchi, and Karshi–Kasan. The main factors influencing the development of educational infrastructure in each zone were identified. The results can be used to improve the school network, locate new educational facilities according to territorial demand, and plan educational infrastructure taking into account future demographic changes.*

Keywords: *Kashkadarya region, general education schools, educational infrastructure, regional development, economic-geographical zoning, regional disparity, school density, student population, demographic potential, territorial planning.*

Kirish. Ta’lim infratuzilmasi hududning ijtimoiy-iqtisodiy rivojlanishini ta’minlovchi muhim tarkibiy qismlardan biridir. Umumta’lim maktablarining soni, hududiy joylashuvi, sig‘imi va moddiy-texnik ta’minoti aholining demografik tarkibi, joylashuvi, tabiiy-geografik sharoitlari hamda transport-kommunikatsiya tizimining rivojlanganligi bilan chambarchas bog‘liq. Qashqadaryo viloyatida tabiiy sharoitlarning xilma-xilligi, tog‘li, tog‘oldi va tekislik hududlarining mavjudligi, aholi zichligining hududlar bo‘yicha turlicha taqsimlanganligi umumta’lim maktablari tarmog‘ining shakllanishida sezilarli hududiy tafovutlarni yuzaga keltiradi [2, 4].

Maktab infratuzilmasining rivojlanish darajasini aniqlashda faqat maktablar sonini hisobga olish yetarli emas. Bunda o‘quvchilar kontingenti, bir maktabga to‘g‘ri keladigan o‘quvchilar soni, aholi zichligi, maktablarning moddiy-texnik ta’minoti, transport qulayligi va hududning kelgusidagi demografik ehtiyojlarini kompleks hisobga olish talab etiladi. Shu jihatdan iqtisodiy-geografik rayonlashtirish hududlarning o‘ziga xos xususiyatlarini aniqlash, maktab infratuzilmasining rivojlanishidagi tafovutlarni hududiy jihatdan baholash va tegishli rejalashtirish choralarini ishlab chiqish imkonini beradi.

Tadqiqot metodologiyasi. Tadqiqotda iqtisodiy-geografik taqqoslash, statistik tahlil, hududiy guruhlash, rayonlashtirish va kartografik usullardan foydalanildi. Umumta’lim maktablari infratuzilmasining hududiy rivojlanishini baholashda maktablar soni, o‘quvchilar kontingenti, aholi zichligi, maktablar

zichligi, moddiy-texnik ta’minot, hududning tabiiy-geografik xususiyatlari va transport imkoniyatlari asosiy mezon sifatida olindi[1, 5].

Hududiy farqlarni aniqlashda ko‘rsatkichlarning o‘zaro nisbati va hududlarning geografik o‘xshashligi hisobga olindi. Ayniqsa, tog‘li, tog‘oldi va tekislik hududlarining ta’lim infratuzilmasiga ta’siri alohida baholandi. Mazkur yondashuv asosida Qashqadaryo viloyati umumta’lim maktablari infratuzilmasining hududiy tashkil etilishi uchta iqtisodiy-geografik rayonga ajratildi (1-jadval).

1. **Kitob–Shahrisabz rayoni**;
2. **Dehqonobod–Chiroqchi rayoni**;
3. **Qarshi–Koson rayoni**.

Kitob–Shahrisabz rayoni. Kitob–Shahrisabz rayoniga Kitob tumani, Shahrisabz shahri va tumani hamda Yakkabog‘ tumani kiradi. Mazkur hudud viloyatning tog‘oldi va tog‘li qismlarini qamrab oladi. Relyefning murakkabligi aholi punktlarining tarqoq joylashishiga, transport aloqalarining ayrim hududlarda murakkablashishiga va maktablarning xizmat ko‘rsatish radiusini kengaytirish zaruratiga olib keladi. Tog‘li hududlarda maktablarni joylashtirish tekislik hududlariga nisbatan ko‘proq xarajat talab qiladi. Bundan tashqari, qishloqlararo yo‘llarning mavsumiy holati, ayrim hududlarda aloqa va energiya ta’minotidagi muammolar maktab infratuzilmasidan foydalanish samaradorligiga ta’sir qilishi mumkin. Demografik jihatdan esa mazkur hududlarda o‘quvchilar kontingentining ortishi kuzatilmoqda. Jumladan, Yakkabog‘ tumanida o‘quvchilar sonining 52 ming nafarga yetishi mavjud maktablar tarmog‘iga tushadigan yuklamaning yuqoriligini ko‘rsatadi. Maktablar sonining 102 ta atrofida saqlanib qolishi bir maktabga to‘g‘ri keladigan o‘quvchilar sonining ortishiga sabab bo‘lishi mumkin. Shahrisabz shahrida yangi maktablarning tashkil etilishi esa aholi konsentratsiyasi va ta’lim xizmatlariga bo‘lgan talabning ortib borayotganini ko‘rsatadi [3, 4, 6]. Mazkur rayon uchun maktab infratuzilmasini rivojlantirishda mavjud maktablarni rekonstruksiya qilish, chekka aholi punktlaridagi ta’lim obyektlarini modernizatsiya qilish va transport imkoniyatlarini yaxshilash muhim hisoblanadi.

Dehqonobod–Chiroqchi rayoni. Dehqonobod-Chiroqchi rayoniga Dehqonobod, G‘uzor, Qamashi, Chiroqchi va Ko‘kdala tumanlari kiradi. Mazkur hudud tabiiy sharoitiga ko‘ra tog‘oldi va tekislikka tutash hududlarni qamrab oladi. Rayonda aholining o‘rtacha zichligi nisbatan past bo‘lib, hudud iqtisodiyotida dehqonchilik, paxtachilik va chorvachilik muhim o‘rin tutadi. Aholi punktlarining tarqoq joylashishi ayrim qishloqlarda maktabgacha va umumiy o‘rta ta’lim obyektlariga bo‘lgan ehtiyojni oshiradi. Chiroqchi tumanida maktablar sonidagi o‘zgarishlarning bir qismi 2022-yilda Ko‘kdala tumanining tashkil etilishi bilan bog‘liq ma’muriy-hududiy o‘zgarishlar natijasidir. Mazkur hududda asosiy muammolar ichki transport yo‘llarining holati, ayrim hududlarda o‘qituvchilar yetishmovchiligi, maktablarning moddiy-texnik ta’minotidagi farqlar va o‘quvchilarni uzoq masofadan qatnash zarurati bilan bog‘liq. Shuning uchun Dehqonobod–Chiroqchi rayonida yangi maktablarni joylashtirishda nafaqat aholi

soni, balki aholi punktlari orasidagi masofa, o‘quvchilar oqimi va transport imkoniyatlarini ham hisobga olish lozim.

Qarshi–Koson rayoni. Qarshi–Koson rayoniga Qarshi shahri, Qarshi tumani, Kasbi, Koson, Mirishkor, Muborak va Nishon tumanlari kiradi. Mazkur hudud asosan tekislik relyefiga ega bo‘lib, transport va iqtisodiy aloqalarning nisbatan rivojlanganligi bilan ajralib turadi. Biroq hududda aholi va o‘quvchilar kontingentining yuqori konsentratsiyasi maktab infratuzilmasiga tushadigan bosimni oshiradi. Ayniqsa, Qarshi shahrida o‘quvchilar sonining 62 ming nafardan oshishi mavjud maktablarning sig‘imidan samarali foydalanish va yangi ta’lim obyektlariga bo‘lgan ehtiyojni kuchaytiradi. Tekislik hududlarida maktab qurilishi uchun tabiiy sharoit nisbatan qulay bo‘lsa-da, aholining tez o‘sishi va urbanizatsiya jarayonlari mavjud maktablar quvvatining yetarli bo‘lmasligiga olib kelishi mumkin. Ayrim hududlarda ikki smenali ta’limning saqlanib qolishi ham maktab infratuzilmasiga bo‘lgan talab yuqoriligini ko‘rsatadi. Qarshi–Koson rayonida yangi maktablarni qurish bilan bir qatorda mavjud maktablarni kengaytirish, zamonaviy o‘quv jihozlari bilan ta’minlash, sport va qo‘shimcha ta’lim obyektlarini rivojlantirish muhim yo‘nalishlardan hisoblanadi [5, 7].

Hududiy tafovutlarning asosiy omillari. Qashqadaryo viloyatida umumta’lim maktablari infratuzilmasining hududiy rivojlanishiga bir nechta omillar majmuaviy ta’sir ko‘rsatadi. Ularning ichida tabiiy-geografik, demografik, iqtisodiy va transport-geografik omillar asosiy o‘rinni egallaydi. Tog‘li hududlarda asosiy cheklov relyef va transport sharoitlari bilan bog‘liq bo‘lsa, tog‘oldi hududlarda aholi joylashuvi va transport tarmog‘ining notekisligi muhim ahamiyat kasb etadi. Tekislik hududlarida esa aholi va o‘quvchilar kontingentining yuqori bo‘lishi maktablar quvvatiga tushadigan yuklamani oshiradi. Shuningdek, maktablarning moddiy-texnik ta’minoti ham hududlar bo‘yicha bir xil emas. Ayrim chekka hududlarda maktab binolari, o‘quv jihozlari, sport inshootlari va raqamli ta’lim vositalarini modernizatsiya qilish zarurati yuqori. Ta’lim infratuzilmasini rivojlantirishda demografik prognozlardan foydalanish ham muhim. Chunki bugungi maktablar soni hududning kelgusidagi ehtiyojini to‘liq aks ettirmasligi mumkin. Aholi va o‘quvchilar sonining o‘sishi yangi maktablar qurilishi yoki mavjud maktablarning quvvatini oshirishni talab qiladi. Shu sababli maktab infratuzilmasini hududiy rejalashtirishda “maktablar soni – o‘quvchilar soni – aholi zichligi – transport masofasi – istiqboldagi demografik talab” o‘zaro bog‘liqligidan foydalanish maqsadga muvofiq.

1-jadval

Qashqadaryo viloyatining ichki rayonlarida ta’lim infrastrukturasining asosiy rivojlanish xususiyatlari

Rayonlar	Asosiy tuman va shaharlar	O‘rtacha aholi zichligi (kishi/km²)	Transport va aloqa imkoniyatlari	Asosiy iqtisodiy faoliyat turlari	Ta’lim infrastrukturasining holati
Kitob-Shahrisabz	Kitob, Shahrisabz, Yakkabog‘, Shahrisabz sh	869	Relyef tufayli yo‘llar tor va xavfli, ko‘plab qishloqlarga olib boruvchi yo‘llar mavsumiy yopiladi; mobil aloqa cheklangan	Bog‘dorchilik, uzumchilik, chorvachilik, tog‘-kon sanoati (sement), xizmat sohasi va turizm	Maktablar tarqoq joylashgan, kichik sig‘imli va moddiy-texnik jihatdan zaif; energetik ta’minot va isitish tizimi doimiy muammoga ega; ta’lim sifatida turg‘unlik kuzatiladi.
Dehqonobod-Chiroqchi	Dehqonobod, Chiroqchi, Qamashi, G‘uzor, Ko‘kdala	119,1	Asosiy avtomobil yo‘llariga yaqin, ammo ichki qishloqlarda yo‘llar asfaltlanmagan; aloqa tarmoqlari qamrovi o‘rtacha	Dehqonchilik, paxtachilik, chorvachilik,	Maktablar soni o‘rtacha, infrastruktura qisman ta’mirlangan; ayrim qishloq hududlarida maktabgacha ta’lim bilan qamrov past; sinf sig‘imi yetarli emas; ayrim joylarda o‘qituvchi yetishmovchiligi mavjud
Qarshi-Koson	Mirishkor, Muborak, Nishon, Kasbi, Koson, Qarshi, Qarshi sh.	675	Yo‘l tarmog‘i rivojlangan, ammo aholi tarqoq joylashgani sababli maktabgacha bo‘lgan masofa katta; shaharlararo aloqa yaxshi, ammo qishloqlarda tashuvchi transportga ehtiyoj yuqori	Neft-gaz qazib olish, paxtachilik, yaylov chorvachiligi, avtomobil xizmatlari	Maktablar soni kam, hududlararo maktablar zichlik darajasi ko‘p; markazlashgan tizim va zamonaviy texnik jihozlar yetarli emas; ayrim hududlarda 2 smenali ta’lim davom etmoqda

Tadqiqot natijalariga ko‘ra, Qashqadaryo viloyati umumta’lim maktablari infratuzilmasining rivojlanish darajasida hududiy tafovutlar mavjud bo‘lib, ular tabiiy-geografik, demografik, iqtisodiy va transport-geografik omillar ta’sirida shakllanmoqda.

Kitob–Shahrisabz rayonida asosiy cheklovlar murakkab relyef, aholi punktlarining tarqoqligi va transport sharoitlari bilan bog‘liq. Dehqonobod–Chiroqchi rayonida hududiy masofalar, demografik ehtiyoj, transport aloqalari va moddiy-texnik ta’minotdagi farqlar muhim ahamiyatga ega. Qarshi–Koson rayonida esa aholi va o‘quvchilar kontingentining yuqori konsentratsiyasi maktab infratuzilmasiga tushadigan yuklamani oshirmoqda. Shu asosda har bir rayon uchun differensial yondashuvni qo‘llash maqsadga muvofiq. Tog‘li hududlarda transport va kommunikatsiya tizimini yaxshilash, tog‘oldi hududlarda maktablar tarmog‘ini demografik o‘sishga moslashtirish, tekislik hududlarda esa mavjud maktablarni kengaytirish va yangi ta’lim obyektlarini barpo etish ustuvor yo‘nalishlar sifatida qaralishi mumkin. Umuman olganda, iqtisodiy-geografik rayonlashtirish yondashuvi Qashqadaryo viloyatida umumta’lim maktablari infratuzilmasini hududiy jihatdan baholash, mavjud tafovutlarni aniqlash va ta’lim obyektlarini istiqbolda oqilona joylashtirish uchun samarali ilmiy-metodik asos bo‘lib xizmat qiladi.

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QASHQADARYO VILOYATI TOG'LI HUDUDLARIDA YAYLOV RESURSLARIDAN FOYDALANISH SAMARADORLIGINI OSHIRISHNING IQTISODIY-GEOGRAFIK XUSUSIYATLARI

Annotatsiya. *Ushbu maqola Qashqadaryo viloyati tog'li hududlarida yaylov resurslaridan foydalanish samaradorligini oshirishning iqtisodiy-geografik yo'nalishlarini o'rganishga bag'ishlangan. Tadqiqotda tog'li hududlarda chorvachilikning tabiiy, ijtimoiy-iqtisodiy va hududiy xususiyatlari tahlil qilindi. Yaylov resurslarining hozirgi holati, ularning degradatsiyasi, chorva yuklamasi va foydalanish samaradorligi baholandi.*

Kalit so'zlar: *Qashqadaryo viloyati, tog'li hududlar, chorvachilik, yaylov resurslari, iqtisodiy-geografik tahlil, samaradorlik.*

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ECONOMIC-GEOGRAPHIC CHARACTERISTICS OF IMPROVING THE EFFICIENCY OF PASTURE RESOURCE USE IN THE MOUNTAINOUS AREAS OF THE KASHKADARYA REGION

Abstract. *This article is dedicated to examining the economic-geographic aspects of enhancing the efficiency of pasture resource utilization in the mountainous areas of the Kashkadarya region. The study analyzes the natural, socio-economic, and spatial characteristics of livestock farming in these mountainous regions. It evaluates the current state of pasture resources, including degradation, livestock stocking rates, and utilization efficiency.*

Keywords: *Kashkadarya region, mountainous areas, livestock farming, pasture resources, economic-geographic analysis, efficiency.*

Kirish. Bugungi kunda qishloq xo'jaligi tarmoqlarini barqaror rivojlantirish, ayniqsa chorvachilikni intensiv va samarali tashkil etish masalasi global miqyosda dolzarb ahamiyat kasb etmoqda. Aholi sonining ortib borishi, oziq-ovqat xavfsizligini ta'minlash zarurati hamda tabiiy resurslarga bo'lgan bosimning kuchayishi chorvachilik tarmog'ida mavjud resurslardan oqilona foydalanishni taqozo etadi. Shu nuqtai nazardan, yaylov resurslaridan samarali foydalanish chorvachilikni rivojlantirishning asosiy omillaridan biri hisoblanadi.

O‘zbekiston sharoitida, xususan, Qashqadaryo viloyatining tog‘li hududlarida chorvachilik yetakchi tarmoqlardan biri bo‘lib, mazkur hududlar keng yaylov maydonlari va tabiiy ozuqa bazasiga ega. Biroq, mavjud yaylov resurslaridan foydalanish samaradorligi yetarli darajada emas. So‘nggi yillarda chorva sonining ortib borishi, yaylovlardan tartibsiz foydalanish, tabiiy o‘simlik qoplamining degradatsiyasi hamda ekologik muammolar yaylovlarning mahsuldorligini pasaytirib yubormoqda. Tog‘li hududlarda yaylovlardan foydalanishning o‘ziga xos xususiyatlari mavjud bo‘lib, ular rel’yefning murakkabligi, iqlim sharoitining keskinligi, suv resurslarining notekis taqsimlanganligi bilan izohlanadi. Shu sababli, mazkur hududlarda yaylovlardan foydalanishni ilmiy asosda tashkil etish, ularning sig‘imini aniqlash, chorva yuklamasini me’yorlashtirish va zamonaviy boshqaruv mexanizmlarini joriy etish muhim vazifa hisoblanadi.

Asosiy qism. Qashqadaryo viloyati O‘zbekistonning janubi-g‘arbiy qismida joylashgan bo‘lib, uning tog‘li hududlari asosan Hisor-Olay tizmasining janubi-g‘arbiy qismi bilan qamrab olingan. Bu hududlar relyefi tog‘li va tepaliklardan iborat bo‘lib, yerning balandligi 500-3000 m gacha o‘zgaradi. Tog‘li hududlarning iqlimi kontinentli, yozda issiq va quruq, qishda esa sovuq bo‘lib, yog‘ingarchilik asosan bahor va kuz oylarida tushadi. Shu bilan birga, tog‘li hududlarda suv resurslari asosan tog‘ suv havzalari va kichik daryolar orqali ta’minlanadi, bu esa yaylovlarning sifatiga va chorvachilikning samaradorligiga bevosita ta’sir ko‘rsatadi.

Yaylovlar tog‘li hududlarda chorvachilikning asosiy oziqa manbai hisoblanadi. Ushbu hududlarning tabiiy xususiyatlariga qarab yaylovlarning turi va ularning ozuqa sig‘imi farqlanadi. Masalan, pasttekislik yaylovlari ko‘proq qoramolchilik uchun, baland tog‘ yaylovlari esa qo‘ychilik va echkilarga mos keladi. Tog‘li hududlarda yaylov resurslarining tabiiy ozuqa bazasi yil davomida o‘zgaruvchan bo‘lib, iqlim sharoitlariga qarab hosildorligi pasayishi yoki ortishi mumkin. Qashqadaryo viloyati tog‘li hududlarida yaylovlarning umumiy maydoni taxminan 320 ming gektarni tashkil etadi va ularning 60-70% tabiiy o‘simlik qoplamasidan iborat. Ushbu resurslardan samarali foydalanish chorvachilikning barqaror rivojlanishi va iqtisodiy rentabelligi uchun asosiy omil hisoblanadi.

So‘nggi yillarda Qashqadaryo viloyati tog‘li hududlarida chorvachilik rivojlanishi bilan bir qatorda, yaylov resurslaridan foydalanishning bir qator muammolari yuzaga kelgan. Ularning asosiylari quyidagilardan iborat:

Yaylov degradatsiyasi - ortiqcha chorva yuklamasi va mavsumiy nazoratsiz foydalanish natijasida o‘simlik qoplamasi pasayib, erozion jarayonlar kuchaymoqda. Masalan, viloyatning G‘uzor, Qamashi va Kitob tumanlaridagi past tog‘ yaylovlarida har 1 gektar yaylovga chorva yuklamasi normativdan 20-25% ortiq bo‘lmoqda.

Iqlim sharoitining keskinligi - tog‘li hududlarda qish mavsumida qor miqdori kam bo‘lishi va yozda yog‘ingarchilikning yetishmasligi yaylovlarning yil davomida samarali ishlatilishiga to‘sqinlik qiladi. Bu esa chorvachilik mahsulotlari ishlab chiqarishiga bevosita ta’sir qiladi.

Infratuzilmaning rivojlanmaganligi - tog‘li hududlarda suv manbalari yetishmasligi, chorvachilik uchun zarur bo‘lgan texnika va transport imkoniyatlarining cheklanganligi hayvonlarni boqish va yaylovlardan samarali foydalanish jarayonini qiyinlashtirmoqda.

Ekologik muammolar - yaylovlardan noto‘g‘ri foydalanish natijasida o‘simlik qoplamasi kamayishi, eroziya va to‘qimalarning degradatsiyasi kuchayib, hududning ekologik barqarorligi xavf ostida qolmoqda.

Viloyat tog‘li hududlarida chorvachilikni rivojlantirish uchun mavjud resurslardan samarali foydalanish darajasi hozirgi kunda 60-65% ni tashkil etadi. Bu esa iqtisodiy samaradorlikni oshirish va ekologik barqarorlikni ta’minlash uchun qo‘shimcha choralarni zarur qilmoqda.

Qashqadaryo viloyati tog‘li hududlarida chorvachilikni barqaror rivojlantirish va yaylov resurslaridan samarali foydalanishni ta’minlash uchun bir nechta asosiy yo‘nalishlar shundaki:

Rotatsion yaylov tizimini joriy etish - chorvachilik xo‘jaliklari yaylovlarni mavsumiy va zonal tartibda navbatma-navbat foydalanish orqali o‘simlik qoplamasini tiklash va degradatsiyani kamaytirishi mumkin. Bu tizim chorvachilik mahsulotlarining uzluksiz yetishtirilishini ta’minlaydi.

Yaylovlarni melioratsiya qilish va qayta tiklash - baland tog‘ yaylovlarida sun’iy o‘simlik ekish, sug‘orish va eroziyaga qarshi chora-tadbirlar orqali ozuqa bazasi yaxshilanishi mumkin. Masalan, G‘uzor tumanidagi tajribaviy yaylovlarda melioratsiya tadbirlari o‘simlik qoplamasini 25% ga oshirgan.

Chorva yuklamasini me’yorlashtirish - yaylovlarning har gektariga chorva yuklamasini normativ asosda belgilash orqali ortiqcha bosimni kamaytirish mumkin. Bu chorvachilik mahsulotlarining sifatini va ekotizimni saqlashga yordam beradi.

Zamonaviy monitoring va raqamli tizimlarni joriy etish - GIS texnologiyalari va masofadan boshqarish vositalari yordamida yaylovlarning holatini kuzatish, chorva soni va yaylov sig‘imini boshqarish samaradorligini oshiradi. Shu bilan birga, tarmoqni iqtisodiy jihatdan rejalashtirish osonlashadi.

Ijtimoiy-iqtisodiy mexanizmlar - davlat tomonidan investitsiya dasturlari, kredit va grantlar orqali chorvachilik xo‘jaliklariga qo‘llab-quvvatlashni kuchaytirish. Shu orqali tog‘li hududlarda barqaror chorvachilikni tashkil etish va mahalliy aholining bandligini oshirish mumkin.

Ushbu yo‘nalishlar amalga oshirilsa, Qashqadaryo viloyati tog‘li hududlarida yaylovlardan foydalanish samaradorligi 20-30% ga oshishi va chorvachilik mahsulotlarining ishlab chiqarilishi sezilarli darajada ko‘payishi mumkin. Shu bilan birga, ekologik barqarorlik saqlanadi va hududiy iqtisodiy samaradorlik yaxshilanadi.

Xulosa. Mazkur maqolada Qashqadaryo viloyati tog‘li hududlarida yaylov resurslaridan foydalanish samaradorligini oshirishning iqtisodiy-geografik yo‘nalishlari tahlil qilindi. Tadqiqot natijalari shuni ko‘rsatdiki, viloyat tog‘li hududlari chorvachilik tarmog‘ining rivojlanishi uchun katta tabiiy salohiyatga ega bo‘lib, yaylovlarning tabiiy ozuqa bazasi chorva boqishning asosiy manbai

hisoblanadi. Shu bilan birga, ortiqcha chorva yuklamasi, iqlim sharoitining keskinligi, infratuzilmaning rivojlanmaganligi va ekologik muammolar yaylov resurslaridan samarali foydalanishga to‘sqinlik qilmoqda.

Tog‘li hududlarda chorvachilikni barqaror rivojlantirish va yaylovlardan foydalanish samaradorligini oshirish uchun bir qator chora-tadbirlar tavsiya etildi. Ular orasida rotatsion yaylov tizimini joriy etish, melioratsiya va qayta tiklash ishlari, chorva yuklamasini me’yorlashtirish, zamonaviy monitoring va raqamli tizimlardan foydalanish, shuningdek, ijtimoiy-iqtisodiy mexanizmlarni kuchaytirish asosiy yo‘nalishlar sifatida belgilandi. Ushbu tavsiyalar amalga oshirilganda, yaylovlardan foydalanish samaradorligi sezilarli darajada oshishi, chorvachilik mahsulotlari ishlab chiqarilishi ortishi va hudud ekologiyasining barqarorligi ta’minlanishi mumkin.

Qashqadaryo viloyati tog‘li hududlarida chorvachilikni rivojlantirish bo‘yicha ilmiy asoslangan qarorlar qabul qilish, hududiy iqtisodiy rivojlanish dasturlarini shakllantirish va qishloq xo‘jaligi siyosatini takomillashtirishda amaliy ahamiyat kasb etadi. Natijada, maqola chorvachilik tarmog‘ining barqaror rivojlanishi, yaylov resurslaridan oqilona foydalanish va mahalliy aholining bandligini ta’minlashga hissa qo‘shadi.

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FEATURES AND METHODS OF TREATMENT OF ACUTE RHINOSINUSITIS IN PATIENTS

Abstract. *Among the pathologies of the upper respiratory tract that significantly worsened the patient's health and quality of life, inflammatory diseases of the nasal cavity and paranasal sinuses occupy one of the leading places. One of the leaders here is rhinosinusitis, primarily because of the widespread prevalence of this disease and its growth.*

The data on its actual epidemiology are extremely diverse: There are also inconsistencies in the criteria for making a diagnosis (clinical symptoms, results of an X-rayor diagnostic puncture of the paranasal sinuses (ONP), and low patient referral for professional help for mild forms of the disease, and the fact that rhinosinusitis often develops against the background of ARVI.

Key words:*acute rhinosinusitis, clinical and experimental characteristics,turmeric.*

Introduction. One way or another, experts estimate the annual prevalence of acute rhinosinusitis (ARS) in 6-15% of the general population [1]. According to some sources, at least one 8.4% of the population of the Netherlands suffers from an episode of ARS per year; in the USA – about 31 million person. The important medical and social significance of this disease is due not only to only by its high prevalence and negative impact on quality of life patients, but also high economic costs. Thus, in the United States In the United States, health care costs associated with sinusitis amount to approximately $6 billion per year[2].

In the world, according to rough estimates, about 10 million people annually suffer from acute rhinosinusitis. Those who studied the prevalence of individual Russian specialists note an increase in the nosological forms of ENT diseases ORS in our country: from 9.1 to 19.3 (per 1000 contingent)[3].

It is also worth noting another relevant aspect of the problem: ORS is one of the most common reasons for prescribing antibacterial drugs (ABP): in the USA 9% of antibiotic prescriptions for adults and 21% for children are written for A similar situation is observed in a number of other countries: in Canada, in 84% of cases When patients present with signs of this disease for the first time, they are prescribed systemic antibacterial drugs[4].

And if we take into account that such drugs are often appointments do not provide a statistically significant advantage, and in the etiology of ARS Experts recognize the leading role of viruses in the initiation of inflammation (acute rhinosinusitis has a bacterial etiology in 2-10% of cases), and bacterial Complications from the paranasal sinuses develop rarely (in 0.5%-2.0% of adults patients and 5% of children), the use of antibiotics in most cases is not justified[5,6].

Especially against the backdrop of the development of global resistance of pathogens microorganisms to ABP. Experts also draw the attention of clinicians to possible complications of antibiotic therapy, such as dysbiosis and hepatotoxicity.Thus, the use of antibacterial drugs in uncomplicated ORS forms are not recommended[7].

As is known, the etiopathogenesis of ARS is usually determined by rhinogenic infection with the respiratory tract (the main pathogens are rhinoviruses, respiratory syncytial viruses, adenoviruses, coronaviruses) through natural anastomoses, with with whose help aeration and drainage of the sinuses are carried out.Viruses get on mucous membrane and connect with intracellular adhesion molecules (a receptor that is constantly expressed on the epithelial cells of the cavity nose and nasopharynx), due to which they are capable of damaging the cilia of the ciliated epithelium and destroy the ciliated cells themselves[8]. Caused by a virus inflammation causes edema, plasma transudation and hypersecretion of glands. Edematous the mucous membrane of the ostiomeatal complex blocks natural anastomoses ONP. This disrupts the self-cleaning mechanism of the sinus, as well as absorption oxygen from the cavity of the blocked sinus into the blood vessels of the mucous membrane membranes, which leads to the development of hypoxia. Thus, the most important factors in the development of rhinosinusitis are inflammation and swelling of the nasal mucosa and sinuses, disruption of their aeration and drainage[9].

Initially, the concept of using intranasal glucocorticosteroids (GCS) for the treatment of potentially infectious conditions seemed at odds with most medical schools because of concerns associated with the possible negative impact of these medicinal products (MP) on the patient's immunity. However, subsequent studies have confirmed the possibility

use of InGCS in ARS. In addition to providing anti-inflammatory The action of intranasal glucocorticosteroids may be maintained or enhanced

local innate protective reactions of the patient (including the barrier function epithelium, phagocytosis in alveolar macrophages and secretion by epithelial cells substances that directly interact with microorganisms, etc.)[10].

Purpose of the study. Improve clinical and experimental characteristics in patients with rhinitis and improve the treatment of acute sinusitis.

Materials and research methods. We selected a total of 123 patients who applied to the otolaryngology department of the Medical Institute clinic with acute rhinosinitis in 2024-2025 to fulfill the assigned task

tasks for us.

Results. The main method of treatment of acute bacterial sinusitis is antibacterial therapy, which should be carried out taking into account the main causative agents of this disease, since the main factor in Bacterial flora is recognized in the pathogenesis of acute rhinosinusitis. In recent years,there is an increase in the resistance of most bacteria to antimicrobials drugs, which makes their treatment difficult. The observed growth of bacterial Antibiotic resistance is directly related to the frequency of their use.

In recent years, the antibiotic resistance system has received special attention be given to the role of biofilms. The term biofilm refers to a certain matrix,produced by bacteria. Biofilms can be formed by bacteria of one or several types. In clinical otolaryngology, the greatest importance attention is paid to the biofilms formed*Staphylococcus aureus*And*Streptococcus pneumoniae*[11].

High antibiotic resistance is explained by rapid exchange of plasmids DNA between biofilm bacteria and matrix impermeability for chemical drug molecules.Treatment of diseases of the nose and the OPN should be carried out in compliance principles of minimally invasiveness and be aimed at effective elimination pathological process, preservation and restoration of the functions of the mucous membrane.

During the treatment of inflammatory diseases of the nose and the OPN, it is necessary to rationally combine general measures of influence on the body with local treatment. The purpose of local treatment is to create optimal conditions for drainage of the inflammation site,suppression of local infection and stimulation of reparative processes.

Treatment of acute sinusitis is carried out depending on the degree of spread.Inflammation in the ONP, the number of sinuses involved in the process, the body's response and forms of inflammation. The main task in the treatment of acute sinusitis iseradication of the pathogen from the sinus, prevention of chronicity of the process and complications.

During treatment it is necessary to achieve restoration of the patency of natural anastomoses, functions of the mucociliary apparatus of the mucous membrane of the nose and sinuses,reducing the contamination of the mucous membrane with pathogenic microflora.

The main method of treatment of acute purulent sinusitis, according to the recommendations of the international document EPOS,is systemic antibiotic therapy, which is based on knowledge of the basics(typical) pathogens isolated from the c avity of the affected sinus. According to According to statistics, sinusitis is the fifth most common diagnosis,in the treatment of which antibiotics are used[12].

For the practicing physician in case of empirical antibacterial therapy it is necessary to focus on international and domestic data on sensitivity of the most probable pathogens to modern antibacterial drugs.Antibacterial drugs play a particularly important role in the treatment of sinusitis.In combination with local antibacterial drugs, many Domestic authors and international EPOS recommendations suggest the use of topical glucocorticosteroids, since intranasal corticosteroids do not suppress the mucociliary activity of the nasal epithelium and

the NSC,cause atrophic changes in the mucous membrane and have low systemic bioavailability.

Local decongestants(xylometozoline, levocabastine, naphazoline, oxymetazoline, tetryzoline, etc.) reduce swelling of the nasal mucosa and thus improving nasal breathing, while also improving drainage ONP.

Secretolytic (mucolytic) therapy, affecting mucociliary activity, according to a number of authors, must necessarily be included in the complex treatment of rhinosinusitis with the aim of thinning mucus and stimulating its removal, reducing its intracellular formation, changes in the nature of the secretion. Most often for systemic effects, drugs such as acetylcysteine, etc. are prescribed[13].

Puncture methodtreatment has both positive and negative effects sides. The advantages of the method are the possibility of fast and targeted evacuation of purulent discharge from the sinus, which corresponds to the fundamental principles of purulent surgery, however, due to the trauma and high risk due to complications, this method is used less and less in pediatric practice today.

Figure 1

Severity of symptoms (treatment of acute rhinosinusitis) in 123 patients before onset therapy and after 6 days of treatment with the drug turmeric solution (nasal douche)

- The number of patients with moderate or severe symptoms has decreased over the course ofs tudies from 48% at the beginning of the study to 6% after 6 days of therapy(Figure 1).

- None of the patients experienced severe symptoms during re-examination (compared to 5 patients at the beginning of the study).

- After 6 days of treatment, improvement in the condition was observed in 95% of patients, in 82%patients experienced the disappearance of all symptoms.

- The time to the first improvement in symptoms was 2.1±1.3 days from the start of therapy.

At the same time, local and general complications of maxillary puncture sinuses such as bleeding, needle penetration into the eye socket or into the cheek tissue are known with subsequent formation of phlegmon. Vascular embolism may also occur,anaphylactic and collapse reactions.

In the last decade, sinus puncture has given way to the YAMIK catheterization method. This method is based on the one proposed by A. Proetz displacement method [14]. The advantages of this method are its non-invasiveness, as well as the possibility of therapeutic effects on all ONP At the same time, the disadvantages are the lack of special sinus catheters in many hospitals, the need for special training of personnel, as well as the possibility infection of healthy sinuses[15].

Physiotherapy proceduresare also widely used in treatme ntsinusitis. However, if there is exudate in the ED before prescribing physiotherapy

it is necessary to empty them of their contents. The goal of physiotherapy for sinusitis is relief of inflammation, improvement of microcirculation and metabolism in tissues.Physical methods are prescribed to reduce the manifestations of intoxication (endonasal electrophoresis of various drugs, darsonvalization,

diadynamic therapy), reduction of manifestations inflammation (ultra-high frequency therapy, centimeter wave therapy,

laser therapy, ultrasound therapy) and immune dysfunction (laser irradiation blood, magnetic therapy of the thymus, ultraviolet radiation, air baths,thalassotherapy)[16,17].

Figure 2

General improvement of symptoms with the use of turmeric (nasal douche)

After 1-3 days of treatment, 43% of patients experienced an improvement in symptoms.After 4-7 days of treatment, most of the remaining children showed improvement.Overall, after 7 days of treatment, disease symptoms improved in 83% sick.

Conclusion. The topic raised in this review is far from exhausted - treatment issues patients with acute rhinosinusitis and the choice of productive and rational etiopathogenetic drug therapy remain relevant.Knowledge, extensive clinical data and extensive practical experience foreign and domestic experts in this field, which form the basis consent and recommendation documents make it easier for the practicing physician searching for answers to these questions.

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O‘ZBEKISTONDA UGLEROD SOLIG‘INI JORIY ETISH: XALQARO TAJRIBA, IQTISODIY ASOSLAR VA BOSQICHMA-BOSQICH YONDASHUV

Annotatsiya: *O‘zbekistonda 1 dollarlik yalpi ichki mahsulot yaratish uchun havoga 1 kilogramm karbonat angidrid (CO_2) chiqariladi – bu jahon o‘rtacha ko‘rsatkichidan 2,6 baravar ko‘p. 2026-yildan esa Yevropa Ittifoqi import qilinadigan mahsulotlardagi uglerod uchun to‘lov undirish mexanizmini to‘liq ishga tushirdi. Maqolada shunday sharoitda mamlakatimizda uglerod solig‘ini joriy etish qanchalik asosli ekani va buni qanday tartibda qilish oqilona bo‘lishi o‘rganilgan. Hisob-kitoblar shuni ko‘rsatdiki, 1 tonna CO_2 uchun atigi 5 dollarlik soliq budjetga yiliga qariyb 0,7 milliard dollar keltiradi, benzin narxini esa litriga taxminan 140 so‘mga oshiradi, xolos. Mualliflar soliqni chiqindilarni hisobga olish tizimini yaratishdan boshlab, emissiya savdo tizimi bilan uyg‘un holda to‘rt bosqichda joriy etishni va tushgan mablag‘ni aholini qo‘llab-quvvatlash hamda “yashil” loyihalarga yo‘naltirishni taklif etadi.*

Kalit so‘zlar: *soliq siyosati, ekologik soliqlar, uglerodga narx belgilash, uglerod solig‘i, emissiya savdo tizimi, CBAM.*

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INTRODUCING A CARBON TAX IN UZBEKISTAN: INTERNATIONAL EXPERIENCE, ECONOMIC RATIONALE, AND A PHASED APPROACH

Annotation: *Uzbekistan emits 1 kilogram of carbon dioxide (CO_2) for every dollar of gross domestic product, which is 2.6 times the world average. Since 2026, the European Union has fully launched its Carbon Border Adjustment Mechanism, which charges for the carbon embedded in imported goods. This paper examines whether introducing a carbon tax in Uzbekistan is justified under these conditions and how it could be implemented sensibly. Our estimates show that a tax of only 5 US dollars per tonne of CO_2 would bring about 0.7 billion US dollars to the budget each year, while raising the price of gasoline by roughly 140 soums per litre. The authors propose a four-stage rollout that starts with an emissions accounting system and is aligned with an emissions trading scheme, with revenues directed to household support and green projects.*

Keywords: *tax policy, environmental taxes, carbon pricing, carbon tax, emissions trading system, CBAM.*

KIRISH

So‘nggi o‘n yillikda uglerodga narx belgilash iqlim siyosatining asosiy vositalaridan biriga aylandi. Jahon banki ma’lumotlariga ko‘ra, 2025-yil boshida dunyoda 80 ta shunday vosita – uglerod solig‘i va emissiya savdo tizimlari ishlagan. Ular dunyodagi issiqxona gazlari chiqindilarining qariyb 28 foizini qamrab oladi va 2024-yilda davlat budjetlariga 100 milliard dollardan ortiq mablag‘ olib kelgan. O‘rtacha uglerod narxi ham shu davrda deyarli ikki baravar oshib, 2015-yildagi 10 dollardan biroz yuqori darajadan 2025-yilda 19 dollar atrofiga yetdi (World Bank, 2025).

O‘zbekiston uchun bu masala bir necha sababga ko‘ra dolzarb. Birinchisi – xalqaro majburiyatlar. Mamlakatimiz Parij kelishuvi doirasida 2030-yilgacha yalpi ichki mahsulot birligiga to‘g‘ri keladigan issiqxona gazlari chiqindisini 2010-yil

darajasidan 35 foizga kamaytirish majburiyatini olgan (Government of the Republic of Uzbekistan, 2021). “Yashil” iqtisodiyotga o‘tish strategiyasi va “O‘zbekiston – 2030” strategiyasida ham shu yo‘nalishdagi aniq maqsadlar belgilangan: 2030-yilgacha qayta tiklanuvchi energiya quvvatlarini 25 ming megavattga, ularning elektr energiyasi ishlab chiqarishdagi ulushini esa 54 foizga yetkazish (Institute of Legislation and Legal Policy, n.d.). Ikkinchisi – iqtisodiyotimiz hali ham ko‘p uglerod chiqaradi: 2024-yil hisobotiga ko‘ra, mamlakatda yiliga o‘rtacha 239 million tonna issiqxona gazlari (karbonat angidridga hisoblaganda) havoga chiqariladi.

Uchinchi sabab tashqi bozor bilan bog‘liq. Yevropa Ittifoqining chegara uglerod tuzatish mexanizmi 2026-yil 1-yanvardan to‘liq kuchga kirdi: endi Ittifoqqa mahsulot olib kiruvchilar undagi uglerod uchun haq to‘laydi, shu yilgi import uchun sertifikatlar esa 2027-yil fevralidan sotila boshlaydi (European Parliament & Council of the European Union, 2025).[13] Muhimi, mexanizm eksportchi mamlakatda allaqachon to‘langan uglerod narxini hisobga oladi. Boshqacha aytganda, mamlakatimizda uglerod narxi bo‘lmasa, bu to‘lovlar O‘zbekiston budjetiga emas, Yevropa budjetiga tushadi.

Uglerod solig‘ining nazariy asosi ingliz iqtisodchisi A. Pigou (1920) ilgari surgan g‘oyaga borib taqaladi: ishlab chiqaruvchi atrof-muhitga yetkazgan zararini to‘lamasa, bu zararni soliq orqali mahsulot narxiga qo‘shish kerak. M. Weitzman (1974) keyinroq narx (soliq) va miqdor (chiqindi uchun ruxsat miqdori) vositalaridan qaysi biri qanday sharoitda samaraliroq ekanini ko‘rsatib berdi – bugungi aralash tizimlar aynan shu xulosaga tayanadi. Stavka darajasi borasida fikrlar turlicha. Uglerod narxlari bo‘yicha yuqori darajali komissiya Parij kelishuvi maqsadlariga erishish uchun 2030-yilgacha 1 tonna CO_2 narxi 50–100 dollar bo‘lishi kerak deb hisoblaydi (High-Level Commission on Carbon Prices, 2017). Xalqaro valyuta jamg‘armasi mutaxassislari esa daromadi past rivojlanayotgan mamlakatlar uchun 25 dollarlik eng kam narxni taklif qilgan (Parry va boshqalar, 2021).

Soliq amalda ishlaydimi? Tadqiqotlar bu savolga ijobiy javob beradi. Shvetsiyada soliq transportdan chiqadigan chiqindilarni taxminan 11 foizga (Andersson, 2019), Kanadaning Britaniya Kolumbiyasi provinsiyasida esa 5–15 foizga kamaytirgan (Murray & Rivers, 2015). 21 ta uglerod narxlash tizimini o‘rgangan umumlashtiruvchi tadqiqot ham, narxlar past bo‘lishiga qaramay, chiqindilar 5–21 foizga qisqarganini tasdiqladi (Döbbeling-Hildebrandt va boshqalar, 2024). Yevropa mamlakatlarida bu soliqlar iqtisodiy o‘sish va bandlikka sezilarli salbiy ta’sir ko‘rsatmagan (Metcalf & Stock, 2023). Ammo jamiyat soliqni qabul qilishi uchun tushgan pul qanday ishlatilishi hal qiluvchi ahamiyatga ega (Klenert va boshqalar, 2018) – buni Fransiyadagi “sariq jiletlar” noroziliklari yaqqol ko‘rsatdi (Douenne & Fabre, 2022). Agar tushum boshqa soliqlarni kamaytirishga

[13]Mexanizm sement, cho‘yan va po‘lat, alyuminiy, mineral o‘g‘itlar, vodorod va elektr energiyasi importiga qo‘llaniladi. Yiliga 50 tonnagacha mahsulot import qiluvchilar undan ozod qilingan (European Parliament & Council of the European Union, 2025).

yo‘naltirilsa, bir yo‘la ikki foyda – ham tozaroq havo, ham iqtisodiyotga yengilroq soliq yuki olish mumkin (Goulder, 1995).

O‘zbekiston sharoitida uglerod solig‘ining budjet va narxlarga ta’siri hozircha raqamlarda baholanmagan. Shu bois tadqiqotimizdan maqsad – soliqni joriy etishning iqtisodiy asoslarini aniqlash, uning mumkin bo‘lgan natijasini hisoblash va mamlakat sharoitiga mos joriy etish tartibini taklif qilishdir. Biz quyidagi taxmindan kelib chiqdik: uglerod solig‘i va emissiya savdo tizimi bosqichma-bosqich joriy etilsa, chiqindilarning atrof-muhitga zarari mahsulot narxida aks etadi va korxonalar energiyani tejaydigan, kam uglerod chiqaradigan texnologiyalarga o‘tishdan iqtisodiy manfaatdor bo‘ladi.

TADQIQOT METODOLOGIYASI

Tadqiqotda mamlakatlar tajribasi qiyosiy tahlil qilindi va turli soliq stavkalari uchun hisob-kitoblar bajarildi. Ma’lumotlar 2024-yilgi issiqxona gazlari hisobotidan, Jahon bankining 2025-yilgi ma’lumotlaridan va Milliy statistika qo‘mitasidan olindi. 2025-yilda yalpi ichki mahsulot 1 849,7 trillion so‘mni (O‘zbekiston Respublikasi Milliy statistika qo‘mitasi, 2026), ya’ni 2025-yilgi o‘rtacha kurs bo‘yicha taxminan 145 milliard dollarni tashkil etgan.

Hisob-kitob quyidagi tartibda bajarildi. Avval soliq qaysi chiqindilarga solinishini aniqladik. Energetika va sanoat birgalikda chiqindilarning qariyb 79 foizini beradi, lekin dastlab kichik korxonalar va aholi bevosita soliqqa tortilmasligini hisobga olib, soliq umumiy chiqindilarning 60 foizini – yiliga taxminan 143 million tonnani qamraydi deb oldik. So‘ngra har bir stavka (1 tonna CO_2 uchun 2, 5, 10 va 20 dollar) ta’sirida bu hajm qanchaga kamayishini baholadik. Xorijiy tadqiqotlar natijalariga tayanib, ehtiyotkorlik bilan kamayishni mos ravishda 1; 2,5; 5 va 9 foiz deb oldik. Soliq solingandan keyin qolgan chiqindi hajmini stavkaga ko‘paytirib, budjetga tushadigan mablag‘ni topdik.

Yoqilg‘i narxiga ta’sirni aniqlash uchun bir litr yoqilg‘i yoki bir kub metr gaz yoqilganda qancha CO_2 chiqishini hisobladik va uni soliq stavkasiga ko‘paytirdik. Masalan, bir tonna AI-91 benzini yoqilganda 3,03 tonna CO_2 chiqadi, bu bir litr benzin uchun 2,24 kilogramm demakdir. Dizel va tabiiy gaz uchun xalqaro standart koeffitsiyentlar olindi.[14] Dollar kursi 12 500 so‘m deb olindi va soliq to‘liq xaridorga o‘tadi deb faraz qilindi.

Bu hisob-kitoblar soddalashtirilgan: ular narx oshganda iqtisodiyotning boshqa tarmoqlarida yuzaga keladigan zanjir ta’sirlarni hisobga olmaydi. Shuning uchun natijalarni aniq prognoz emas, balki qaror qabul qilish uchun mo‘ljal sifatida qabul qilish kerak.

NATIJALAR VA MUHOKAMA

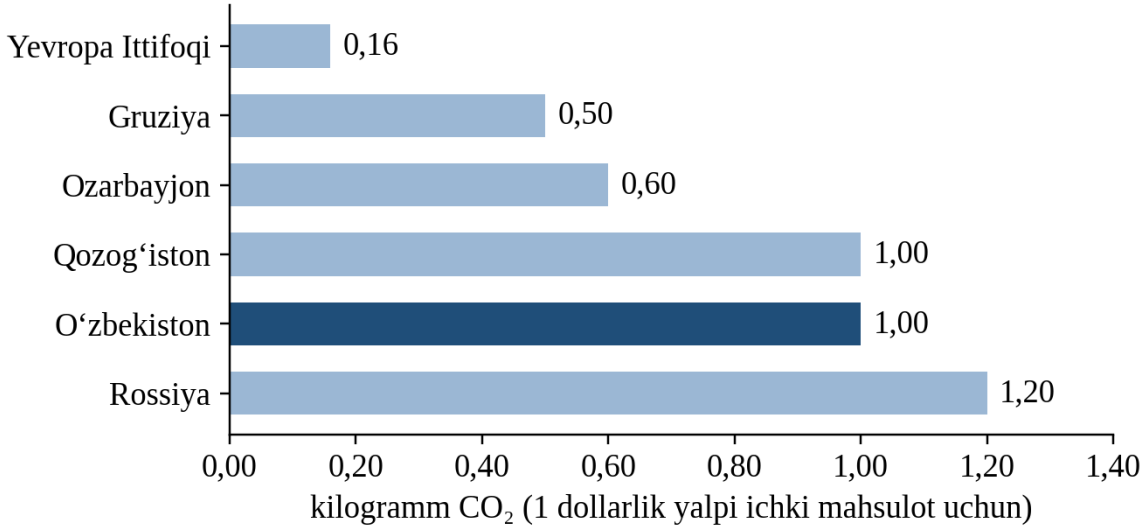
Chiqindilar tarkibi va uglerod sig‘imi

O'zbekistonning BMT Iqlim o'zgarishi to'g'risidagi doiraviy konvensiyasiga taqdim etgan Birinchi ikki yillik shaffoflik hisobotiga ko'ra, 2022-yilda issiqxona

[14]Dizel yoqilg‘isi uchun 1 litrga taxminan 2,65 kilogramm, tabiiy gaz uchun 1 kub metrga taxminan 1,9 kilogramm CO_2 olindi. Bu qiymatlar Iqlim o‘zgarishi bo‘yicha hukumatlararo ekspertlar guruhining standart koeffitsiyentlari asosida hisoblangan (IPCC, 2006).

gazlari chiqindilarining 63,7 foizi energetika, 17,6 foizi qishloq xo'jaligi, 15 foizi sanoat jarayonlari va 5,2 foizi chiqindilar sohasiga to'g'ri kelgan (Agency of Hydrometeorological Service of the Republic of Uzbekistan, 2024). Demak, chiqindilarning katta qismi yoqilg'i yoqishdan kelib chiqadi. Bu soliqni undirishni ancha osonlashtiradi: uni minglab iste'molchidan emas, soni uncha ko'p bo'lmagan yoqilg'i ishlab chiqaruvchi va import qiluvchi korxonalardan olish mumkin.

Jahon bankining 2025-yilgi ma’lumotlariga ko‘ra, O‘zbekistonda 1 dollarlik yalpi ichki mahsulot yaratish uchun 1 kilogramm CO_2 chiqariladi – bu jahon o‘rtachasidan 2,6 baravar ko‘p. Bu ko‘rsatkich bo‘yicha biz Qozog‘iston bilan bir darajada va Rossiyadan biroz yaxshiroq holatdamiz, lekin Gruziyadan ikki baravar, Yevropa Ittifoqidan esa olti baravardan ko‘proq ortda qolmoqdamiz (1-rasm). Bu, bir tomondan, muammo bo‘lsa, ikkinchi tomondan, energiya samaradorligini oshirish uchun katta zaxira borligini bildiradi.



1-rasm. 1 dollarlik yalpi ichki mahsulot uchun chiqariladigan CO_2, kilogramm

Manba: Jahon banki 2025-yil ma’lumotlari asosida tuzilgan.

Xalqaro tajriba

Uglerod solig‘ining o‘ziga xosligi shundaki, soliq mahsulot hajmiga emas, balki uni ishlab chiqarish yoki yoqishda havoga chiqadigan CO_2 miqdoriga solinadi. Masalan, 1 tonna AI-91 benzini yoqilganda 3,03 tonna CO_2 chiqadi va soliq aynan shu tonnalarning har biri uchun hisoblanadi. Benzin, dizel, tabiiy gaz, ko‘mir, sement, mineral o‘g‘itlar ana shu tartibda soliqqa tortilishi mumkin.

Jahon banki ma’lumotlariga ko‘ra, hozir 37 ta mamlakatda uglerod solig‘i amal qiladi va 2025-yilda u budjetlarga jami 27 milliard dollar keltirgan. 1 tonna CO_2 uchun o‘rtacha stavka 19,5 dollarni tashkil etadi, lekin mamlakatlar o‘rtasidagi farq juda katta – Shvetsiyadagi 155 dollardan Ukrainadagi 1 dollargacha (1-jadval).

1-jadval

Ayrim mamlakatlarda uglerod solig‘i

Mamlakat	Joriy etilgan yil	Stavka (1 tonna CO_2 uchun, dollar)	Xususiyatlari
Shvetsiya	1991	155	Daromad solig‘ini kamaytirish bilan birga joriy etilgan (Andersson, 2019)
Fransiya	2014	52	2018-yilda stavkani oshirish ijtimoiy noroziliklar sababli to‘xtatilgan (Douenne & Fabre, 2022)
Latviya	2004	17,4	Asosan Yevropa emissiya savdo tizimiga kirmagan korxonalarga qo‘llaniladi (World Bank, 2025)
Yaponiya	2012	1,8	Butun tushum energiyani tejash va qayta tiklanuvchi energiyaga sarflanadi (Ministry of the Environment, Japan, n.d.)
Ukraina	2011	1	Stavka past bo‘lgani uchun rag‘batlantiruvchi ta’siri cheklangan (World Bank, 2025)

Manba: stavkalar – Jahon banki ma’lumotlari; xususiyatlar – ko‘rsatilgan manbalar asosida tuzilgan.

Jadvaldan ikki muhim saboq chiqadi. Fransiyada stavkani aholiga tushuntirmasdan va zararni qoplamasdan tez oshirishga urinish ommaviy noroziliklarga sabab bo‘ldi va hukumat rejadan voz kechishga majbur bo‘ldi. Yaponiya esa, aksincha, juda past stavka bilan ham energiyani tejash loyihalari uchun barqaror moliya manbasi yaratish mumkinligini ko‘rsatdi. Umuman, ko‘p mamlakatlar bu mablag‘ni qayta tiklanuvchi energiya, “yashil” transport va aholining kam ta’minlangan qatlamlarini qo‘llab-quvvatlashga sarflaydi. Mintaqamizdan misol sifatida Qozog‘istonni keltirish mumkin: u 2013-yildan beri emissiya savdo tizimini qo‘llab keladi va bu tizim yiliga 20 ming tonnadan ortiq CO_2 chiqaradigan korxonalarni qamrab oladi (ICAP, n.d.).

Soliqning budjet, chiqindilar va narxlarga ta’siri

Hisob-kitoblarimiz natijalari 2-jadvalda keltirilgan. Hatto 5 dollarlik stavkada ham soliq budjetga yiliga qariyb 0,7 milliard dollar (yalpi ichki mahsulotning 0,48 foizi) olib keladi va chiqindilarni 3,6 million tonnaga kamaytiradi. Stavka jahon o‘rtachasiga yaqin – 20 dollarga yetkazilsa, tushum 2,6 milliard dollarga, chiqindilarning kamayishi esa 12,9 million tonnaga (umumiy hajmning 5,4 foizi) yetadi.

Aholi uchun eng sezilarli ta’sir yoqilg‘i narxida bo‘ladi. 5 dollarlik stavkada bir litr AI-91 benzini taxminan 140 so‘mga, bir kub metr tabiiy gaz 119 so‘mga qimmatlashadi. 20 dollarda bu farq mos ravishda 560 va 475 so‘mga yetadi. Bundan tashqari, elektr energiyasi, sement va o‘g‘itlar narxi ham bilvosita oshadi.

2-jadval

Uglerod solig‘ining turli stavkalardagi ta’siri

Stavka (1 tonna CO_2 uchun, dollar)	Chiqindilar kamayishi, million tonna (foiz)	Budjet tushumi, million dollar	Yalpi ichki mahsulotga nisbatan, foiz	Benzin (AI-91) narxi oshishi, so‘m/litr	Dizel narxi oshishi, so‘m/litr	Tabiiy gaz narxi oshishi, so‘m/kub metr
2	1,4 (1,0)	284	0,20	56	66	48
5	3,6 (2,5)	699	0,48	140	166	119
10	7,2 (5,0)	1 362	0,94	280	331	238
20	12,9 (9,0)	2 610	1,80	560	662	475

Manba: mualliflar hisob-kitoblari.

Misol tariqasida 5 dollarlik stavka bo‘yicha hisob-kitobni ko‘rsatamiz. Avvalo chiqindining kamayishi topiladi: qamrov (143,4 mln t) chiqindi kamayishi foiziga ko‘paytiriladi, ya’ni 143,4 × 2,5% = 3,6 mln t. Soliqqa tortiladigan qoldiq hajm 143,4 − 3,6 = 139,8 mln t bo‘ladi. Budjet tushumi bu qoldiq hajmni stavkaga ko‘paytirish orqali olinadi: 139,8 × 5 = 699 mln dollar. Uning YaIMga (145 mlrd dollar) nisbati esa 699 / 145 000 × 100 = 0,48% ni tashkil etadi. Jadvaldagi boshqa qatorlar ham xuddi shu tartibda hisoblangan.

Natijalar muhokamasi

Olingan natijalar taxminimizni qisman tasdiqlaydi. Past stavkada ham soliq budjet uchun sezilarli mablag‘ beradi va chiqindilarni kamaytiradi. Bosqichma-bosqich joriy etilgan soliq va emissiya savdo tizimi korxonalarni energiyani tejaydigan texnologiyalarga o‘tishga undaydi, qayta tiklanuvchi energiyadan foydalanishni kengaytiradi va budjet uchun qo‘shimcha daromad manbasini yaratadi.

Biroq 1–9 foizlik qisqarish Parij kelishuvi bo‘yicha olingan 35 foizlik majburiyatni bajarish uchun yetarli emas. Demak, uglerod solig‘i qayta tiklanuvchi energiya va energiya samaradorligi dasturlarining o‘rnini bosa olmaydi, u faqat ularni to‘ldiradi. Qolaversa, 2–10 dollarlik stavkalar jahon o‘rtachasidan (19,5 dollar) ham, Xalqaro valyuta jamg‘armasi taklif qilgan 25 dollarlik eng kam narxdan ham ancha past. Shuning uchun stavkani oldindan e’lon qilingan jadval bo‘yicha asta-sekin oshirib borish ma’qul.

Soliq yaxshimi yoki emissiya savdo tizimi? Fikrimizcha, bu savolni “yo u, yo bu” tarzida qo‘yish to‘g‘ri emas. Soliq uglerod narxini oldindan ma’lum qiladi va yoqilg‘iga mavjud aksiz tizimi orqali oson undiriladi. Emissiya savdo tizimida esa davlat chiqindilarning umumiy chegarasini belgilaydi, korxonalar ruxsatnomalarni o‘zaro sotib olib-sotadi, natijada chiqindi qayerda arzonroq qisqartirilsa, o‘sha yerda qisqaradi. Shu sababli yoqilg‘i va kichik chiqaruvchilar uchun soliq, elektr energetikasi, sement, metallurgiya va o‘g‘it ishlab chiqarish kabi yirik korxonalar uchun esa emissiya savdo tizimi qo‘llaniladigan aralash model maqbul ko‘rinadi.

Bu tarmoqlar Yevropa Ittifoqining chegara mexanizmi qamroviga ham kiradi, shuning uchun mamlakatimizdagi uglerod narxi eksportchilarning Yevropada to‘laydigan summasini kamaytiradi (European Parliament & Council of the European Union, 2023).

Albatta, xavflar ham bor. Soliq mahsulot tannarxini oshiradi, energiyani ko‘p sarflaydigan tarmoqlarning raqobatbardoshligiga bosim tushiradi, qo‘shimcha xarajatning bir qismi esa narxlar orqali xaridor zimmasiga o‘tadi. Bu xavflarni qanday yumshatish mumkinligi keyingi bo‘limdagi takliflarda ko‘rsatilgan.

TAKLIFLAR

Birinchi. Soliq va emissiya savdo tizimini birdaniga emas, to‘rt bosqichda joriy etish.

Birinchi bosqich (2027-yil) tayyorgarlikka bag‘ishlanadi va bu davrda soliq undirilmaydi. Korxonalar chiqindilarini o‘lchash, hisobot berish va mustaqil tekshirish tizimi yaratiladi, yirik chiqaruvchilar ro‘yxati tuziladi, zarur qonunchilik bazasi tayyorlanadi. Yiliga 10 ming tonnadan ortiq CO_2 chiqaradigan korxonalar hisobot bera boshlaydi. Bunday hisob tizimisiz na soliq, na emissiya savdo tizimi to‘g‘ri ishlay olmaydi (Timilsina, 2022).

Ikkinchi bosqichda (2028–2029-yillar) yoqilg‘iga 1 tonna CO_2 uchun 2–5 dollar miqdorida soliq joriy etiladi. U energetika korxonalari va yiliga 20 ming tonnadan ortiq CO_2 chiqaradigan sanoat korxonalariga qo‘llaniladi. Shu bilan bir vaqtda aholining kam ta’minlangan qatlamlariga qo‘shimcha xarajatni qoplash tizimi ishga tushiriladi.

Uchinchi bosqichda (2030–2032-yillar) stavka 5–10 dollargacha oshiriladi va soliq umumiy chiqindilarning 60 foizigacha qamrab oladi. Energetikada emissiya savdo tizimi sinov tariqasida ishga tushiriladi, Yevropa Ittifoqi chegara mexanizmiga kiradigan tarmoqlarga alohida e’tibor qaratiladi.

To‘rtinchi bosqichda (2033-yildan) emissiya savdo tizimi to‘liq quvvat bilan ishlaydi, stavka 15–25 dollarga yetkaziladi va milliy tizim xalqaro uglerod bozorlariga ulanadi. Qamrov chegaralarini (10 va 20 ming tonna) belgilashda Qozog‘iston tajribasiga tayanildi.

Ikkinchi. Stavkalarning o‘sish jadvalini kamida uch yil oldin qonun bilan belgilash. Korxona investitsiya qilishdan oldin kelgusi yillarda uglerod qancha turishini bilishi kerak.

Uchinchi. Vakolatlarni aniq taqsimlash. Chiqindilarni hisobga olish, soliqni undirish va emissiya savdo tizimi ro‘yxatini yuritish vazifalari ekologiya sohasidagi vakolatli organ, Soliq qo‘mitasi va gidrometeorologiya xizmati o‘rtasida aniq bo‘linishi, ular o‘rtasidagi ma’lumot almashinuvi esa elektron shaklda yo‘lga qo‘yilishi lozim.

To‘rtinchi. Tushgan mablag‘dan shaffof foydalanish. Taxminan 30 foizini kam ta’minlangan oilalarga manzilli yordam sifatida, 40 foizini qayta tiklanuvchi energiya, energiyani tejash va “yashil” transport loyihalarini moliyalashtiradigan maxsus jamg‘armaga, qolgan 30 foizini esa ish haqiga solinadigan soliq yukini kamaytirishga yo‘naltirishni taklif qilamiz. Bu nisbatlar taxminiy bo‘lib, ularni

aniqlashtirish uchun oilalar daromadi bo‘yicha qo‘shimcha tahlil kerak. Eng muhimi – mablag‘ qayerga sarflangani har yili ochiq e’lon qilinishi lozim.

Beshinchi. Raqobatbardoshlikni himoya qilish. Eksportga ishlaydigan va energiyani ko‘p sarflaydigan korxonalarga to‘langan soliqning bir qismini ularning ishlab chiqarish hajmiga qarab vaqtincha qaytarish tartibi kerak. Bu ishlab chiqarishning uglerod solig‘i yo‘q mamlakatlarga ko‘chib ketishining oldini oladi. Soliq islohoti energiya tariflari islohoti bilan ham muvofiqlashtirilishi zarur.

Oltinchi. Imtiyozlarga muddat qo‘yish. Uglerod solig‘i bo‘yicha har qanday imtiyoz 3–5 yillik muddatga berilishi kerak. Muddat tugashidan oldin imtiyozning budjet, iqtisodiyot va ekologiyaga ta’siri majburiy baholanadi. Natija ijobiy bo‘lsagina imtiyoz uzaytiriladi, aks holda u avtomatik bekor bo‘ladi, baholash natijalari esa ochiq e’lon qilinadi. Bu tartib imtiyozni shunchaki rasman uzaytirish vositasiga aylanib qolmasligi uchun yagona baholash uslubi, aniq mezonlar va mustaqil baholovchi zarur.

XULOSA

Tadqiqot O‘zbekistonda uglerod solig‘ini joriy etish uchun yetarli iqtisodiy asos borligini ko‘rsatdi. Chiqindilarning qariyb uchdan ikki qismi energetikaga to‘g‘ri keladi, iqtisodiyotning uglerod sig‘imi esa jahon o‘rtachasidan 2,6 baravar yuqori. Bunday sharoitda soliq ham chiqindilarni kamaytirish, ham undirish jihatidan samarali ishlaydi. Hisob-kitoblarimizga ko‘ra, 1 tonna CO_2 uchun 2–20 dollarlik stavkada soliq yiliga 0,28–2,61 milliard dollar qo‘shimcha daromad keltiradi va chiqindilarni 1,4–12,9 million tonnaga kamaytiradi. Shu bilan birga, Parij kelishuvi bo‘yicha majburiyatlarni faqat soliq bilan bajarib bo‘lmaydi: u qayta tiklanuvchi energiya va energiya samaradorligi siyosati bilan birga qo‘llanishi kerak.

Xalqaro tajriba bosqichma-bosqich yondashuv to‘g‘ri ekanini tasdiqlaydi. Ya’ni, dastlab chiqindilarni hisobga olish tizimi, keyin past stavkali sinov solig‘i, so‘ngra emissiya savdo tizimini joriy etish maqsadga muvofiq hisoblanadi. Oldindan e’lon qilingan stavkalar jadvali va tushgan mablag‘dan shaffof foydalanish soliqqa jamiyat ishonchini ta’minlaydi. Yevropa Ittifoqi chegara mexanizmining ishga tushishi esa bu qarorni uzoq kechiktirishga imkon bermaydi. Keyingi tadqiqotlarda soliqning alohida tarmoqlar va turli daromadli oilalarga ta’sirini chuqurroq baholash maqsadga muvofiq.

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SHAXSIYLASHTIRILGAN HUDUDIY OVQATLANISH TAVSIYALARI VA O‘QUV NATIJALARINI TAHLIL QILISH UCHUN GIBRID INTELLEKTUAL MODEL

Annotatsiya: *Ushbu maqolada shaxsiylashtirilgan ovqatlanish tavsiyalarini shakllantirish hamda ovqatlanish aralashuvlarining o‘quv natijalariga bog‘liqligini aniqlash uchun RNLSTM (Recurrent Neural Network–Long Short-Term Memory), Apriori va K-Means usullarini birlashtiruvchi gibrid intellektual model taklif etiladi. Tadqiqot ikki ilmiy manbaning qiyosiy ikkilamchi tahliliga asoslandi. Birinchi manbada hududiy taomlar, tana massasi indeksi va foydalanuvchi xususiyatlari asosida RNN (Recurrent Neural Network), LSTM (Long Short-Term Memory) va DNN (Deep Neural Network) komponentlarini uyg‘unlashtirgan tavsiya tizimi yoritilgan bo‘lib, RNLSTM modeli 80,54 foiz aniqlikka erishgan [1]. Ikkinchi manbada 1 361 o‘quvchining 2024/2025 o‘quv yilidagi baholari Apriori va K-Means yordamida tahlil qilingan; ayrim fanlarda 33–39 foiz support va 80 foiz confidence qiymatlari aniqlangan, barcha klasterlarda o‘rtacha ball oshgani kuzatilgan [2]. Sintez natijasida foydalanuvchi profili, hududiy oziq-ovqat bazasi, ketma-ket iste’mol ma’lumotlari, tavsiya modeli, assotsiativ qoidalar, klasterlash va qayta aloqa mexanizmini yagona yopiq konturga birlashtiruvchi arxitektura ishlab chiqildi. Modelning afzalligi tavsiyani faqat kaloriya yoki BMI bilan cheklamasdan, hududiy mavjudlik, madaniy moslik, ta’lim bosqichi va kuzatiladigan natijalar bilan bog‘lashidadir. Maqolada manbalardan olingan empirik ko‘rsatkichlar yangi eksperiment natijasi sifatida emas, taklif etilgan modelni asoslovchi qiyosiy dalillar sifatida talqin qilinadi.*

Kalit so‘zlar: *shaxsiylashtirilgan ovqatlanish, hududiy taomlar, RNLSTM, Apriori, K-Means, assotsiativ qoidalar, o‘quv natijalari, qarorlarni qo‘llab-quvvatlash tizimi.*

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A HYBRID INTELLIGENT MODEL FOR ANALYZING PERSONALIZED REGIONAL DIETARY RECOMMENDATIONS AND LEARNING OUTCOMES

Abstract: *This article proposes a hybrid intelligent model integrating RNLSTM (Recurrent Neural Network–Long Short-Term Memory), Apriori, and K-*

Means methods to generate personalized dietary recommendations and determine the relationship between nutritional interventions and educational outcomes. The study is based on a comparative secondary analysis of two scientific sources. The first source presents a recommendation system combining RNN (Recurrent Neural Network), LSTM (Long Short-Term Memory), and DNN (Deep Neural Network) components based on regional foods, body mass index, and user characteristics. The RNLSTM model achieved an accuracy of 80.54% [1]. In the second source, the academic grades of 1,361 students for the 2024/2025 academic year were analyzed using Apriori and K-Means. Support values of 33–39% and a confidence value of 80% were identified for certain subjects, while an increase in the average score was observed across all clusters [2]. Based on the synthesis, an architecture was developed that integrates the user profile, regional food database, sequential consumption data, recommendation model, association rules, clustering, and feedback mechanism into a unified closed-loop system. The key advantage of the model is that it does not limit recommendations solely to calorie intake or BMI but also links them to regional availability, cultural suitability, educational level, and observable outcomes. The empirical indicators obtained from the sources are interpreted not as the results of a new experiment but as comparative evidence supporting the proposed model.

Keywords: *personalized nutrition, regional foods, RNLSTM, Apriori, K-Means, association rules, educational outcomes, decision support system.*

KIRISH

Raqamli sog‘liqni saqlash tizimlarida ovqatlanish tavsiyasini shaxsiylashtirish ikki xil vazifani bir vaqtda hal qilishni talab etadi. Birinchisi, foydalanuvchining yoshi, jinsi, bo‘yi, vazni, tana massasi indeksi, jismoniy faolligi, sog‘liq holati va maqsadlariga mos oziqaviy tarkibni aniqlashdir. Ikkinchisi, nazariy jihatdan to‘g‘ri tavsiyani amalda topish, xarid qilish va tayyorlash mumkin bo‘lgan mahalliy taomlar bilan bog‘lashdir. Umumiy yoki global ma’lumotlar bazasiga tayangan tizimlar ko‘pincha shu ikkinchi shartni bajarmaydi: foydalanuvchiga begona masalliqlar tavsiya qilinadi, mavsumiylik hisobga olinmaydi va natijada tavsiyaga rioya qilish pasayadi [1].

Ovqatlanishning oqibati faqat antropometrik ko‘rsatkichlarda namoyon bo‘lmaydi. Maktab yoshidagi bolalarda energiya, oqsil, mikroelementlar va ovqatlanish muntazamligi diqqat, xotira, jismoniy faollik hamda darsdagi ishtirok bilan bog‘lanishi mumkin. Bepul sog‘lom ovqat dasturlarini o‘rgangan tadqiqotlar ayrim guruhlarda davomat va o‘zlashtirish yaxshilanishini qayd etadi, biroq ta’sir fanlar, yosh bosqichlari va boshlang‘ich holat bo‘yicha bir xil emas [2], [13]. Demak, dastur samaradorligini bitta o‘rtacha qiymat bilan emas, yashirin guruhlar va takrorlanuvchi qoidalar orqali baholash zarur.

Shaxsiy tavsiya tizimlari va ta’limiy natijalarni tahlil qiluvchi tizimlar odatda alohida ishlab chiqiladi. Birinchi yo‘nalish foydalanuvchiga qanday taom tavsiya qilish kerakligini hal qiladi; ikkinchi yo‘nalish esa aralashuvdan keyin qanday o‘zgarish yuz berganini aniqlaydi. Ushbu ajralish amaliy boshqaruvda muammo

tug‘diradi: tavsiya sifati oshsa ham uning uzoq muddatli ta’siri kuzatilmasligi, yoki natija aniqlansa ham uni qaysi menyu xususiyatlari bilan bog‘lash mumkinligi noma’lum qolishi mumkin.

Mazkur maqolaning maqsadi hududiy taomlarga asoslangan shaxsiy ovqatlanish tavsiyasi bilan o‘quv natijalarining assotsiativ va klaster tahlilini yagona gibrid modelga birlashtirishdir. Tadqiqot savoli quyidagicha shakllantirildi: RNLSTM asosidagi tavsiya mexanizmi, Apriori qoidalari va K-Means segmentatsiyasi qanday integratsiya qilinsa, tizim bir vaqtning o‘zida individual menyu ishlab chiqishi, guruhiy qonuniyatlarni aniqlashi va natijaga qarab yangilanib borishi mumkin?

Taklif etilayotgan yondashuvning ilmiy yangiligi uch qatlamning uyg‘unligida ko‘rinadi. Prediktiv qatlam foydalanuvchining vaqt bo‘yicha o‘zgaruvchi holatini modellashtiradi; tavsiflovchi qatlam ovqat, foydalanuvchi va natija belgilarining tez-tez birga uchrashini aniqlaydi; segmentatsiya qatlami esa bir xil aralashuvga turlicha javob beradigan guruhlarni ajratadi. Shu tariqa tizim “qaysi taom mos?” savolidan tashqari “kim uchun, qachon va qanday natija bilan mos?” savoliga ham javob bera oladi.

Maqolaning amaliy ahamiyati maktab ovqatlanishi, universitet talabalarining sog‘lom turmush dasturlari, klinik bo‘lmagan profilaktik xizmatlar va hududiy parhez platformalarida namoyon bo‘ladi. Bunda algoritmik natija dietolog, shifokor yoki pedagog qarorini almashtirmaydi; aksincha, katta hajmdagi turli ma’lumotlarni tartibga solib, kuzatuv va qaror qabul qilishni qo‘llab-quvvatlaydi.

Tadqiqotning vazifalari

- Ikki asosiy manbaning maqsadi, ma’lumotlari, algoritmlari va natijalarini bir xil mezonlarda qiyoslash.
- RNLSTM, Apriori va K-Means usullarining vazifalarini hamda o‘zaro to‘ldiruvchi tomonlarini aniqlash.
- Hududiy menyu, foydalanuvchi profili va o‘quv natijasini bog‘laydigan ma’lumotlar modelini taklif etish.
- Tavsiya aniqligi, assotsiativ qoidalar sifati va klaster barqarorligini birgalikda baholash protokolini ishlab chiqish.
- Modelni real sharoitda sinash uchun cheklovlar, etik talablar va istiqboldagi tajriba dizaynini belgilash.

MATERIALLAR VA METODLAR

Tadqiqot dizayni va manbalar

Tahlil birligi sifatida har bir maqolaning muammo bayoni, ma’lumotlar manbai, kirish belgilar, qayta ishlash bosqichlari, algoritm, baholash mezoni, sonli natija, amaliy cheklov va kelgusidagi rivojlantirish taklifi qabul qilindi. Ma’lumotlar avval alohida kodlandi, keyin vazifa–algoritm–natija zanjiri bo‘yicha umumlashtirildi. Manbalarda keltirilmagan tajriba qiymatlari hisoblab topilmadi va yangi o‘lchov sifatida taqdim etilmadi.

Tahlil qilingan maqoladagi tizim Google Forms orqali yosh, bo‘y, vazn va parhez afzalliklarini yig‘adi, hududiy oziq-ovqat ma’lumotlarini veb manbalardan

to‘playdi, yetishmagan qiymatlarni tozalaydi va Min-Max masshtablashdan foydalanadi [1]. LSTM ketma-ket odatlarni, DNN esa oziq komponentlari va sog‘liq natijalari orasidagi chiziqli bo‘lmagan munosabatlarni o‘rganadi. Ularning bashoratlari intrgrallashgan mexanizmi orqali birlashtiriladi.

Boshqa bir maqoladagi tahliliy ma’lumotlar 2024/2025 o‘quv yilining toq va juft semestrlaridagi baholarni qamrab oladi: boshlang‘ich bosqichdan 136, o‘rta bosqichdan 626, yuqori bosqichdan 207 va kasbiy ta’limdan 392 o‘quvchi, jami 1 361 kuzatuv [2]. Apriori tez-tez uchraydigan baho o‘tishlarini, K-Means esa dasturdan oldingi va keyingi o‘rtacha ballarga ko‘ra guruhlarni aniqlash uchun qo‘llangan.

1-jadval. Asosiy manbalarning metodik qiyosi

Mezon	Hududiy parhez tizimi [1]	Ovqat dasturi va o‘zlashtirish [2]
Asosiy vazifa	Shaxsiy va hududiy mos menyu tavsiya qilish	Ovqat dasturi bilan baho o‘zgarishi orasidagi naqshlarni aniqlash
Ma’lumotlar	Profil, BMI, maqsad, afzallik, taom tarkibi	1 361 o‘quvchi, ta’lim bosqichi, oldingi va keyingi baholar
Algoritmlar	RNN, LSTM, DNN va ansambl RNLSTM	Apriori va K-Means
Asosiy mezon	Aniqlik, yo‘qotish, MAE va R^2 konsepsiyasi	Support, confidence va klaster sentroidlari
Eng muhim natija	RNLSTM aniqligi 80,54%	Ayrim qoidalarda confidence 80%; barcha klasterlarda o‘sish
Cheklov	Statik baza, hududiy moslashuv va real vaqt ma’lumoti	Kausal xulosa cheklangan; matematika bo‘yicha aniq aloqa yo‘q

RNLSTM tavsiya komponenti

Taklif etilgan modelda RNLSTM komponenti ketma-ket iste’mol tarixi va hozirgi foydalanuvchi profilini birlashtiradi. LSTM hujayrasi uzoq muddatli bog‘liqliklarni saqlash uchun kirish, unutish va chiqish darvozalaridan foydalanadi. Bu mexanizm parhez odatlaridagi mavsumiylik, haftalik takrorlanish, vaznning o‘zgarishi va tavsiyaga rioya qilish dinamikasini oddiy statik klassifikatordan yaxshiroq ifodalashi mumkin [1], [9].

DNN komponenti yosh, BMI, energiya ehtiyoji, oqsil, uglevod, yog‘, tolalar, sog‘liq cheklovlari va taom kategoriyasi kabi belgilar orasidagi chiziqli bo‘lmagan munosabatlarni o‘rganadi. Birlashma mexanizmi natijasi alohida modellar bashoratini birlashtirish orqali tasodifiy xatoni kamaytirishga qaratiladi. Manba maqolada yakuniy bashorat N ta model natijasining o‘rtachasi ko‘rinishida berilgan [1].

$$\hat{y} = (1/N)\ \Sigma_{i=1}^{N} P_i \qquad (1)$$

Bu yerda $\hat{y}$ — yakuniy tavsiya bahosi, P_i — i-modelning bashorati, N — birlashma majnuasidagi modellar soni. Oddiy o‘rtachalash boshlang‘ich variant

bo‘lsa-da, amaliy tizimda validatsiya natijasiga qarab vaznlangan o‘rtacha qo‘llanishi mumkin. Vaznlar alohida modelning umumiy aniqligidan tashqari, ma’lum yosh yoki sog‘liq guruhidagi barqarorligini ham aks ettirishi kerak.

$$C_t = f_t \cdot C_{t-1} + i_t \cdot tanh(Wc[h_{t-1}, x_t] + bc) \quad (2)$$

LSTM hujayra holatining yangilanishida C_t joriy xotirani, f_t unutish darvozasini, i_t kirish darvozasini, x_t joriy kirishni va h_{t-1} avvalgi yashirin holatni anglatadi [1]. Mazkur ifoda vaqt bo‘yicha muhim oziqaviy odatlarni saqlash hamda tasodifiy yoki eskirgan signalni pasaytirish imkonini beradi.

Apriori asosidagi assotsiativ tahlil

Apriori algoritmi tranzaksiyalar to‘plamida tez-tez birgalikda uchraydigan elementlar majmuasini topadi. Mazkur maqola doirasida tranzaksiya — foydalanuvchi yoki o‘quvchining ma’lum davrdagi menyu xususiyatlari, profil segmenti, tavsiyaga rioya holati va natija kategoriyalaridan tuzilgan yozuvdir. Masalan, “oqsil me’yori bajarildi”, “nonushta muntazam”, “o‘rta ta’lim bosqichi” va “ingliz tili bahosi oshdi” elementlari bitta tranzaksiyaga kirishi mumkin.

Qoidaning support qiymati X va Y elementlari jami kuzatuvlarning qanchasida birga uchrashini, confidence esa X sodir bo‘lgan holatlarning qanchasida Y ham sodir bo‘lganini ifodalaydi. Bu ko‘rsatkichlar sababiylikni isbotlamaydi, biroq kuzatuv ma’lumotida tekshirishga arzigulik barqaror kombinatsiyalarni ko‘rsatadi [2].

$$support(X \rightarrow Y) = count(X \cup Y) / n \quad (3)$$

$$confidence(X \rightarrow Y) = support(X \cup Y) / support(X) \quad (4)$$

Faqat support va confidence bilan cheklanish ommabop natijalar ta’sirida chalg‘itishi mumkin. Shuning uchun taklif etilayotgan modelda lift ham qo‘shiladi. Lift birdan katta bo‘lsa, X mavjud bo‘lganda Y ning kuzatilishi uning umumiy ehtimoliga nisbatan yuqoriroq ekanini bildiradi. Qoidalar minimal support, minimal confidence, lift va klinik-pedagogik mazmun bo‘yicha birgalikda saralanadi.

$$lift(X \rightarrow Y) = confidence(X \rightarrow Y) / support(Y) \quad (5)$$

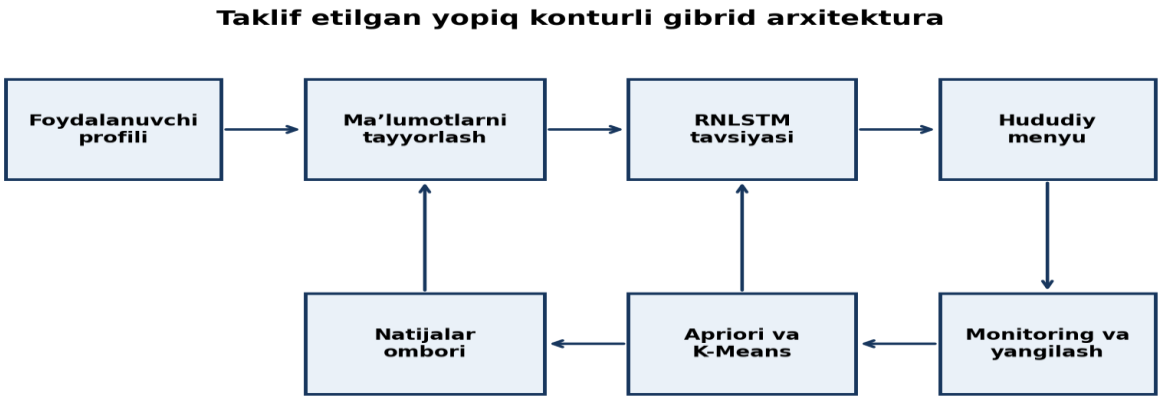
K-Means orqali segmentatsiya

K-Means kuzatuvlarni K ta klasterga ajratib, har bir nuqta bilan tegishli klaster markazi orasidagi kvadratik masofalar yig‘indisini kamaytiradi. Ta’limiy ovqatlanish kontekstida belgilar sifatida dasturdan oldingi baho, keyingi baho, o‘zgarish miqdori, ta’lim bosqichi, menyuga rioya darajasi va antropometrik ko‘rsatkichlarning normallashtirilgan qiymatlari ishlatilishi mumkin [2], [14].

Klaster soni oldindan ma’muriy guruhlar soniga tenglashtirilmasligi kerak. Silhouette koeffitsiyenti, elbow grafigi va klasterlarning mazmuniy talqin qilinishi birgalikda qo‘llanadi. Kategorik belgilar ko‘p bo‘lsa, ularni ehtiyotkor kodlash yoki K-Prototypes kabi muqobil usulni sinash lozim. Manba natijasidagi uch klaster ta’lim bosqichlari va boshlang‘ich ball darajalariga mos kelgan bo‘lsa-da, yangi hududda ayni tuzilma avtomatik takrorlanadi deb bo‘lmaydi.

$$J = \sum_{j=1}^{K} \sum_{x \in C_j} \|x - \mu_j\|^2 \rightarrow min \quad (6)$$

Taklif etilgan gibrid arxitektura



1-rasm. RNLSTM Apriori va K-Means komponentlarini birlashtiruvchi gibrid arxitektura

Arxitektura yetti funksional blokdan iborat. Foydalanuvchi profili blokida demografik ma'lumotlar, antropometriya, allergiya, sog‘liq cheklovlari, jismoniy faollik, ta'lim bosqichi va maqsadlar saqlanadi. Hududiy menyu bazasi mahalliy nom, masalliq, porsiya, energiya va makronutrientlar, mavsum, narx oralig‘i, tayyorlash usuli hamda mavjudlikni qamrab oladi. Bu ikki manba yagona identifikator va vaqt belgisi orqali bog‘lanadi.

Ma'lumotlarni tayyorlash bosqichi takror yozuvlarni olib tashlash, yetishmagan qiymatlarni qayta ishlash, birliklarni standartlashtirish va sonli belgilarni masshtablashni bajaradi. Sog‘liq uchun xavfli yoki mantiqan mumkin bo‘lmagan qiymatlar avtomatik tavsiyaga uzatilmaydi; ular mutaxassis tekshiruviga chiqariladi. Trening, validatsiya va test to‘plamlari bir foydalanuvchining yozuvlari turli to‘plamlarga tushib qolmaydigan tarzda ajratiladi.

RNLSTM tavsiya bloki foydalanuvchining maqsadli energiya va ozuqa ehtiyojiga mos nomzod menyularni baholaydi. Qattiq cheklovlar, jumladan allergen yoki tibbiy taqiq, model ballidan oldin qo‘llanadi. Yumshoq cheklovlar — did, narx, mavsum va tayyorlash vaqti — reyting funksiyasida vaznlanadi. Natijada tizim bir dona qat'iy menyu emas, izohlangan muqobillar ro‘yxatini beradi.

Natijalar ombori qabul qilingan tavsiya, almashtirilgan taom, haqiqiy iste'mol, foydalanuvchi bahosi, antropometrik dinamika, davomat va o‘quv ko‘rsatkichlarini vaqt kesimida saqlaydi. Apriori ushbu omborda tez-tez uchraydigan kombinatsiyalarni, K-Means esa o‘xshash javob profillarini aniqlaydi. Monitoring bloki yangi naqshlarni tavsiya qatlamiga qaytaradi va shu bilan yopiq qayta aloqa konturini hosil qiladi.

Integratsiyaning asosiy tamoyili prediktiv model va tavsiflovchi tahlil vazifalarini aralashtirib yubormaslikdir. RNLSTM kelgusidagi moslik yoki reytingni bashorat qiladi; Apriori kuzatilgan hodisalar orasidagi assotsiatsiyani ochadi; K-Means esa oldindan belgilanmagan guruhlarni topadi. Ularning chiqishlari bitta qaror oynasida ko‘rsatilishi mumkin, ammo har biri o‘z mezoni bilan baholanadi.

2-jadval. Gibrid model uchun tavsiya etiladigan belgilar

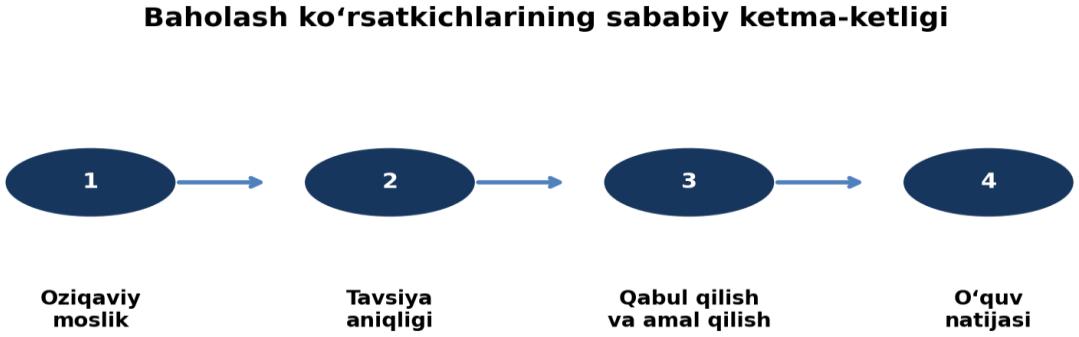
Belgi guruhi	Misollar	Vazifasi	Maxfiylik talabi
Profil	Yosh, jins, bo‘y, vazn, BMI	Bazaviy ehtiyojni hisoblash	Psevdonimlashtirish
Sog‘liq	Allergiya, cheklov, tashxis toifasi	Xavfli taomni chiqarib tashlash	Alohida rozilik va qat’iy kirish nazorati
Turmush tarzi	Faollik, uyqu, ovqatlanish vaqti	Energiya va ketma-ketlik modeli	Minimal zarur hajmda yig‘ish
Taom	Energiya, oqsil, uglevod, yog‘, tola	Oziqaviy moslik va reyting	Manba va yangilanish sanasini saqlash
Hududiylik	Mavsum, narx, mavjudlik, madaniy moslik	Amaliy bajarilishni oshirish	Agregat ko‘rinishda ishlatish
Natija	Qabul qilish, BMI dinamikasi, davomat, baho	Monitoring va qayta aloqa	Ta’lim va sog‘liq ma’lumotlarini ajratish

Baholash protokoli

Gibrid tizimni baholash to‘rt darajada olib borilishi kerak. Birinchi daraja oziqaviy xavfsizlik va me’yorlarga moslikni tekshiradi. Ikkinchi daraja algoritmik sifatni, jumladan accuracy, precision, recall, F1, MAE yoki R^2 ni vazifaga qarab hisoblaydi. Uchinchi daraja foydalanuvchining tavsiyani qabul qilishi, almashtirishlar soni va amal qilish ulushini baholaydi. To‘rtinchi daraja esa vaqt davomida sog‘liq yoki ta’lim natijasining o‘zgarishini kuzatadi.

Natijani baholashda vaqt bo‘yicha ajratilgan test dizayni tavsiya etiladi. Tasodifiy bo‘linish bir foydalanuvchining juda o‘xshash yozuvlarini trening va testga taqsimlab, aniqlikni sun’iy ravishda oshirishi mumkin. Shu sababli yangi davr yoki yangi foydalanuvchilar alohida test to‘plamida qolishi lozim. Modelni ta’lim bosqichi, jins, boshlang‘ich BMI va hudud bo‘yicha ham tekshirish adolatli ishlashni baholashga yordam beradi.

O‘quv natijasidagi oddiy “oldin–keyin” farqi dastur sababini to‘liq isbotlamaydi. O‘qitish sifati, oilaviy sharoit, uyqu, davomat, boshlang‘ich bilim va boshqa omillar natijaga ta’sir qilishi mumkin. Kelgusidagi tajribada nazorat guruhi, propensity score matching yoki difference-in-differences kabi dizaynlar qo‘llansa, kausal talqin kuchayadi. Assotsiativ qoidalar esa gipoteza yaratish vositasi sifatida qoladi.



2-rasm. Gibrid tizimni ko‘p bosqichli baholash mantig‘i

3-jadval. Algoritmlar va baholash mezonlari

Komponent	Chiqish	Asosiy mezon	Qo‘shimcha nazorat
RNLSTM	Taom reytingi yoki miqdor bashorati	Accuracy, F1, MAE, R^2	Kalibrlash, guruhlar bo‘yicha xato
Apriori	X → Y assotsiativ qoidalar	Support, confidence, lift	Qoidalar soni va amaliy mazmun
K-Means	Javob profili klasterlari	Silhouette, SSE	Boshlang‘ich nuqtaga barqarorlik
Tavsiya interfeysi	Qabul qilingan yoki almashtirilgan menyu	Acceptance rate, adherence	Izoh tushunarliligi va javob vaqti
Natija monitoringi	Sog‘liq yoki o‘quv dinamikasi	O‘zgarish va ishonch oralig‘i	Chalg‘ituvchi omillar va missing data

NATIJALAR

Manba natijalarining qiyosiy sintezi

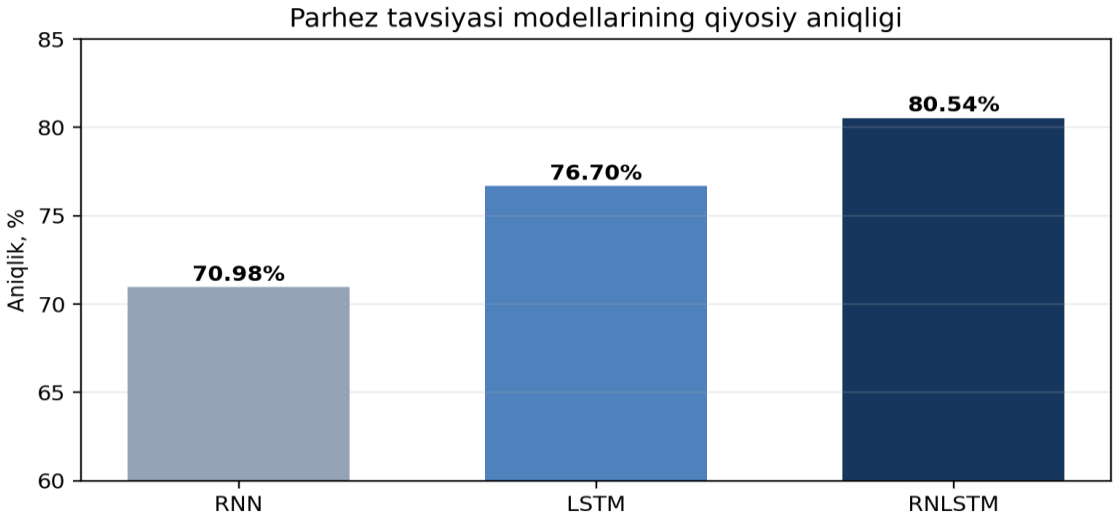
Birinchi manbada hududiy parhez tavsiyasi uchun uch model qiyoslangan: RNN 70,98 foiz, LSTM 76,70 foiz va RNLSTM 80,54 foiz aniqlik ko‘rsatgan [1]. RNLSTM RNNdan 9,56 foiz punkt, LSTMdan 3,84 foiz punkt yuqori. Bu farq ansambl va ketma-ketlik xususiyatlarini birgalikda ishlatish foydali bo‘lishi mumkinligini ko‘rsatadi. Biroq bitta accuracy qiymati klasslar muvozanati, test to‘plami tuzilishi va klinik xavfsizlikni to‘liq ifodalamaydi.

Manbada RNLSTM trening va validatsiya yo‘qotishining dastlabki epoxalarda pasayishi, taxminan 40-epoxadan keyin esa tekislanishi tasvirlangan [1]. LSTM grafigida trening yo‘qotishi yuqoriroq va tebranuvchan bo‘lib, mualliflar buni murakkab yoki uzoq bog‘liqliklarni optimallashtirishdagi qiyinchilik bilan izohlagan. Ushbu kuzatuv yangi gibrid modelda erta to‘xtatish, muntazamlashtirish va vaqt bo‘yicha validatsiya zarurligini asoslaydi.

Ikkinchi manbada Apriori natijalari ijtimoiy fan bahosining B+ dan A+ ga o‘tishi uchun 39 foiz support va 80 foiz confidence ko‘rsatgan [2]. Ingliz tili B+ dan A+ ga o‘tishi, din fanidagi A bahosi bilan ijtimoiy fandagi A+ bahosi hamda matematika B+ bilan ingliz/ijtimoiy fandagi A+ natijasi uchun support 33 foiz, confidence 80 foiz deb berilgan [2]. Matematika bahosining bevosita yaxshilanishi bo‘yicha muhim assotsiatsiya aniqlanmagan.

K-Means tahlilida uchala klasterda o‘rtacha ball ko‘tarilgan. Eng yuqori boshlang‘ich natijaga ega birinchi klasterda ko‘rsatkich 90,87521 dan 92,51072 ga, ikkinchi klasterda 82,91327 dan 84,97662 ga, uchinchi klasterda 82,26082 dan 84,47545 ga oshgan [2]. Mutlaq o‘sish mos ravishda 1,64; 2,06 va 2,21 ballni tashkil etadi. Mualliflar birinchi klasterni o‘rta ta’lim bosqichining eng ijobiy javobi sifatida tavsiflagan, ammo mutlaq farq bo‘yicha uchinchi klasterdagi o‘sish kattaroq. Bu talqin mezonini oldindan aniq belgilash zarurligini ko‘rsatadi.

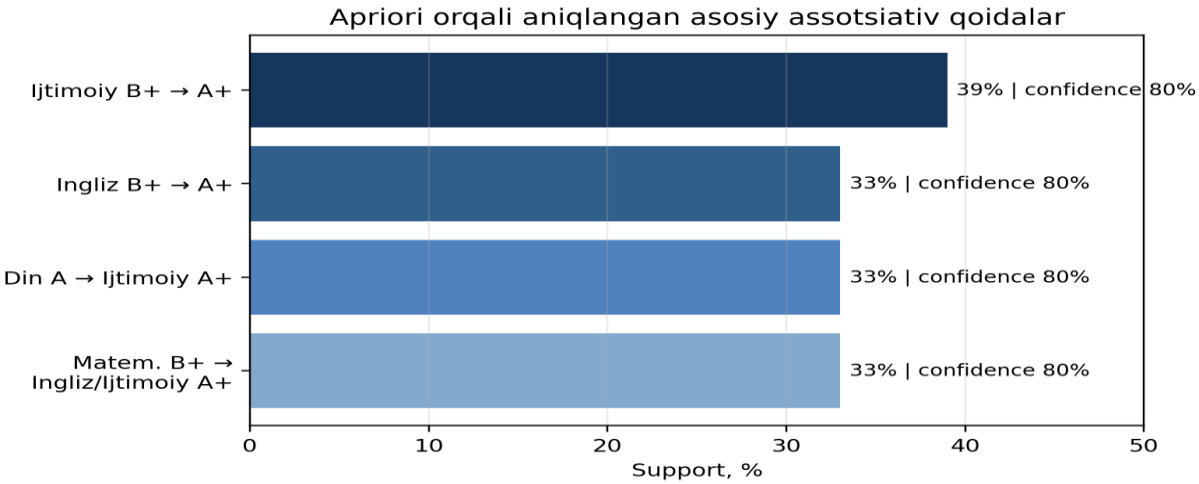
Ikki manbaning natijalari bir-birini funksional jihatdan to‘ldiradi. Birinchi ish individual foydalanuvchiga mos menyuni yaratishga urg‘u beradi, ikkinchi ish esa dastur natijalaridan guruhiy naqshlarni chiqaradi. Ularning integratsiyasi tavsiya yaratish, haqiqiy iste’molni qayd etish, natijani kuzatish va yangi qoidalarni modelga qaytarish jarayonini yaxlitlashtiradi.



3-rasm. RNN LSTM va RNLSTM modellarining manbada keltirilgan aniqligi [1]

4-jadval. Parhez tavsiyasi modellarining sonli natijalari [1]

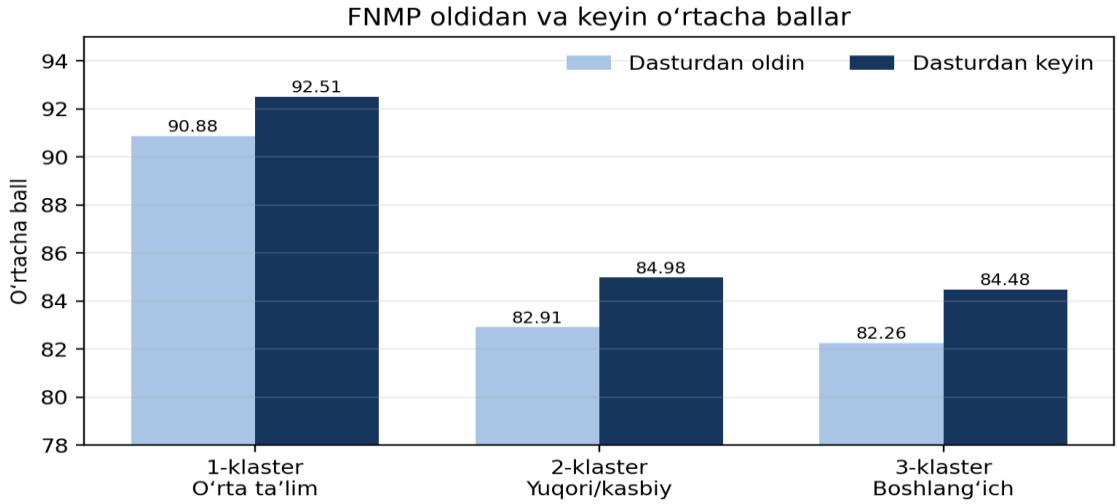
Model	Aniqlik	RNLSTMga nisbatan farq	Tahliliy talqin
RNN	70,98%	−9,56 foiz punkt	Qisqa ketma-ketlikni ushlaydi, uzoq bog‘liqlikda cheklanishi mumkin
LSTM	76,70%	−3,84 foiz punkt	Uzoq muddatli bog‘liqlikni saqlaydi
RNLSTM	80,54%	0	Birlashma mexanizmi natijasi; manbadagi eng yuqori aniqlik



4-rasm. O‘quv natijalariga doir asosiy assotsiativ qoidalar [2]

5-jadval. Apriori natijalarining mazmuniy talqini [2]

Qoida	Support	Confidence	Ehtiyotkor talqin
Ijtimoiy fan B+ → A+	39%	80%	Kuzatuvlarning sezilarli qismida takrorlangan o‘tish
Ingliz tili B+ → A+	33%	80%	Til ko‘nikmasi o‘sishi bilan bog‘langan naqsh
Din A → Ijtimoiy fan A+	33%	80%	Fanlararo birgalik; sababiy bog‘lanish emas
Matematika B+ → Ingliz va ijtimoiy A+	33%	80%	Boshlang‘ich akademik profil bilan bog‘liq qoida
Matematika natijasining bevosita o‘sishi	Muhim emas	Muhim emas	Qo‘shimcha pedagogik omillar zarur bo‘lishi mumkin



5-rasm. Uch klaster bo‘yicha dasturdan oldingi va keyingi o‘rtacha ballar [2]

6-jadval. Klasterlar bo‘yicha ball o‘zgarishi [2]

Klaster	Manbadagi guruh talqini	Oldin	Keyin	Mutlaq o‘sish
1	O‘rta ta’lim	90,87521	92,51072	1,64
2	Yuqori va kasbiy ta’lim	82,91327	84,97662	2,06
3	Boshlang‘ich ta’lim	82,26082	84,47545	2,21

Taklif etilgan modeldan olingan konseptual natijalar

Qiyosiy sintez natijasida uchta asosiy moslik aniqlandi. Birinchidan, RNLSTMning ketma-ketlikni modellashtirish qobiliyati oziq-ovqat iste’moli va foydalanuvchi holatining vaqt bo‘yicha o‘zgarishiga mos keladi. Ikkinchidan, Apriori tavsiya, amal qilish va natija kategoriyalarining birga uchrashini izohlanuvchi qoida shaklida beradi. Uchinchidan, K-Means umumiy o‘rtacha ichida yo‘qolib ketadigan javob guruhlarini ajratadi. Ushbu funksiyalar bir-birini takrorlamaydi, shuning uchun ularni yagona tizimda saqlash metodik jihatdan asosli.

Modelning kutiladigan chiqishi uch darajali bo‘ladi. Individual darajada tizim foydalanuvchiga oziqaviy va hududiy jihatdan mos menyular reytingini beradi. Guruh darajasida o‘xshash javob profillari va ular uchun samarali bo‘lgan menyu xususiyatlari ko‘rsatiladi. Boshqaruv darajasida dastur qamrovi, qabul qilinish darajasi, xavfsizlik signallari va natija dinamikasi monitoring qilinadi.

Gibrid modelning izohlanuvchanligi faqat neyron tarmoq balliga bog‘liq bo‘lmaydi. Har bir tavsiya uchun energiya va ozuqa mosligi, chiqarib tashlangan allergenlar, hududiy mavjudlik, foydalanuvchi afzalligi hamda tegishli assotsiativ qoida ko‘rsatilishi mumkin. Shunda foydalanuvchi yoki mutaxassis tavsiyaning asosini tushunadi, zarur bo‘lsa muqobilni tanlaydi.

Taklif etilgan qaror mantig‘ida xavfsizlik qoidalari mashinali o‘qitish natijasidan ustun turadi. Model yuqori ball bergan taom allergiya, tibbiy cheklov yoki yoshga mos porsiya talabini buzsa, tavsiya ro‘yxatiga kiritilmaydi. Bu tamoyil algoritmik aniqlik va amaliy xavfsizlikning bir xil tushuncha emasligini e’tirof etadi.

Sintez modelni bosqichma-bosqich joriy qilishni talab etadi. Dastlab ma’lumotlar lug‘ati va hududiy taom bazasi yaratiladi. Keyin tavsiya prototipi retrospektiv ma’lumotda tekshiriladi. Uchinchi bosqichda kichik pilot guruhida qabul qilish va foydalanish qulayligi baholanadi. Faqat xavfsizlik va monitoring mexanizmi barqarorlashgach, o‘quv natijalariga ta’sirni baholovchi uzoq muddatli tadqiqotga o‘tiladi.

MUHOKAMA

Olingan qiyosiy natijalar hududiylik va vaqt omili shaxsiy ovqatlanish tizimining markaziy tarkibiy qismlari bo‘lishi kerakligini ko‘rsatadi. Foydalanuvchi uchun oziqaviy jihatdan mukammal, ammo bozorda mavjud bo‘lmagan yoki madaniy jihatdan qabul qilinmaydigan menyu amaliy qiymatga ega emas. Shu sababli taom tarkibi bilan bir qatorda mavsum, narx, tayyorlash ko‘nikmasi va mahalliy nomlar ham tavsiya modeliga kiritilishi lozim [1].

RNLSTMning 80,54 foizlik natijasi istiqbolli, lekin uni universal ustunlik sifatida talqin qilish mumkin emas. Natija muayyan ma’lumotlar to‘plami, preprocessing va train-test bo‘linishiga bog‘liq [1]. Yangi hududga ko‘chirishda masalliqlar nomlari, porsiya hajmi va ovqatlanish madaniyati o‘zgaradi. Transfer learning yoki qayta o‘qitishdan oldin ma’lumotlar siljishi aniqlanishi kerak. Bundan tashqari, accuracy bilan bir qatorda xavfli tavsiyaning xato berilish darajasi ham alohida o‘lchanishi shart.

Apriori natijalari ovqat dasturidan keyingi ayrim fan baholari bilan barqaror qo‘shma naqshlarni ko‘rsatadi [2]. Biroq confidence 80 foiz bo‘lishi qoidaning sababiyligini anglatmaydi. Bahoning yaxshilanishi ovqatlanishdan tashqari o‘qituvchi, dastur mazmuni, baholash mezoni, davomat yoki oilaviy qo‘llab-quvvatlash bilan bog‘liq bo‘lishi mumkin. Shuning uchun qoidalar pedagogik ekspertiza va nazoratli statistik tahlil bilan tekshirilishi zarur.

Matematika natijasida bevosita muhim assotsiatsiya topilmagani muhim salbiy natijadir [2]. Bu ovqatlanish dasturi foydasizligini emas, formal va hisoblash ko‘nikmalari boshqa pedagogik omillarga kuchliroq bog‘liq bo‘lishi mumkinligini ko‘rsatadi. Model bunday holatda “ta’sir yo‘q” degan keskin hukm bermasdan, qo‘shimcha mashq, metodika va boshlang‘ich tayyorgarlik belgilarini yig‘ishni tavsiya qilishi kerak.

Klasterlar bo‘yicha barcha guruhlarda o‘sish kuzatilishi dastur bilan ijobiy vaqt bog‘lanishini ko‘rsatadi, ammo klaster sentroidlari individual o‘quvchining o‘zgarishini to‘liq tasvirlamaydi. O‘rtacha qiymat ichida pasaygan, o‘zgarmagan va keskin oshgan holatlar birga bo‘lishi mumkin. Shu sababli taklif etilgan model klaster markazi bilan birga taqsimot, ishonch oralig‘i va individual trayektoriyalarni ham saqlashi lozim.

Ikki manbaning birlashtirilishi “tavsiya–amal qilish–natija” zanjiridagi kuzatuv bo‘shlig‘ini kamaytiradi. Agar tizim faqat tavsiya yaratsa, foydalanuvchi uni bajargan-bajarmagani noma’lum qoladi. Agar faqat natija tahlil qilinsa, qaysi menyu komponenti ta’sirga mos kelgani aniqlanmaydi. Yopiq kontur har bir bosqichni vaqt belgisi va identifikator bilan bog‘lab, modelni muntazam qayta baholashga imkon beradi.

Hududiy ovqat bazasini yaratishda standartlashtirish alohida muammo hisoblanadi. Bitta taom turli oilalarda boshqa porsiya, yog‘ miqdori yoki pishirish usuli bilan tayyorlanadi. Shuning uchun retsept nomini yagona oziq qiymati bilan bog‘lash o‘rniga masalliq darajasi, porsiya oralig‘i va tayyorlash varianti saqlanishi maqsadga muvofiq. Manba kelib chiqishi va yangilanish sanasi ko‘rsatilmasa, tavsiya modelining izohlanishi va takrorlanishi pasayadi.

Foydalanuvchi roziligi va ma’lumotlarni minimallashtirish tizimning texnik arxitekturasiga boshidan kiritilishi kerak. Sog‘liq va o‘quv ma’lumotlari ayniqsa sezgir bo‘lib, ularni birlashtirish qayta identifikatsiya xavfini oshiradi. Shaxsiy ma’lumotlarni shartli identifikatorlar bilan almashtirish, rollarga asoslangan kirish, audit jurnali, saqlash muddatini cheklash va umumlashtirilgan hisobotlar zarur. Voyaga yetmaganlar ishtirokidagi tadqiqotda ota-ona yoki qonuniy vakil roziligi va etik komissiya talablari bajarilishi shart.

Algoritmik adolat ham e’tibordan chetda qolmasligi kerak. Model ko‘p uchraydigan oziq-ovqat va katta guruhlarga yaxshiroq moslashib, kam uchraydigan allergiya, kichik hudud yoki iqtisodiy jihatdan cheklangan foydalanuvchilar uchun yomonroq ishlashi mumkin. Natijalar umumiy o‘rtacha bilan cheklanmay, demografik va hududiy kesimlarda tekshiriladi. Noto‘g‘ri ishlaydigan guruh uchun qoidaviy xavfsizlik va mutaxassis nazorati kuchaytiriladi.

Tizimning amaliy qabul qilinishi aniqlikdan kam bo‘lmagan ahamiyatga ega. Tavsiyaning sababi oddiy tilda tushuntirilmasa yoki taom tayyorlash juda murakkab bo‘lsa, texnik jihatdan yuqori ball foydalanuvchi xulqiga aylanmaydi. Interfeys bir nechta ekvivalent tanlov, masalliq almashtirish, porsiya tavsifi va taxminiy narxni ko‘rsatishi kerak. Foydalanuvchining rad etish sababi ham model uchun foydali qayta aloqa hisoblanadi.

Maktab yoki universitet miqyosida joriy etishda pedagogik natija asosiy, ammo yagona ko‘rsatgich bo‘lmasligi kerak. Davomat, darsdagi faollik, subyektiv energiya holati, sog‘liq shikoyatlari va ovqat isrofi ham kuzatilsa, tizimning ta’sir mexanizmi yaxshiroq tushuniladi. Aks holda, bahodagi kichik o‘zgarishga ortiqcha ma’no yuklash xavfi paydo bo‘ladi.

Tavsiya tizimini real vaqt ma’lumoti bilan boyitish istiqbolli yo‘nalishdir. Faollik kuzatuc vositalari glyukoza monitoringi yoki mobil kundalikdan ma’lumot olish individual moslashuvni kuchaytirishi mumkin [5], [9]. Shu bilan birga qurilma xatosi, uzilgan signal va ma’lumotga teng bo‘lmagan kirish yangi tarafkashliklarni keltirib chiqaradi. Shuning uchun real vaqt oqimi sifat nazoratidan o‘tkazilib, qurilmasiz foydalanuvchi ham tizimdan foydalanishi ta’minlanadi.

Taklif etilgan model qarorlarni qo‘llab-quvvatlash tizimi sifatida talqin qilinadi. U dietolog yoki shifokorning klinik hukmini, o‘qituvchining pedagogik

bahosini va oilaning tanlovini avtomatik almashtirmaydi. Aksincha, ko‘p o‘lchovli ma’lumotdan tushunarli tavsiya, xavf signali va kuzatuv guruhi yaratadi. Yuqori xavf holatlari avtomatik emas, inson nazoratidagi yo‘lga uzatilishi kerak.

Modelning ustunliklari va cheklovlari

7-jadval. Taklif etilgan yondashuvning ustunliklari va cheklovlari

Yo‘nalish	Ustunlik	Cheklov yoki xavf	Kamaytirish chorasi
Shaxsiylashtirish	Profil va vaqt ketma-ketligini birlashtiradi	Sovuq start va yetishmagan tarix	Qoidaviy boshlang‘ich model va bosqichli moslashuv
Hududiylik	Mahalliy va mavsumiy taomni hisobga oladi	Retsept va porsiya o‘zgaruvchanligi	Ingredient darajasida standartlashtirish
Izohlanuvchanlik	Apriori qoidalari tushunarli naqsh beradi	Assotsiatsiya sababiylik emas	Ekspert tekshiruvi va nazoratli dizayn
Segmentatsiya	Turli javob guruhlarini ko‘rsatadi	K tanlovi va boshlang‘ich markazga sezgirlik	Silhouette va qayta ishga tushirish
Monitoring	Natijaga qarab model yangilanadi	Model drift va xato qayta aloqa	Versiyalash, audit va holdout nazorati
Maxfiylik	Maqsadli ma’lumotlar modeli	Sog‘liq va ta’lim ma’lumotini bog‘lash xavfi	Psevdonim, minimal yig‘ish, rol asosidagi kirish

Ushbu tadqiqotning birinchi cheklovi ikki maqolaga tayangan ikkilamchi tahlildir. Manba ma’lumotlarining xom to‘plamlari qayta hisoblanmagan, shu bois keltirilgan natijalar mualliflar e’lon qilgan qiymatlar doirasida qoladi. Ikkinchi cheklov — ikki tadqiqotning populyatsiyasi va maqsadi turlicha: biri individual parhez tavsiyasi, ikkinchisi maktab dasturining ta’limiy natijasidir. Ularni birlashtirish to‘g‘ridan-to‘g‘ri meta-tahlil emas, funksional arxitektura sintezidir.

Uchinchi cheklov natijalarning hududga xosligidir. Tamil Nadu taomlari yoki Indoneziyadagi bepul ovqat dasturidan olingan tuzilma O‘zbekiston sharoitiga avtomatik ko‘chirilmaydi [1], [2]. Mahalliy taomlar tarkibi, maktab menyusi, baholash tizimi va ijtimoiy sharoit bo‘yicha yangi ma’lumot yig‘ilishi talab etiladi. To‘rtinchi cheklov — o‘quv natijasidagi o‘zgarishni faqat ovqatlanish bilan izohlash mumkin emasligi.

Shunga qaramay, konseptual sintez keyingi empirik tadqiqot uchun tekshiriladigan arxitektura va aniq o‘lchovlar beradi. U ma’lumotlar sxemasi, algoritmlarning vazifasi, baholash mezonlari, xavfsizlik shartlari va bosqichli sinov ketma-ketligini oldindan belgilaydi. Bu esa prototip yaratishda metodik noaniqlikni kamaytiradi.

Kelgusidagi empirik sinov dizayni

Birinchi bosqichda Xorazm hududiga mos oziq-ovqat ontologiyasi tuzilishi mumkin. Unda mahalliy taomlarning retsepti, porsiya oralig‘i, energiya va makronutrient tarkibi, mavsumiy mavjudligi, taxminiy narxi va allergenlari standart shaklda saqlanadi. Ma’lumot dietolog va oziq-ovqat texnologlari tomonidan tekshiriladi. Foydalanuvchi profilining minimal majburiy maydonlari oldindan belgilanadi.

Ikkinchi bosqich avval to‘plangan ma’lumotlar asosidagi texnik validatsiyadan iborat bo‘ladi. Baseline sifatida popularity-based, kontentga asoslangan, K-NN yoki oddiy DNN modellari tanlanadi. RNLSTM shu bazaviy usullar bilan bir xil train-validation-test bo‘linishida qiyoslanadi. Natijalar accuracy yoki MAE bilan birga tavsiya xilma-xilligi, oziqaviy cheklov buzilishi va guruhlar bo‘yicha xato orqali baholanadi.

Uchinchi bosqichda 8–12 haftalik dastlabki tajriba-sinov tadqiqot rejalashtiriladi. Ishtirokchilar tavsiya qilingan menyu, tanlangan muqobil va haqiqiy iste’molni qayd etadi. Maktab kontekstida davomat, subyektiv diqqat ko‘rsatkichi va fanlar bo‘yicha baholar vaqt kesimida yig‘iladi. Apriori faqat yetarli tranzaksiya soni mavjud bo‘lganda ishga tushiriladi; juda past supportli qoidalar alohida ogohlantirish bilan ko‘rsatiladi.

To‘rtinchi bosqichda klaster barqarorligi tekshiriladi. K qiymati bir nechta mezon bilan tanlanadi, turli boshlang‘ich nuqtalarda algoritm qayta ishlatiladi va klasterlarning talqini pedagog hamda dietolog bilan birga baholanadi. Bir guruhga yuqori aniqlik bilan tegishlilikni klinik yoki pedagogik yorliq sifatida qabul qilish mumkin emas; klaster faqat o‘xshash kuzatuv profili hisoblanadi.

Beshinchi bosqichda model monitoringi yo‘lga qo‘yiladi. Ma’lumotlar taqsimoti, tavsiya qabul qilinishi, xavfsizlik filtrlari soni va guruhlar bo‘yicha xato har oy kuzatiladi. Belgilar taqsimoti sezilarli siljisa, model avtomatik qayta o‘qitilmaydi; avval sabab va ma’lumot sifati tekshiriladi. Tasdiqlangan yangi versiya oldingi model bilan nazoratli ravishda qiyoslanadi.

8-jadval. Empirik sinovni bosqichma-bosqich tashkil etish

Bosqich	Asosiy ish	Natija	Qabul mezoni
1	Hududiy taom bazasi va ma’lumotlar lug‘ati	Tekshirilgan oziq-ovqat katalogi	Maydonlar to‘liqligi va ekspert tasdig‘i
2	Retrospektiv model qiyosi	Baseline va RNLSTM metrikalari	Test to‘plamida ustun yoki teng xavfsiz natija
3	Kichik pilot	Qabul qilish, rioya va dastlabki natija	Xavfsizlik buzilishi yo‘q; yetarli foydalanish
4	Apriori va K-Means tahlili	Qoidalar va javob profillari	Barqaror, mazmunli va tekshiriladigan naqshlar

Bosqich	Asosiy ish	Natija	Qabul mezoni
5	Prospektiv baholash	Nazoratli ta’sir bahosi	Oldindan belgilangan statistik va amaliy mezonlar
6	Monitoring	Model drift va adolat hisoboti	Tasdiqlangan yangilash jarayoni

XULOSA

Tadqiqot hududiy taomlarga asoslangan shaxsiy parhez tavsiyasi bilan ovqatlanish aralashuvining o‘quv natijalarini tahlil qilishni yagona gibrid intellektual modelga birlashtirdi. Manba tahlili RNLSTMning RNN va LSTMga nisbatan yuqori aniqlik ko‘rsatganini, Apriori ayrim fanlardagi baho o‘tishlari uchun 33–39 foiz support hamda 80 foiz confidence aniqlaganini, K-Means esa barcha uch klasterda o‘rtacha ball o‘sishini ko‘rsatganini tasdiqladi [1], [2].

Taklif etilgan arxitekturada RNLSTM individual va vaqtga bog‘liq tavsiyani ishlab chiqadi, Apriori kuzatiladigan kombinatsiyalarni tushunarli qoidalarga aylantiradi, K-Means esa turlicha javob beradigan foydalanuvchi guruhlarini ajratadi. Natijalar ombori va monitoring qatlami ushbu komponentlarni yopiq qayta aloqa konturida bog‘laydi. Shunday tuzilma tavsiyaning oziqaviy mosligi, hududiy bajarilishi, foydalanuvchi tomonidan qabul qilinishi va uzoqroq muddatli natijasini birgalikda baholash imkonini beradi.

Maqolada keltirilgan sonli ko‘rsatkichlar yangi tajriba natijasi emas, ikki asosiy manbadan olingan qiyosiy dalillardir. Modelni O‘zbekiston sharoitida qo‘llash uchun mahalliy oziq-ovqat bazasi, etik tasdiq, prospektiv ma’lumot yig‘ish, baseline modellar bilan qiyoslash va nazoratli ta’sir bahosi talab etiladi. Amaliy tizimda xavfsizlik qoidalari algoritm ballidan ustun turishi, tavsiya izohlanishi va mutaxassis nazorati saqlanishi lozim.

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ENERGY EFFICIENCY TRANSFORMATION IN UZBEKISTAN: STATE POLICY, FISCAL, AND FINANCIAL MECHANISMS

Abstract. *This study examines Uzbekistan's energy efficiency transformation through state policy, fiscal instruments, and financial mechanisms. Using a qualitative analytical approach, it assesses the institutional framework, energy audits, financial support, ESCO mechanisms, and measurement and verification procedures. The findings indicate a shift toward an integrated framework connecting energy assessment, investment financing, implementation, and performance measurement to support energy efficiency and green economic transformation.*

Keywords: *Energy efficiency; fiscal instruments; financial mechanisms; energy audits; ESCO; green economy; Uzbekistan.*

I. Inroduction

One of the most important directions in the country's transition to a green economy is improving energy efficiency. For a country like Uzbekistan, which aims to sustain rapid economic growth while experiencing a relatively high rate of population growth, making energy efficiency a key priority is a natural and increasingly important part of the transition toward a greener economy.

Uzbekistan's relatively high energy intensity highlights the importance of improving energy efficiency as part of its broader economic transformation. According to the International Energy Agency (IEA), although Uzbekistan's per capita energy consumption is around one-quarter below the global average, its economy remains highly energy-intensive, with energy consumption per unit of GDP more than 50% above the world average. The IEA also notes that Uzbekistan's energy use declined by approximately 14% between 2010 and 2020, reaching around 33 million tonnes of oil equivalent (Mtoe), while substantial potential for further efficiency improvements remains across major sectors of the economy (IEA, 2022). The World Bank similarly identifies the high energy intensity of Uzbekistan's economy as being closely associated with historically low, below-cost energy tariffs and substantial energy subsidies, which have contributed to inefficient resource use. In 2020, energy subsidies were estimated at 6.6% of GDP (World Bank, 2023). These indicators suggest that reducing energy intensity in Uzbekistan requires not only technological modernization but also structural and policy measures capable of encouraging more efficient energy use and investment.

In response to these challenges, Uzbekistan has been increasingly strengthening its institutional and policy framework for improving energy efficiency. A significant step in this direction was the establishment of the National

Agency for Energy Efficiency under the Cabinet of Ministers in 2025. The Agency was assigned a broad range of responsibilities, including coordinating state policy on energy efficiency, developing the energy audit system, supporting energy-efficient investment projects, developing the ESCO market, and promoting more rational energy use among households and businesses. At the same time, a number of financial support instruments have been introduced to encourage energy efficiency investments, including subsidies for energy audits, support for solar energy and heating technologies, and partial compensation of interest expenses on green loans.

Recent policy initiatives also indicate a shift from individual energy-saving measures toward a more systematic approach to energy efficiency management. In particular, the proposed framework for improving the energy audit system envisages mandatory energy audits for entities included in the State Energy Register, energy performance classification of buildings, energy passports, benchmarking, risk-based monitoring, and measurement and verification of achieved energy savings. It also links the results of energy audits with the identification of energy-saving measures, investment requirements, capital and operating costs, economic efficiency, and implementation roadmaps.

Research gap

Despite these developments, there remains a limited understanding of how Uzbekistan's emerging institutional framework, fiscal incentives, and financial mechanisms can function as an integrated system for promoting energy-efficiency investment. Existing policy initiatives have introduced a range of instruments, including energy audits, subsidies, preferential financing, ESCO mechanisms, and performance monitoring. However, these instruments are generally considered as separate components, while the links between energy-efficiency assessment, investment decision-making, public support, private financing, and measurement of achieved savings remain insufficiently examined. In particular, limited attention has been given to how the results of energy audits can be translated into investment decisions, how fiscal support can reduce investment barriers, and how private financing mechanisms can contribute to the implementation and verification of energy-efficiency measures. This creates a research gap concerning the development of an integrated policy and financing framework for accelerating energy efficiency transformation in Uzbekistan.

Research Questions

Based on the identified research gap, this study examines Uzbekistan's energy efficiency transformation from three interconnected perspectives: the institutional and policy framework, the role of fiscal and financial mechanisms in stimulating investment, and the integration of these instruments into a coherent energy efficiency mechanism. Accordingly, the study addresses the following research questions:

RQ1. What are the key features and gaps in Uzbekistan's current institutional and policy framework for improving energy efficiency?

RQ2. What fiscal and financial mechanisms can be used to stimulate investment in energy efficiency in Uzbekistan?

RQ3. How can energy audits, performance measurement, fiscal incentives, and private financing be integrated into an effective energy efficiency mechanism in Uzbekistan?

Literature review

In last dacedes, energy efficiency has become an important component of sustainable economic development and the transition toward low-carbon growth. In the economic literature, energy efficiency is generally associated with the ability to generate a given level of economic output or energy service with lower energy consumption. Consequently, improvements in energy efficiency can contribute simultaneously to economic, environmental, and energy-security objectives. IEA identifies energy efficiency as one of the most cost-effective means of strengthening energy security, improving competitiveness and welfare, and reducing the environmental footprint of energy systems (IEA, 2019). This broader perspective indicates that energy efficiency should not be considered solely as a technical issue, but also as an important element of economic policy and structural transformation.

A central concept in this literature is energy intensity, commonly measured as energy consumption per unit of gross domestic product. A decline in energy intensity is often interpreted as an improvement in the efficiency with which an economy uses energy to generate economic value. However, changes in aggregate energy intensity do not necessarily reflect technological improvements alone. They may also result from changes in the sectoral composition of economic activity. OECD analysis demonstrates that structural factors can either reinforce or offset the effects of technical energy-efficiency improvements. In particular, a shift toward less energy-intensive sectors can reduce aggregate energy intensity even in the absence of equivalent improvements in the efficiency of individual production processes (IEA, 2019).

The distinction between technical efficiency and structural change is therefore important when assessing the relationship between economic growth and energy consumption. Empirical research on OECD economies has shown that changes in sectoral composition account for a significant part of observed energy-intensity dynamics, while energy intensity has also declined in many manufacturing sectors over time (Mulder and de Groot, 2012). This suggests that improvements in energy efficiency should be assessed not only through aggregate energy-intensity indicators but also through technological modernization, sector-specific energy performance, and changes in the structure of economic activity.

The relationship between economic growth and energy consumption has also received considerable attention in the literature on decoupling. The IEA reports that energy consumption and economic growth have increasingly shown signs of decoupling in a number of economies, with improvements in energy intensity playing an important role. Under the IEA's Sustainable Development Scenario, additional energy-efficiency improvements represent a major source of projected energy savings, particularly in industry, buildings, and transport (IEA, 2019). At the

same time, the literature cautions against assuming that efficiency improvements automatically lead to proportional reductions in total energy consumption. Economy-wide rebound effects may partly offset the expected energy savings because lower energy costs or increased productivity can stimulate additional consumption and economic activity (Brockway et al, 2021).

More recent evidence reinforces the importance of energy efficiency for maintaining economic growth while reducing energy demand and environmental pressures. The IEA estimates that improvements in energy efficiency have allowed economies to accommodate substantial economic expansion without a corresponding increase in final energy demand. In IEA member countries, for example, final energy demand remained broadly stable over two decades while real economic output increased substantially, reflecting the cumulative contribution of efficiency improvements and changes in economic structure (IEA, 2022).

From a green-transition perspective, energy efficiency therefore represents an important mechanism through which economic development can become less dependent on energy consumption and associated emissions. However, the literature indicates that achieving such a transition requires more than technological improvements. The pace of energy-efficiency improvement depends on investment, market incentives, institutional arrangements, energy prices, and the policy environment. This is particularly relevant for emerging economies, where rapid growth in industrial production, urbanisation, infrastructure, and household energy demand can create additional pressure on energy systems. Energy efficiency in this context becomes not simply a means of reducing energy consumption, but a mechanism for improving the productivity of energy resources while supporting continued economic development.

This perspective is particularly relevant to Uzbekistan. The World Bank characterises Uzbekistan as an energy-intensive economy and argues that decarbonisation of the energy-intensive economic structure can contribute to the country's development objectives and improvements in living standards (World Bank, 2023). Thus, the energy-efficiency challenge in Uzbekistan should be understood within the broader process of economic transformation: reducing energy intensity requires improvements in technologies and infrastructure, but also changes in incentives, investment behaviour, institutional capacity, and the allocation of financial resources. This provides a basis for examining the institutional and policy mechanisms through which governments can translate the economic potential of energy efficiency into actual investment and energy savings.

The literature increasingly emphasizes that energy efficiency is not determined by technological potential alone, but also by the institutional and policy environment in which energy-related decisions are made. Governments use a combination of regulatory, informational, and incentive-based instruments to influence the behaviour of households, firms, and investors. The International Energy Agency identifies regulation, information, and incentives as three complementary pillars of effective energy-efficiency policy, arguing that their coordinated implementation is more effective than relying on individual measures

in isolation (IEA, 2024). Regulatory measures can establish minimum performance requirements, while information instruments reduce information asymmetries and incentives improve the financial attractiveness of energy-efficiency investments.

Regulation is particularly important in sectors where consumers and firms face limited information or where the benefits of efficiency investments materialize over a relatively long period. Building energy codes, minimum energy performance standards, mandatory energy audits, energy-management requirements, and energy-performance certification can establish common performance requirements and create more predictable conditions for investment. At the same time, information-based measures such as benchmarking, energy labels, energy audits, and performance indicators can help economic agents identify efficiency opportunities that may otherwise remain unrecognized (IEA, 2024). The literature therefore suggests that institutional arrangements for collecting, assessing, and communicating energy-performance information are an important part of energy-efficiency policy.

Financial constraints represent another major barrier identified in the literature. Energy-efficiency projects frequently require substantial initial expenditure, while their economic benefits are realized through future reductions in energy consumption and operating costs. This creates a financing challenge because conventional lending decisions may place greater emphasis on collateral and immediate cash flows than on future energy savings. Recent policy research therefore highlights the importance of preferential loans, grants, tax incentives, guarantees, risk-sharing mechanisms, and other forms of public support that can reduce investment risks and mobilise private capital for energy-efficiency projects (IEA, 2026). In this context, public financial intervention does not necessarily replace private finance; rather, it can improve the risk-return profile of projects and facilitate the participation of commercial financial institutions.

The role of Energy Service Companies (ESCOs) has also received increasing attention as a mechanism for overcoming financing and technical barriers. ESCO models can combine technical expertise, project implementation, financing arrangements, and performance-based remuneration, allowing energy consumers to undertake efficiency improvements without bearing all of the initial financial and technical risks themselves. A recent systematic review of the ESCO literature shows that research has increasingly focused on business models, market development, and energy performance contracting, while risk management and market evaluation remain important areas for further research (Cebekhulu et al., 2024). This indicates that the effectiveness of ESCO mechanisms depends on the existence of appropriate contractual, regulatory, and financial conditions.

These findings are relevant to Uzbekistan because the country's energy-efficiency transformation is increasingly moving from individual energy-saving measures toward a broader institutional and financing framework. The emerging policy approach combines energy audits and performance assessment with financial support, investment mechanisms, ESCO development, and monitoring of energy savings. From the perspective of the existing literature, the key issue is therefore not

simply whether individual instruments are available, but whether they can operate as complementary components of a single mechanism. This creates a basis for examining how fiscal and financial instruments can support energy-efficiency investment and how energy audits, financing mechanisms, and measurement of results can be connected within Uzbekistan's institutional framework.

The reviewed literature demonstrates that energy efficiency should be approached as a multidimensional economic and policy issue rather than as a purely technological objective. The existing studies establish several important relationships. First, improvements in energy efficiency can contribute to lower energy intensity, greater energy security, improved economic competitiveness, and reduced environmental pressures. Second, the effectiveness of efficiency improvements depends on the institutional and regulatory environment, including standards, information systems, monitoring, and enforcement. Third, financing conditions are critical because the technical and economic potential of energy-saving measures does not automatically translate into actual investment. Finally, mechanisms such as ESCOs, energy performance contracting, and measurement and verification can help connect identified energy-saving opportunities with implementation and financing.

At the same time, the literature indicates that these elements are frequently examined separately. Studies on energy efficiency and economic growth primarily focus on energy intensity, technological change, structural transformation, and rebound effects. Policy-oriented research tends to concentrate on regulatory instruments, standards, information measures, and institutional capacity. Another strand of the literature examines financing barriers and the role of subsidies, concessional finance, guarantees, and private capital, while research on ESCOs focuses on contractual arrangements, performance-based financing, and market development. Although these strands are complementary, relatively less attention has been given to how they can be combined into an integrated policy and financing mechanism within a specific national institutional context.

This perspective is especially important in the case of Uzbekistan. Existing international studies provide a broad analytical basis for understanding energy efficiency, but relatively limited academic attention has been devoted to the emerging institutional and financial architecture of energy efficiency in Uzbekistan. In particular, there is a need for further examination of how the country's developing energy-audit system, financial support instruments, ESCO mechanisms, investment incentives, and performance-monitoring arrangements can interact within a single policy framework. This is important because the effectiveness of energy-efficiency policy depends not only on the formal availability of individual instruments but also on their coordination and ability to support the full investment cycle.

Accordingly, the main research gap identified from the literature is the limited analysis of the interaction between institutional arrangements, fiscal incentives, financial mechanisms, energy audits, and performance measurement in Uzbekistan's energy-efficiency transformation. Existing literature provides substantial evidence on individual components of this system, but does not sufficiently explain how these

components can be integrated to overcome investment barriers and convert identified energy-saving potential into measurable economic and energy savings. Addressing this gap requires an approach that considers energy efficiency simultaneously as a policy, institutional, and investment process.

The present study contributes to this discussion by examining Uzbekistan's energy-efficiency transformation through the interaction of state policy, fiscal instruments, and financial mechanisms. It focuses not only on the existence of individual policy measures, but also on their institutional linkages and their potential to form a coherent mechanism connecting energy assessment, investment decision-making, financing, implementation, and measurement of results. In this way, the study seeks to extend the existing literature by providing an integrated assessment of the policy and financing architecture supporting energy-efficiency transformation in Uzbekistan.

II. Methodology

This study applies a qualitative analytical approach to examine energy-efficiency transformation in Uzbekistan. The analysis combines policy and institutional analysis with an assessment of fiscal and financial mechanisms supporting energy-efficiency investment. The study uses national regulatory documents, government policy materials, and reports and analytical publications of international organisations, including the IEA and World Bank.

The analysis focuses on four interconnected elements: (i) the institutional and regulatory framework for energy efficiency, (ii) fiscal and financial instruments supporting investment, (iii) energy audits and ESCO mechanisms, and (iv) measurement and verification of energy savings. These elements are assessed in terms of their institutional responsibilities, implementation mechanisms, financing conditions, and potential to support investment and measurable energy savings.

III. Results

Institutional and Policy Framework

Uzbekistan has recently strengthened its institutional framework for energy efficiency. In March 2025, the National Energy Efficiency Agency was established under the Cabinet of Ministers with responsibility for coordinating state policy, developing the ESCO market, supporting high-efficiency projects and private investment, and establishing a system for training and registering energy auditors.

The emerging policy framework combines institutional reform with direct financial support. For households, the existing measures include full coverage of energy-audit costs, a 20% subsidy for solar panels, solar collectors and domestic heating boilers, and a subsidy covering up to 40% of heat-pump costs. Interest expenses on green loans are also partially compensated. For businesses, support includes partial compensation of interest on loans for solar installations in textile enterprises and subsidies for heat pumps used by greenhouse farms.

The scale of implementation also indicates a gradual transition from individual measures toward programme-based energy-efficiency interventions. In 2025, reported measures included 969 thousand m² of thermal insulation, 21.8 thousand kW of solar panels, 430 solar collectors and 965 heat pumps. In addition,

2.9 thousand heating boilers and 14,800 automatic burners were renewed, generating reported annual savings of 2.9 million kWh of electricity and 8.8 million m^3 of natural gas.

A further development is the increasing use of energy audits as a basis for investment decisions. Under the emerging framework, energy-efficiency projects are increasingly linked to energy audits, while energy performance monitoring, auditor training, ESCO mechanisms and digital data systems are being developed as complementary elements. The policy direction therefore indicates a shift from subsidising individual technologies toward establishing an institutional system that connects assessment, investment, implementation and monitoring.

The scale of the planned transformation is also reflected in the national targets. These include improving energy efficiency in social and public buildings, conducting energy audits of 371 industrial enterprises, training more than 1,000 energy auditors by 2030, developing the ESCO market, and achieving significant reductions in electricity and gas consumption.

Fiscal and Financial Mechanisms

Uzbekistan's emerging energy-efficiency policy combines direct subsidies, preferential financing, interest-rate compensation, and investment programmes. In 2025, 588.3 billion soums in preferential loans and subsidies were allocated to households to encourage energy-efficiency improvements, including green renovations and related measures.

Financial support is also being extended to businesses and infrastructure. For example, interest expenses on loans for solar installations in textile enterprises are partially compensated, while 25 billion soums is planned for the renewal of drinking-water pumps through energy-service-contract arrangements. In addition, financing is being mobilised through international financial institutions, with approximately US$539 million identified for energy-efficiency projects.

These instruments indicate that public financing is increasingly being used to reduce the initial investment barrier associated with energy-efficiency technologies. At the same time, the emerging approach increasingly involves commercial banks, ESCOs and international financing, suggesting a gradual shift from direct budget support toward mechanisms capable of mobilising private investment. The effectiveness of this transition, however, will depend on the development of reliable energy audits, project assessment, and measurement and verification systems.

Energy Audits, ESCOs and Measurement and Verification

The emerging energy-efficiency framework in Uzbekistan places energy audits at the centre of investment planning and performance assessment. The proposed framework establishes a system in which mandatory energy audits are conducted by qualified auditors included in a unified register, while audit procedures and contracts are managed through a digital platform. The framework also introduces different audit types, including initial, periodic, express, extraordinary, and targeted audits, allowing the depth of assessment to be adjusted to the characteristics and energy-performance risks of the consumer.

A particularly important feature is the connection between energy audits and investment decisions. The proposed methodology uses energy-performance indicators (EnPI), baseline energy performance indicators (EnB), and energy-performance improvement opportunities (EPIO) to assess efficiency potential. Measurement and verification (M&V) is defined as the process of measuring and confirming the actual savings achieved after energy-efficiency measures are implemented. For investment-oriented measures, M&V results are intended to provide evidence of the actual energy savings achieved, thereby strengthening the link between technical assessment and financial decision-making.

The proposed digital platform further strengthens this mechanism by integrating energy-audit procedures, auditor registration, energy-performance data and monitoring. The National Agency's plans also envisage the integration of information from energy and other relevant systems, as well as the use of digital technologies in energy audits and project development.

ESCO mechanisms represent another component of the emerging system. The National Agency reports that Uzbekistan has joined the Global ESCO Network and is developing an ESCO-based approach for improving the energy efficiency of social-sector facilities and other consumers. The reported targets include making 5,000 social-sector facilities more energy efficient and generating substantial electricity and natural-gas savings through ESCO arrangements. These figures represent planned results rather than outcomes already achieved.

Integrated Energy Efficiency Mechanism

The analysis of Uzbekistan’s current policy framework indicates that the country is moving toward an integrated mechanism in which institutional, fiscal, financial, and technical instruments complement each other. The National Agency for Energy Efficiency provides the institutional coordination function, while subsidies and preferential financing reduce the initial investment burden. Energy audits identify energy-saving opportunities and estimate their technical and economic potential, while ESCO arrangements can provide an alternative implementation and financing channel. The proposed M&V framework then provides a basis for determining and verifying the savings achieved.

From this perspective, the emerging mechanism can be represented as a continuous investment cycle. First, energy consumption and efficiency performance are assessed through audits and performance indicators. Second, technically and economically viable measures are identified together with their investment requirements and expected savings. Third, projects can be financed through public subsidies, preferential loans, international financing, private investment, or ESCO arrangements. Fourth, the implemented measures are monitored and their results are verified through M&V. Finally, verified savings provide information for further monitoring, investment planning, and improvement of energy-efficiency programmes. The proposed framework explicitly connects energy-performance indicators and M&V with energy-saving programmes and the assessment of achieved results.

This integrated approach is particularly relevant for public and social-sector facilities, where large-scale modernization programmes are increasingly being linked to energy audits. The National Agency reports that project documentation for the modernization of social-sector facilities is being developed on the basis of energy-audit reports and that energy-efficiency measures are incorporated into the modernization process. International financing is also being mobilised for energy-efficiency projects, including measures targeting schools, kindergartens, and medical facilities.

The results therefore suggest that Uzbekistan's energy-efficiency transformation is evolving from a predominantly technology-support approach toward a broader policy–finance–performance framework. Its central feature is the connection between identifying energy-saving potential, mobilising finance, implementing efficiency measures, and verifying their actual outcomes. At the same time, the analysis indicates that many elements of this mechanism remain at the stage of institutional development or planned implementation. Consequently, its long-term effectiveness will depend on the practical coordination of the institutions, financing instruments, ESCO market, audit system, and M&V procedures.

IV. Discussion

The findings of this study indicate that Uzbekistan's energy-efficiency transformation is increasingly moving beyond isolated technological interventions toward an institutional and investment-oriented framework. This development is consistent with the broader literature, which emphasizes that energy efficiency depends not only on technological improvements but also on regulation, information, incentives, financing conditions, and institutional capacity. In the Uzbek context, the establishment of a dedicated institutional structure and the development of energy-audit, ESCO, financing, and M&V mechanisms indicate an attempt to address these dimensions simultaneously.

The findings also reinforce the importance of financial mechanisms in translating energy-saving potential into actual investment. The availability of subsidies, preferential loans, interest-rate compensation, and international financing can reduce the initial capital barrier faced by households, businesses, and public institutions. However, public financial support alone is unlikely to be sufficient for large-scale transformation. The emerging involvement of commercial banks, international financial institutions, and ESCOs suggests the potential for a gradual transition toward greater mobilisation of private capital. This is particularly important because many energy-efficiency investments generate returns through future energy-cost savings rather than immediate revenues.

A further implication concerns the role of energy audits. The analysis shows that Uzbekistan is developing an approach in which audits are increasingly connected with investment planning rather than being treated simply as diagnostic exercises. The use of energy-performance indicators, baseline measurements, estimates of investment requirements, and M&V procedures can improve the quality of investment decisions by providing a more systematic assessment of expected and achieved savings. This corresponds with the literature's emphasis on

reducing information asymmetries and improving the reliability of energy-performance information.

The findings also highlight the importance of coordination among policy instruments. A subsidy without adequate project assessment may support investments with limited efficiency potential, while an energy audit without access to finance may identify technically viable measures that remain unimplemented. Similarly, financing mechanisms require reliable information on expected and achieved savings, particularly where repayment or remuneration is linked to energy performance. The emerging Uzbek framework therefore suggests that the effectiveness of individual instruments depends partly on the availability of complementary institutional mechanisms.

At the same time, the analysis identifies several implementation challenges. Many elements of the emerging framework remain under development, meaning that the formal availability of an instrument does not necessarily imply its effective operation at scale. The development of qualified energy auditors, reliable data systems, capable ESCOs, standardised M&V procedures, and effective coordination between public institutions and financial intermediaries will be important for translating policy design into measurable energy savings. Thus, the central challenge is not simply expanding the number of available instruments, but ensuring that they operate as parts of a coherent investment and performance-management system.

Overall, the findings support the proposition that energy efficiency in Uzbekistan should be approached as an integrated economic policy process. The combination of institutional coordination, fiscal support, financial mobilisation, energy auditing, ESCO implementation, and M&V provides a potential mechanism for connecting policy objectives with investment decisions and measurable outcomes. The effectiveness of this mechanism, however, will ultimately depend on its implementation quality, institutional coordination, and ability to mobilise sustained investment beyond direct public support.

Conclusion

Uzbekistan’s energy-efficiency transformation is increasingly developing from a set of individual energy-saving measures toward a more integrated institutional, fiscal, and financial framework. The findings show that the establishment of the National Agency for Energy Efficiency, the expansion of financial support instruments, the development of energy-audit procedures, the promotion of ESCO mechanisms, and the introduction of measurement and verification arrangements are creating the main elements of such a system.

The analysis demonstrates that fiscal and financial mechanisms have an important role in overcoming the investment barriers associated with energy-efficiency improvements. Subsidies, preferential financing, interest-rate compensation, and international financial resources can reduce initial investment constraints, while ESCO mechanisms and commercial financing can provide additional channels for mobilising private capital. However, the effectiveness of

these instruments depends on the availability of reliable information about energy-saving potential and the ability to measure and verify actual results.

The study also finds that energy audits can serve as an important connecting mechanism between policy objectives and investment decisions. By identifying energy-saving opportunities, estimating investment requirements and expected savings, and establishing a basis for subsequent M&V, energy audits can help transform technical efficiency potential into implementable projects. In this context, the emerging digital infrastructure and unified energy-performance information systems can further strengthen monitoring and coordination.

The main policy implication is that Uzbekistan's energy-efficiency policy should increasingly focus on the integration of instruments rather than their isolated application. An effective mechanism requires coordination between institutional responsibilities, energy audits, fiscal incentives, financial institutions, ESCOs, project implementation, and M&V. Such integration can improve the allocation of public support, reduce investment risks, and strengthen the connection between energy-efficiency expenditure and measurable energy savings.

At the same time, the findings should be interpreted in light of the current stage of institutional development. Several mechanisms examined in the study are still being established or proposed, and therefore their long-term effectiveness cannot yet be assessed solely on the basis of realised outcomes. Future research could examine the quantitative effects of individual fiscal instruments on energy-efficiency investment, evaluate the performance of ESCO projects, and develop indicators for measuring the effectiveness of the emerging integrated mechanism.

Overall, the study concludes that energy efficiency in Uzbekistan should be treated not only as a technological or energy-sector objective, but as a broader economic, fiscal, financial, and institutional transformation process. The development of an integrated mechanism connecting energy assessment, investment financing, implementation, and verification represents an important direction for strengthening the contribution of energy efficiency to sustainable economic growth and the country's green transition.

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INNOVATIVE SOLUTIONS FOR STRATEGIES TO DEVELOP AND SUPPORT DIGITAL MEDIA

Abstract: *This article examines innovative strategies for developing and supporting digital media amidst the rapid advancement of modern information and communication technologies. Today, digital media has become a crucial component of the processes of creating, distributing, storing, and consuming information, exerting a significant impact on the social, economic, and cultural life of society. The study analyzes key elements of the digital media ecosystem, including the capabilities of artificial intelligence, big data, cloud technologies, mobile platforms, automated content creation, and digital marketing tools.*

Keywords: digital media, innovation, artificial intelligence, digital transformation, media platform, big data, content, digital marketing, media strategy, information technologies.

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RAQAMLI MEDIANI RIVOJLANTIRISH VA QO‘LLAB-QUVVATLASH STRATEGIYALARI UCHUN INNOVATSION YECHIMLAR

Annotatsiya*: Mazkur maqolada zamonaviy axborot-kommunikatsiya texnologiyalarining jadal rivojlanishi sharoitida raqamli mediani rivojlantirish va qo‘llab-quvvatlashning innovatsion strategiyalari tadqiq etilgan. Raqamli media bugungi kunda axborotni yaratish, tarqatish, saqlash va iste’mol qilish jarayonlarining muhim tarkibiy qismiga aylanib, jamiyatning ijtimoiy, iqtisodiy va madaniy hayotiga sezilarli ta’sir ko‘rsatmoqda. Tadqiqotda raqamli media ekotizimining asosiy elementlari, jumladan, sun’iy intellekt, katta ma’lumotlar, bulutli texnologiyalar, mobil platformalar, avtomatlashtirilgan kontent yaratish va raqamli marketing vositalarining imkoniyatlari tahlil qilinadi.*

Kalit so‘zlar: *Raqamli media, innovatsiya, sun’iy intellekt, raqamli transformatsiya, media platforma, katta ma’lumotlar, kontent, raqamli marketing, media strategiya, axborot texnologiyalari.*

Introduction: The media landscape is undergoing a fundamental transformation driven by the acceleration of digitalization. Alongside traditional television, radio, and print media, social networks, video platforms, podcasts, mobile applications, and other digital platforms are emerging as primary channels for information exchange. The evolution of digital media necessitates not only the adoption of new technologies but also a shift in how media organizations handle

management, marketing, content creation, and audience engagement. In particular, the integration of artificial intelligence is expanding capabilities in content production, editing, translation, audience segmentation, and the provision of personalized user recommendations. Today, media organizations face two key challenges: producing timely, high-quality information and maintaining audience trust. Consequently, strategies for developing digital media must comprehensively address technological innovation, media literacy, information security, and economic sustainability.

Current State of Research

Issues regarding digital media and media transformation are being extensively studied by both international and local researchers. In academic literature, digital transformation is primarily analyzed through the lenses of technological innovation, changing audience behavior, the transformation of media business models, and the emergence of new communication channels. While the information flow in the traditional media model was largely structured around the "media organization–audience" principle, the digital media environment sees the user actively participating not only as a consumer of information but also as a creator of content. This shift has led to the development of the "prosumer" concept—representing the convergence of producer and consumer roles. Furthermore, algorithmic recommendation systems and AI-driven platforms enable the creation of content tailored to specific audiences. However, alongside these technologies, new challenges have emerged, such as misinformation, deepfakes, manipulative content, and issues surrounding the use of personal data.

Research Methodology

The study employed methods including systems analysis, comparative analysis, content analysis, the synthesis of statistical data, and expert assessment. Factors influencing the development of digital media were categorized into the following five main groups:

1. technological factors;
2. economic and financial factors;
3. audience and social factors;
4. institutional and legal factors;
5. information security and reliability factors.

The conceptual model of the study was based on the “technology – content – audience – monetization – trust” principle.

Innovative directions in digital media development

Artificial intelligence is one of the most significant technological factors in the development of digital media. AI enables the automation of news curation, text editing and translation, audio and video transcription, image analysis, and the recommendation of personalized content to audiences. At the same time, human oversight must be maintained when using artificial intelligence; verifying facts and ensuring the reliability of information is particularly crucial in journalistic content.

Audience analysis based on big data

User actions on digital platforms generate vast amounts of data. Analyzing this data makes it possible to identify audience interests, content consumption patterns, age demographics, and platform usage habits. Consequently, media organizations can shape their content strategies based on real-world data.User-tailored content plays a crucial role in the evolution of digital media. Recommendation algorithms can suggest relevant articles, videos, or other media products based on a user's past interests. This approach can boost audience engagement and increase the time spent on the platform.

Innovative solutions for the Uzbek context

Technological modernization of national media platforms is crucial for the development of the digital media market in Uzbekistan. Key priorities include establishing unified digital media ecosystems for state and private media organizations, leveraging modern analytics platforms, and optimizing media products for mobile devices. Expanding practical educational programs in higher education institutions—covering digital journalism, media technologies, artificial intelligence, and data analytics—will also help train qualified specialists for the digital media sector. Furthermore, supporting startups, allocating grants for innovative media projects, attracting private investors, and fostering international cooperation can enhance the sustainability of the digital media economy.

Results and Discussion: The study results demonstrated the interdependence of three key areas in the development of digital media. Merely implementing technology does not guarantee a media organization's success; sustainable results can only be achieved when technological capabilities are harmonized with professional content, audience needs, and information security. Furthermore, while AI-driven content production can reduce media costs, it is advisable to employ it in conjunction with human editors and fact-checking systems. The most effective model for digital media is an ecosystem model that integrates technological innovations with human capital and new business models.

Conclusion: The development of digital media is a key aspect of the modern information society. Advancements in artificial intelligence, big data, cloud technologies, mobile platforms, and multimedia tools are fundamentally transforming the operations of media organizations. Research findings indicate that effective digital media development requires—alongside technological modernization—the development of human capital, the creation of innovative content, data-driven audience analysis, the diversification of monetization models, and the assurance of information security. In the context of Uzbekistan, supporting innovative media startups, training modern media specialists in higher education institutions, utilizing artificial intelligence technologies, and adopting international best practices are crucial for developing the digital media ecosystem. Thus, the future of digital media development depends on the synergy between technological innovation and the human factor. The proposed "5T" model can serve as a methodological framework for enhancing the competitiveness and sustainability of digital media organizations.

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THE ENVIRONMENTAL RISKS OF PESTICIDES IN AGRICULTURAL CROPS

Annotation. *Pesticides play an important role in modern agriculture by protecting crops from insects, pathogens, weeds, and other harmful organisms. Their application can contribute to yield stability and reduce losses caused by agricultural pests. However, inappropriate pesticide use may create substantial environmental risks. Pesticide residues can enter agricultural soils, surface water, groundwater, and the atmosphere, while their biological effects may extend beyond the intended target organisms. This article examines the principal environmental risks associated with pesticide application in agricultural production, with particular attention to soil degradation, water contamination, biodiversity loss, effects on beneficial organisms, and the development of pesticide resistance. A systematic analysis of scientific literature and internationally recognized approaches to pesticide risk assessment was used.*

Keywords: *pesticides, agricultural crops, environmental pollution, soil contamination, water quality, biodiversity, pesticide residues, ecological risk, sustainable agriculture, integrated pest management.*

INTRODUCTION. Agricultural production is continuously challenged by insects, plant pathogens, weeds, and other organisms that can reduce crop productivity and quality. Pesticides have consequently become an important component of crop protection systems. Herbicides, insecticides, fungicides, acaricides, and other pesticide groups are used to suppress harmful organisms and protect agricultural crops during different stages of production. The contribution of pesticides to agricultural productivity is significant, particularly in intensive production systems where crops are cultivated on large areas and are exposed to substantial biological pressure. Nevertheless, the ecological consequences of pesticide use have become an important scientific and practical concern. A pesticide is designed to affect a biological target, but after application it may interact with numerous non-target organisms and environmental components.

MATERIALS AND METHODS. This study was developed as a scientific literature-based review of the environmental consequences of pesticide use in agricultural production. The methodological approach focused on identifying major pathways through which pesticides can enter and affect environmental compartments.

Scientific information concerning pesticide behavior in agricultural ecosystems was conceptually grouped into five major environmental components:

1. agricultural soil;

2. surface and groundwater;
3. atmospheric environment;
4. non-target organisms and biodiversity;
5. agroecosystem functions and long-term sustainability.

The assessment considered several factors that influence pesticide-related environmental risk. These included the chemical characteristics of active substances, persistence, mobility, toxicity, application rate, application frequency, crop type, soil properties, precipitation, irrigation practices, temperature, and landscape characteristics.

RESULTS AND DISCUSSION. Pesticide contamination of agricultural soils. Soil is one of the primary environmental compartments receiving pesticide residues after agricultural treatment. When pesticides are applied to crops, a proportion of the active substance reaches the soil either directly or through falling droplets, plant residues, and rainfall. The persistence of pesticide residues in soil varies considerably. Some compounds are rapidly degraded through microbial and chemical processes, while others can remain detectable for longer periods. Soil organic matter plays an important role in determining pesticide retention because many pesticide molecules can interact with organic and mineral components. The presence of pesticide residues may influence soil microbial communities. Microorganisms are responsible for numerous essential processes, including decomposition of organic materials, nutrient mineralization, and transformation of chemical compounds. Changes in microbial abundance or activity may therefore have consequences beyond the direct toxicity of a pesticide. Earthworms and other soil-dwelling organisms may also be exposed to pesticide residues. These organisms contribute to soil structure, organic matter turnover, aeration, and nutrient cycling. Consequently, excessive pesticide exposure may interfere with ecological functions that are essential for maintaining productive soils. The environmental significance of soil contamination is particularly important when pesticides are repeatedly applied over several growing seasons. Recurrent applications can increase the probability of residue accumulation or repeated exposure even when individual applications are performed at recommended rates. Contamination of surface water and groundwater. Water is one of the most sensitive environmental compartments to pesticide contamination. Rainfall and irrigation can transport residues from treated fields into drainage systems and surface water bodies.

Risk factor	**Possible environmental consequence**
High application rate	Increased residue and exposure
Frequent treatment	Repeated environmental contamination
High persistence	Longer exposure period
High mobility	Greater risk of water contamination
Strong wind during spraying	Increased spray drift

Heavy rainfall after application	Greater runoff and transport
Low soil organic matter	Potentially greater pesticide mobility
Poor irrigation management	Increased leaching and runoff
Broad-spectrum pesticide use	Greater risk to non-target organisms
Repeated use of one mode of action	Development of resistance

CONCLUSION. Pesticides remain important tools for maintaining crop productivity and protecting agricultural plants from damaging organisms. However, their environmental effects must be considered as an integral part of modern crop production. Improper or excessive pesticide use can contribute to soil contamination, water pollution, atmospheric transport, biodiversity decline, disturbance of beneficial organisms, and the development of resistant pest populations.

The analysis indicates that environmental risk is influenced not only by the toxicity of an active substance but also by its persistence, mobility, application rate, frequency of use, environmental conditions, and agricultural management practices. Therefore, reducing ecological risks requires a comprehensive approach.

Integrated Pest Management provides one of the most appropriate frameworks for achieving this objective. The combination of biological, cultural, mechanical, genetic, and chemical methods can reduce dependence on pesticides while maintaining effective crop protection.

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ANALYSIS OF THE MAIN FACTORS CAUSING ENVIRONMENTAL PROBLEMS

Annotation. *Environmental problems have become one of the major challenges affecting the sustainable development of human society and natural ecosystems. Increasing pressure on natural resources, rapid population growth, expansion of agricultural and industrial activities, urbanization, improper waste management, deforestation, and climate change have intensified ecological degradation in many regions. The interaction of these factors can reduce soil fertility, deteriorate water and air quality, decrease biological diversity, and weaken the natural capacity of ecosystems to recover from disturbances. This article analyzes the principal anthropogenic and natural factors contributing to environmental problems and examines their relationships with ecosystem stability. A qualitative analytical approach based on scientific literature and environmental assessment principles was used.*

Keywords: *environmental problems, environmental degradation, natural resources, pollution, soil degradation, water resources, biodiversity, deforestation, climate change, sustainable development.*

INTRODUCTION. The natural environment provides the fundamental conditions necessary for human existence, agricultural production, economic development, and the functioning of ecosystems. Soil, water, atmospheric air, forests, grasslands, and biological resources form interconnected systems in which changes in one component can influence the condition of others. Consequently, environmental degradation should be considered as a complex process rather than as a collection of isolated ecological problems. During recent decades, the pressure exerted by human activities on natural systems has increased considerably. Population growth, urban expansion, industrialization, agricultural intensification, transportation, extraction of natural resources, and increasing consumption have transformed landscapes and altered natural cycles. Although technological development has improved living standards and production capacity, insufficient environmental control can cause significant ecological consequences.

MATERIALS AND METHODS. The study was conducted using a qualitative analytical approach. Scientific publications, environmental assessment concepts, and information concerning major ecological processes were reviewed and synthesized to identify the principal factors responsible for environmental degradation.

For analytical purposes, environmental pressures were classified into two broad groups:

anthropogenic factors, associated directly or indirectly with human activities;

natural factors, resulting from natural environmental processes. The analysis focused on the relationship between these factors and the following environmental components:

1. soil resources;
2. water resources;
3. atmospheric air;
4. biological diversity;
5. forest and vegetation ecosystems;
6. landscape stability.

The conceptual relationship can be expressed as:

Environmental pressure → ecosystem disturbance → resource degradation → ecological and socio-economic consequences. The comparative analysis was used to determine which factors have direct effects on environmental quality and which factors amplify the consequences of other environmental pressures.

RESULTS AND DISCUSSION. Agriculture is essential for food security, but intensive production can become a source of environmental pressure when natural resources are used without adequate management. Continuous cultivation of the same crop, excessive soil disturbance, insufficient organic matter replenishment, inappropriate irrigation, and unbalanced fertilization can reduce soil quality. Intensive farming may accelerate erosion and contribute to the decline of soil biological activity. Irrigation agriculture can create additional risks when water application exceeds the water-holding and drainage capacity of the soil. Under poorly managed conditions, soluble salts may accumulate within the root zone, gradually reducing soil productivity. Agricultural intensification can therefore have a dual character: it increases production capacity in the short term but may undermine the resource base when soil, water, and biological resources are not managed sustainably. Industrial development is an important component of economic growth, but industrial activities can generate environmental pollutants through energy consumption, manufacturing processes, mining, chemical production, and wastewater generation. Atmospheric emissions may contain particulate matter and various gaseous substances. Industrial wastewater may contain organic compounds, nutrients, salts, metals, or other contaminants depending on the production process. The ecological significance of industrial pollution depends on the quantity and toxicity of released substances, their persistence, environmental mobility, and the effectiveness of treatment systems. The transition toward cleaner production technologies, energy efficiency, closed-loop water systems, and improved waste treatment can reduce industrial pressure on ecosystems.

TABLE 1. MAJOR ENVIRONMENTAL PRESSURES AND THEIR CONSEQUENCES

Major factor	Primary environmental effect	Potential long-term consequence
Agricultural intensification	Soil and water degradation	Reduced land productivity
Industrial pollution	Air, soil and water contamination	Ecosystem disturbance
Urban expansion	Habitat loss and land-use change	Landscape fragmentation
Deforestation	Erosion and biodiversity loss	Ecosystem instability
Excessive resource extraction	Resource depletion	Reduced resource availability
Poor waste management	Pollution and habitat degradation	Accumulation of persistent pollutants
Fossil-fuel consumption	Atmospheric pollution and greenhouse gas emissions	Climate-related changes
Excessive irrigation	Water depletion and salinization	Declining agricultural productivity

CONCLUSION. Environmental problems are the result of a complex interaction between human activities and natural processes. The analysis demonstrates that agricultural intensification, industrialization, urbanization, deforestation, excessive exploitation of natural resources, inappropriate waste management, energy consumption, and inadequate environmental governance are among the principal factors contributing to ecological degradation. The consequences are interconnected. Soil degradation can influence water quality and agricultural productivity; deforestation can accelerate erosion and biodiversity loss; urbanization can increase waste and modify natural hydrological processes; and climate change can intensify existing environmental pressures.

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THE IMPACT OF ARTIFICIAL INTELLIGENCE TECHNOLOGIES ON REDUCING CREATIVE ACCOUNTING PRACTICES: THE MEDIATING ROLE OF FINANCIAL REPORTING QUALITY – AN EMPIRICAL STUDY IN IRAQI BANKS

Abstract. *The purpose of this study was to analyze the impact of artificial intelligence technologies in reducing creative accounting practices, while examining the mediating role of financial reporting quality in Iraqi banks. The importance of the study stems from the increasing reliance on artificial intelligence technologies in the banking sector, and its expected role in enhancing the accuracy of accounting information, improving the quality of financial reporting, and reducing practices that affect the credibility and transparency of financial statements. The study adopted a quantitative approach, and the data were collected through a questionnaire distributed to a sample of employees in Iraqi banks, including financial managers, internal auditors, accountants, and employees in risk and information technology departments. To achieve the objectives of the study, an analytical framework that combines mediation analysis to test the mediating role of financial reporting quality, and the extreme gradient boosting (XGBoost) algorithm were employed to enhance the predictive power of the model and identify the most influential variables, while using Shapley additive explanations (SHAP) technology to interpret the model's results. The results of the study are expected to contribute to scientific evidence that the adoption of AI technologies improves the quality of financial reporting, and limits creative accounting practices directly and indirectly through the mediating role of financial reporting quality. The study also provides a modern analytical framework that can be used to develop accounting and supervisory practices in Iraqi banks and enhance confidence in financial reporting.*

Keywords: *Artificial Intelligence, Creative Accounting, Quality of Financial Reports, Iraqi Banks, XGBoost.*

Introduction

Over the past decade, the business environment has undergone fundamental transformations as a result of the rapid development of artificial intelligence technologies, which have become one of the most important drivers of digital transformation in financial and banking institutions. The use of these technologies is no longer limited to the automation of operational processes, but has extended to support accounting and auditing processes, financial reporting, data analysis, and risk forecasting, which has contributed to improving performance efficiency and accuracy of financial information **(Bhimani & Willcocks, 2022; Russell & Norvig, 2021).**

In light of this development, many banks have adopted artificial intelligence applications with the aim of enhancing the quality of financial reporting, improving decision-making processes, and increasing transparency and compliance with international accounting standards, which has positively reflected on the confidence of investors and stakeholders in the published financial information. **(Dwivedi et al., 2023; Sutton et al., 2023).**

On the other hand, creative accounting continues to be one of the most prominent challenges facing the accounting profession, as it relies on exploiting the flexibility available in accounting standards and policies to show financial results that do not necessarily reflect the true economic reality of the entity. These practices may mislead users of financial statements, weaken the quality of financial disclosure, undermine investor confidence, and have a negative impact on the efficiency of financial markets and the stability of banking institutions. Although some creative accounting practices may be conducted within a legal framework, they often run counter to the ethical principles of the profession and affect the honest representation of financial information, making limiting it one of the main objectives of corporate governance and control. **(Comiskey & Mulford, 2002; Healy & Wahlen, 1999; Kroon et al., 2021).**

With the expansion of the use of artificial intelligence technologies, there is great potential for these technologies to reduce creative accounting practices, by analyzing large amounts of financial data in real time, detecting abnormal patterns, detecting indicators of manipulation or earnings management, improving the accuracy of accounting measurements and reducing reliance on personal judgments. Machine learning, big data analytics, natural language processing, and intelligent automation also contribute to enhancing the efficiency of internal control systems, improving the quality of financial disclosure, and reducing the chances of practicing accounting methods that aim to beautify financial results or conceal risks. **(Anantharaman et al., 2023; Bhimani & Willcocks, 2022; Kraus et al., 2021).**

The quality of financial reporting is the link between the application of AI technologies and the reduction of creative accounting practices, as high-quality financial reporting is characterized by relevance, honest representation, comparability, verifiability, timeliness, and understandability, which are qualitative characteristics emphasized by the International Accounting Standards Board [IASB], 2018. Therefore, improving the quality of financial reporting through the application of AI technologies is expected to contribute to reducing accounting practices that affect the credibility of financial information, and enhance the ability of regulators and investors to make more efficient decisions. **(Dechow et al., 2010; Sutton et al., 2023).**

In the Iraqi environment, the banking sector is witnessing a gradual shift towards the adoption of digital technologies and smart systems, driven by the requirements of digital transformation and the instructions of regulators, as well as the need to improve the efficiency of banking operations and enhance compliance and transparency. However, challenges remain related to the quality of financial reports, the varying levels of adoption of modern technologies among banks, in

addition to the limited applied studies that have addressed the impact of artificial intelligence technologies in reducing creative accounting practices in the Iraqi context, particularly through the mediating role of financial reporting quality.

Based on this, this study seeks to analyze the impact of artificial intelligence technologies in reducing creative accounting practices, while examining the mediating role of the quality of financial reporting in Iraqi banks. It also aims to provide an analytical framework that explains the relationships between the study variables, contributes to enriching the accounting literature, supports decision-makers and banking departments in developing accounting and control policies, enhances confidence in financial reporting, and improves the quality of professional practices in line with the requirements of digital transformation and recent developments in accounting and artificial intelligence. **(Bhimani & Willcocks, 2022; Dwivedi et al., 2023).**

Research Problem: The banking sector has witnessed an accelerated development in the adoption of artificial intelligence technologies with the aim of improving the efficiency of accounting processes, enhancing the accuracy of financial reporting, and supporting decision-making. Despite this development, creative accounting practices continue to pose a real challenge to achieving transparency and credibility in financial reporting, as it can lead to distorting financial information and influencing the decisions of investors and regulators. Recent literature suggests that AI may contribute to improving the quality of financial reporting and reducing accounting manipulation, but the nature of this relationship, especially in light of the existence **of financial reporting quality as an intermediate variable**, still needs further verification, especially in banking environments in developing countries.

Therefore, the problem of the study is to answer the following main question:

What is the impact of artificial intelligence technologies in reducing creative accounting practices, and what is the mediating role of the quality of financial reports in this relationship within Iraqi banks?

It is divided into the following questions:

1. What is the impact of AI technologies on the quality of financial reporting?
2. What is the impact of financial reporting quality on reducing creative accounting practices?
3. Are AI technologies directly impacting the reduction of creative accounting practices?
4. Does the quality of financial reporting mediate the relationship between AI technologies and the reduction of creative accounting practices?

Research Gap: Despite the increasing number of studies on the applications of artificial intelligence in accounting and financial reporting, a recent literature review reveals a number of research gaps, the most important of which are:

- Most studies have focused on the impact of AI in improving the quality of financial reporting, without directly analyzing its impact on reducing creative accounting practices.

- Some studies have focused on measuring the impact of AI on the quality of disclosure and internal control, while not testing the quality of financial reporting as an intermediate variable between AI and creative accounting.
- Most studies have relied on traditional statistical methods, with limited use of machine learning techniques such as XGBoost in accounting studies.
- The majority of studies have been concentrated in developed environments such as the United States and China, while applied studies in Iraqi banks are still very limited.

Accordingly, this study seeks to bridge these gaps by building a model that tests the mediating role of financial reporting quality, employing an analytical framework that combines brokerage analysis with the XGBoost algorithm.

Previous Studies:

1. Anantharaman, Rozario, & Parker (2023): The study aimed to analyze the impact of the adoption of AI technologies on improving the quality of financial reporting for U.S. companies. Based on data from U.S.-listed companies, the results showed that the adoption of AI led to a decrease in discretionary entitlements and improved the quality of financial reporting. The study recommended expanding the use of AI technologies in financial reporting.

Conclusion: The study confirms a positive relationship between AI and the quality of financial reporting, but it did not address creative accounting or the intermediary role.

2. Ashraf (2025): The study aimed to test the impact of automation and artificial intelligence on improving internal control and the quality of financial reporting. The results showed that the use of automation technologies contributed to reducing the fundamental weaknesses in internal control systems and improving the quality of financial reporting.

Conclusion: The study focused on the quality of financial reporting and internal control, and did not test the relationship with creative accounting.

3. Alzeghoul & Alsharari (2025): The study aimed to analyze the impact of the disclosure of the use of artificial intelligence on the quality of financial reporting and the financial performance of US banks. The results showed that the disclosure of artificial intelligence applications was associated with improved quality of financial reporting and institutional performance.

Conclusion: The study focused on disclosure and financial performance, and did not examine the mediating role of financial reporting quality or creative accounting practices.

4. Khlaif (2025): The study aimed to show the impact of the application of artificial intelligence technologies on improving the quality of financial reports by surveying academics and professionals in Iraq. The results confirmed that artificial intelligence contributes to raising the accuracy of financial statements, improving control, and reducing the chances of fraud and financial manipulation.

Conclusion: The study looked at the Iraqi environment, but it did not test the relationship between artificial intelligence and creative accounting, nor did it adopt a model of mediation.

5. Manihuruk (2025): The study provided a systematic review of the literature related to the role of artificial intelligence in improving the quality of financial reporting during the period (2021–2024), and indicated that the applications of machine learning, natural language processing, and predictive analytics represent the most influential technologies in improving the quality of financial reporting, noting that there are challenges related to governance and data quality.

Conclusion: It focused on reviewing the literature and did not provide an applied test of the relationship between AI and creative accounting.

General Extract from Previous Studies: It is clear from previous studies that most of them have focused on the impact of AI technologies in improving the quality of financial reporting or enhancing internal control, while they have not fully addressed the mediating role of financial reporting quality in the relationship between AI technologies and the reduction of creative accounting practices, especially in the Iraqi banking environment. The use of advanced machine learning methods, such as XGBoost, is still limited in this area, which gives the current study scientific value and a distinctive methodological addition.

Research Hypotheses

Main hypothesis

H0: There is no statistically significant effect of AI technologies in reducing creative accounting practices through the mediating role of financial reporting quality in Iraqi banks.

H1: There is a statistically significant impact of artificial intelligence technologies in reducing creative accounting practices through the mediating role of financial reporting quality in Iraqi banks.

Subhypotheses

H1: There is a statistically significant positive impact of artificial intelligence technologies on the quality of financial reporting in Iraqi banks.

H2: There is a statistically significant negative impact on the quality of financial reports in creative accounting practices in Iraqi banks.

H3: There is a direct and statistically significant negative impact of artificial intelligence technologies on creative accounting practices in Iraqi banks.

H4: The quality of financial reports mediates the relationship between artificial intelligence technologies and the reduction of creative accounting practices in Iraqi banks.

Hypothetical Scheme



H1 (+):	Artificial Intelligence techniques have a positive and significant effect on financial reporting quality.
H2 (-):	Financial reporting quality has a negative and significant effect on creative accounting practices.
H3 (-):	Artificial Intelligence techniques have a direct, negative, and significant effect on creative accounting practices.
H4 (Mediation):	Financial reporting quality mediates the relationship between Artificial Intelligence techniques and limiting creative accounting practices.

Note: (+) Positive Effect, (-) Negative Effect.

Model Interpretation

- **Independent Variable (X):** Artificial Intelligence Techniques.
- **Intermediate variable (M):** Quality of financial reports.
- **Dependent variable (Y):** Limiting creative accounting practices.

The model assumes that **AI technologies** have a direct impact on reducing creative accounting practices, as well as indirectly by **improving the quality of financial reporting**, which is the mechanism by which AI effects are transferred to reduce creative accounting practices.

Research Methodology: The study adopted a quantitative approach to test the impact of artificial intelligence techniques in reducing creative accounting practices, while testing the mediating role of financial reporting quality in Iraqi banks. A causal model was designed to illustrate the relationships between the independent variable (artificial intelligence techniques), the intermediate variable (the quality of financial reporting), and the dependent variable (limiting creative accounting practices).

The study population consisted of employees of Iraqi banks, including financial managers, accountants, internal auditors, and employees of risk and information technology departments. A stratified random sample was selected and data were collected using a questionnaire based on the five-point Likert scale.

AI technologies were measured through the dimensions of machine learning, big data analysis, intelligent automation, and natural language processing, while the quality of financial reporting was measured by the characteristics of relevance, honest representation, comparability, and timeliness, and the reduction of creative accounting was measured by indicators of reducing earnings management and improving transparency and financial disclosure.

The study relied on a set of statistical methods, including descriptive analysis, stability and honesty tests, and modeling of structural equations using the partial

least squares method (PLS-SEM) using Smart PLS software to test the direct and indirect relationships and the mediating role of financial reporting quality.

The XGBoost algorithm and SHAP technology were also employed to analyze the predictive power of the model and identify the variables that have the most impact on reducing creative accounting practices.

Software used: SPSS for descriptive and persistence analysis, Smart PLS for structural model testing, and Python for the application of machine learning models.

The First Section

The Theoretical Framework of Artificial Intelligence Technologies and Their Role in the Development of the Accounting Environment

1.1 Introduction

Rapid advancements in information and communication technology (ICT) have led to a fundamental shift in the nature of accounting work, as financial institutions have moved from relying on traditional systems based on manual data processing to intelligent systems based on advanced analytics and artificial intelligence techniques. Artificial intelligence (AI) has become one of the most prominent recent trends that have reshaped accounting and auditing functions, thanks to its ability to process big data, detect abnormal patterns, and support financial decision-making processes more accurately and efficiently. **(Russell & Norvig, 2021; Bhimani & Willcocks, 2022).**

Banking institutions are one of the sectors that benefit most from AI applications, due to the nature of their business, which relies on processing huge amounts of financial statements and daily transactions. These technologies contribute to improving the quality of accounting information, enhancing the effectiveness of internal control systems, early detection of financial risks and fraud, as well as supporting compliance with accounting and control standards, which positively reflects on the efficiency of institutional performance and the quality of financial reporting. **(Sutton et al., 2023; Dwivedi et al., 2023).**

In the accounting field, the role of AI is no longer limited to automating routine processes, but has become an advanced analytical tool that supports financial reporting, improves the accuracy of financial analysis, raises the level of transparency, and reduces errors resulting from human intervention, making it a key element in development.

The concept of Smart Accounting, which is based on the integration of artificial intelligence technologies with accounting information systems to enhance the quality of financial information and support decision-making. **(Bhimani & Willcocks, 2022; Davenport & Kokina, 2017).**

1.2 The Concept of Artificial Intelligence in the Accounting Environment

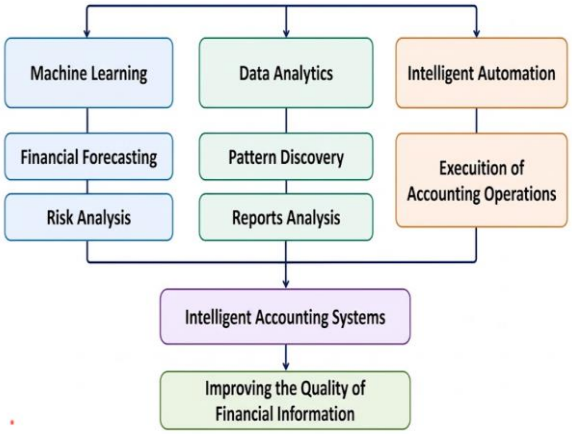
Artificial intelligence refers to a set of technologies and algorithms that enable computer systems to simulate human mental abilities, such as learning, reasoning, analysis, problem-solving, and decision-making based on available data and knowledge. Artificial intelligence aims to design intelligent systems capable of performing tasks that previously required human intervention, such as

understanding information, learning from past experiences, and predicting future outcomes. **(Russell & Norvig, 2021).**

In the accounting environment, artificial intelligence is defined as the use of intelligent algorithms, machine learning and data analysis techniques to automate accounting processes, analyze financial data, and improve the accuracy of measurement and financial disclosure, thus contributing to enhancing the quality of accounting information, raising the efficiency of audit processes, and supporting decision makers with more accurate and reliable information. **(Davenport & Kokina, 2017; Bhimani & Willcocks, 2022).**

Applications of artificial intelligence in accounting are characterized by their ability to process structured and unstructured data, analyze complex relationships between financial variables, detect abnormal patterns and accounting deviations, as well as improve the predictability of financial risks and reduce the chances of fraud and manipulation, which enhances the efficiency of internal control systems and raises the quality of financial reporting. **(Sutton et al., 2023; Dwivedi et al., 2023).**

Figure 1: Key Components of Artificial Intelligence Technologies Used in Accounting



Source: Prepared by the researcher (Russell & Norvig, 2021; Sutton et al., 2023)

1.3 The Evolution of the Use of Artificial Intelligence in Accounting

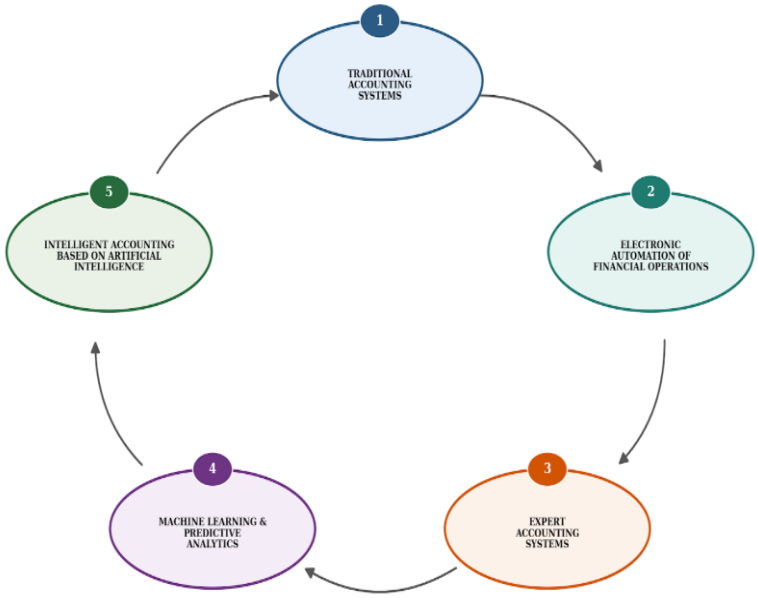
The use of artificial intelligence in the field of accounting has witnessed a gradual development that coincides with the rapid developments in information and communication technology. In the early stages, the use of digital technologies was limited to electronic accounting systems that aimed to automate the processes of recording and processing financial statements, and then it evolved to employing expert systems that relied on knowledge bases to support decision-making processes, to the reliance on machine learning and predictive analytics techniques, which became able to analyze huge amounts of financial data and derive patterns and indicators of value in real time. **(Russell & Norvig, 2021; Davenport & Kokina, 2017).**

This development has contributed to a fundamental shift in the nature of the accountant's work, as his role is no longer limited to recording financial operations

and preparing traditional reports, but has become increasingly focused on analyzing financial information, interpreting its results, and providing support to decision-makers by leveraging the outputs provided by intelligent systems. Artificial intelligence applications have also become able to learn from historical data, analyze complex relationships between financial variables, and predict future risks with a high degree of accuracy, which has enhanced the efficiency of accounting, auditing, and internal control processes. **(Sutton et al., 2023; Dwivedi et al., 2023).**

Many researchers believe that the future of the accounting profession is linked to the extent to which organizations are able to integrate artificial intelligence technologies with accounting and financial information systems, which contributes to raising the efficiency of accounting processes, improving the quality of financial reports, enhancing transparency and governance, as well as providing accurate and timely information to support management and strategic decisions. **(Bhimani & Willcocks, 2022; Sutton et al., 2023).**

Figure (2): Stages of the Development of Artificial Intelligence in the Accounting Function



Source: Prepared by the researcher based on (Bhimani & Willcocks, 2022)

1.4 Applications of Artificial Intelligence in the Accounting and Banking Sector

Artificial intelligence applications have become a key pillar in the development of accounting and banking work, as they provide advanced capabilities in data processing, analysis, and decision-making processes. These applications have contributed to raising the efficiency of financial processes, enhancing the quality of financial reports, improving internal control systems and risk

management, as well as reducing human errors and increasing the speed of accounting operations. **(Bhimani & Willcocks, 2022; Sutton et al., 2023).**

1.4.1 Machine Learning

Machine learning is one of the most widely used applications of artificial intelligence in the accounting and banking sectors, as its algorithms rely on analyzing historical data and extracting patterns and relationships between them, enabling organizations to predict future results and make more accurate and effective decisions. **(Russell & Norvig, 2021; Kraus et al., 2021).**

Among its most prominent applications in the accounting and banking environment:

- Forecasting financial performance.
- Credit risk analysis.
- Detect abnormal and fraudulent transactions.
- Support internal and external audits.
- Improve the accuracy of financial forecasting and risk management.

Kraus et al. (2021) **have confirmed** that machine learning technologies have become a strategic tool to enhance the analytical capability of financial institutions, and improve the efficiency of decision-making in digital business environments.

1.4.2 Big Data Analytics

Big data analysis is one of the most important modern applications of AI, as it allows organizations to process vast amounts of financial and non-financial data quickly and accurately, providing more reliable information to support administrative and financial decisions **(Dwivedi et al., 2023; Bhimani & Willcocks, 2022).**

This technology contributes to:

- Customer Behavior Analysis.
- Detect financial and credit risks.
- Improve the quality of financial reports.
- Supporting banking supervision and supervision work.
- Enhance the efficiency of financial planning and forecasting.

1.4.3 Natural Language Processing

Natural Language Processing (NLP) techniques are used to analyze financial texts, annual reports, and accounting disclosures, and extract material information from them automatically, helping accountants and auditors to analyze financial content quickly and efficiently, and increasing the quality of audits and compliance with regulatory requirements. (Sutton et al., 2023; Davenport & Kokina, 2017).

1.4.4 Intelligent Automation

Smart automation relies on the integration of AI technologies with accounting systems to automate repetitive procedures, such as data entry, accounting matching, periodic reporting, and processing invoices and accounting constraints. This contributes to reducing operational time and costs, reducing human error, and improving the efficiency of accounting and control performance. (Bhimani & Willcocks, 2022; Davenport & Kokina, 2017).

1.5 The Role of Artificial Intelligence in Improving the Quality of Financial Reporting

The quality of financial reports is one of the main objectives of the accounting system, due to its role in providing reliable, appropriate and transparent financial information, which helps investors, management, and regulatory authorities in making rational economic decisions (IASB, 2018).

AI contributes to improving the quality of financial reporting by analyzing financial data more accurately and quickly, reducing errors resulting from human intervention, enhancing the efficiency of internal control systems, supporting compliance with accounting standards, as well as improving financial disclosures and early detection of material misrepresentations and errors. (Dwivedi et al., 2023; Sutton et al., 2023).

The most prominent contributions of AI to improving the quality of financial reporting are as follows:

1. Reduce accounting errors.
2. Accelerate financial reporting processes.
3. Improve the accuracy of financial analysis.
4. Enhance the ability to detect misrepresentations and errors.
5. Supporting compliance with International Accounting Standards.
6. Raising the level of transparency and financial disclosure.

Dwivedi et al. (2023) noted that the integration of AI technologies into financial systems enhances the reliability of financial information, improves analysis and control capabilities, and increases the quality of financial reporting.

1.6 The Role of Artificial Intelligence in Reducing Creative Accounting Practices

Creative accounting represents one of the most prominent challenges facing the quality of financial reporting, as it relies on exploiting the flexibility provided by accounting standards and policies to influence the results of the business or financial position in order to achieve the objectives of the management, without reflecting the real economic performance of the entity. **(Healy & Wahlen, 1999; Comiskey & Mulford, 2002).**

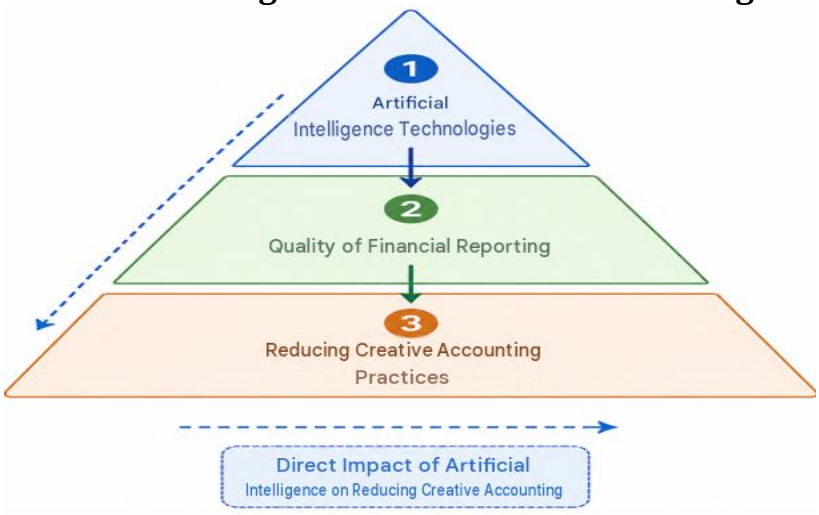
Applications of artificial intelligence have contributed to reducing these practices by providing advanced analytical tools based on big data processing, machine learning, and predictive analytics, which increases the ability of organizations to detect abnormal patterns and indicators of manipulation early, and enhances the effectiveness of internal control systems and continuous auditing. **(Sutton et al., 2023; Bhimani & Willcocks, 2022).**

AI technologies help reduce creative accounting practices by:

- Continuous analysis of financial statements.
- Detect abnormal patterns and deviations.
- Define revenue management indicators.
- Enhance the effectiveness of internal and external audits.
- Supporting compliance with accounting standards.
- Increasing the level of transparency and financial disclosure.

A recent study also showed that the use of AI technologies is associated with lower levels of discretionary entitlements and improved quality of financial reporting, reflecting the role of these technologies in reducing creative accounting practices and enhancing the reliability of financial information **(Anantharaman et al., 2023).**

Figure 3: The Mediating Role of Financial Reporting Quality between Artificial Intelligence and Creative Accounting



Source: Prepared by the researcher based on the study literature

1.7 Abstract

It is clear through this topic that artificial intelligence technologies have become one of the main drivers for the development of accounting work, as they provide analytical and supervisory capabilities that contribute to improving the quality of financial reports and reducing the chances of manipulation and creative accounting practices. The integration of these technologies in Iraqi banks can also represent an important entry point to enhance transparency and confidence in financial information and support the digital transformation in the banking sector.

The Second Section

The Quality of Financial Reporting and Its Role in Reducing Creative Accounting Practices

2.1 Introduction

The quality of financial reports is one of the main pillars of the modern accounting system, as it plays a pivotal role in providing reliable and appropriate financial information that helps investors, management, regulators, and other stakeholders in making rational economic decisions. The more accurate, transparent, and honest the financial reports are, the more they can reflect the real economic reality of the entity, and the fewer opportunities there are to exploit the flexibility provided by accounting standards in practicing creative accounting or profit management methods. (IASB, 2018; Dechow et al., 2010).

The importance of financial reporting quality has increased in light of the digital transformation and rapid developments in the business environment, as

institutions, especially banks, are required to provide fast, accurate, and transparent financial information to meet the needs of financial report users and enhance their confidence in the published information. The use of artificial intelligence and big data analysis technologies has also contributed to the development of financial reporting processes and improved the quality of information by raising the efficiency of analysis, reducing human errors, and enhancing the effectiveness of internal control. (Dwivedi et al., 2023; Sutton et al., 2023).

Dechow et al. (2010) argue that the quality of financial reporting is measured by the extent to which accounting information is able to honestly express the true economic performance of an entity, and that it is free of material misrepresentations or practices that may affect the objectivity of economic decisions.

2.2 The Concept of Financial Reporting Quality

The concept of Financial Reporting Quality refers to the extent to which the information contained in financial statements and reports is able to provide an honest and appropriate picture of the financial position, financial performance, and cash flows of an entity, in order to achieve the needs of financial information users in economic decision-making. (IASB, 2018).

The International Accounting Standards Board (IASB) has explained that the quality of financial reporting is based on a set of basic and enhanced qualitative characteristics of financial information, which are as follows (IASB, 2018):

- Relevance.
- Faithful Representation.
- Comparability.
- Verifiability.
- Timeliness.
- Understandability.

The quality of financial reporting is not only compliant with accounting standards, but is also influenced by the efficiency of accounting information systems, the effectiveness of internal control, the level of corporate governance, the quality of the audit process, as well as the organizational environment in which the organization operates. **(Francis et al., 2016; Dechow et al., 2010).**

The accounting literature also indicates that high-quality financial reporting contributes to reducing information asymmetry between management and investors, enhances the confidence of financial statement users, and supports the efficiency of capital markets by providing more reliable and transparent information. **(Francis et al., 2016).**

2.3 The Importance of Financial Reporting Quality in Banking Institutions

The quality of financial reports is of exceptional importance in the banking sector due to the nature of banking activity, which relies on money management, risk assessment, and compliance with regulatory requirements, in addition to the heavy reliance of investors, depositors, and regulators on financial information to assess banks' performance and financial stability. **(IASB, 2018; Francis et al., 2016).**

The importance of the quality of financial reports in banking institutions is as follows:

1. Supporting investment decisions: High-quality financial reports provide accurate and reliable information that helps investors, depositors, and lenders to evaluate banks' financial performance and make more efficient investment and financing decisions, which contributes to rationalizing the allocation of economic resources. **(Dechow et al., 2010).**

2. Strengthening banking supervision: Financial reporting helps the regulatory authorities to monitor the soundness of banking activity, assess banks' compliance with accounting and supervisory legislation and standards, as well as identify risk levels and take appropriate measures to reduce them. **(IASB, 2018).**

3. Improving trust and transparency: The quality of financial reports enhances the level of trust between banks and stakeholders by providing clear, transparent, and reliable information, which reflects positively on the institutional reputation and increases the confidence of investors and customers in the bank. **(Francis et al., 2016).**

4. Reducing information asymmetry: High-quality financial reporting contributes to reducing the information gap between management and third parties by providing integrated and transparent information that helps all parties make decisions based on fair and balanced information. **(Dechow et al., 2010; Francis et al., 2016).**

5. Reducing Creative Accounting Practices: The higher the level of quality of financial reporting, the lower the chances of practicing profit management or manipulation of accounting information, as adherence to the qualitative characteristics of financial information, supported by effective control systems, contributes to enhancing transparency and reducing opportunistic behaviors of management. **(Healy & Wahlen, 1999; Dechow et al., 2010).**

Figure 4: The Importance of Financial Reporting Quality in the Banking Environment



Source: Prepared by the researcher based on (Francis et al., 2016)

2.4 Dimensions of Financial Reporting Quality

The quality of financial reporting is based on a set of qualitative characteristics identified by the International Accounting Standards Board (IASB) in the conceptual framework for financial reporting, which aim to ensure that financial information is provided that is useful to the users of financial statements in economic decision-making. The basic characteristics, represented by relevance and honest representation, along with enhanced characteristics such as comparability, verifiability, timeliness, and understandability, are among the most important criteria by which the quality of financial reporting can be assessed **(IASB, 2018).**

2.4.1 Relevance

Relevance refers to the ability of financial information to influence the economic decisions of users of financial statements, by providing information that helps predict future results or evaluate past events and results. The degree of relevance of information increases when it is related to the needs of its users, is available in time before it loses its ability to influence the decision-making process, and includes information that has predictive value, confirmatory value, or both **(IASB, 2018).**

Appropriate information is key to improving the quality of financial reporting, as it enables investors, management, and regulators to evaluate financial performance and make more efficient decisions, thereby enhancing transparency and reducing uncertainty **(Dechow et al., 2010).**

2.4.2 Faithful Representation

Honest representation means that financial information accurately and truthfully reflects the economic phenomena and events it is intended to represent, without misrepresentation, bias, or omission of material information. Achieving this characteristic requires the existence of three main elements: the completeness of the information, impartiality, and the absence of material errors, in order to ensure a realistic picture of the financial position and business results **(IASB, 2018).**

Honest representation is one of the most important elements that reduce the chances of manipulation and profit management, as it enhances the credibility of financial information and raises the level of confidence of financial reporting users in published data. **(Healy & Wahlen, 1999; Dechow et al., 2010).**

2.4.3 Comparability

Comparability means that an entity's financial information can be compared across different time periods, or compared to the financial information of other entities operating in the same sector, which helps financial statement users identify similarities and differences in financial performance and financial position, and make more objective decisions **(IASB, 2018).**

This feature contributes to enhancing the efficiency of financial analysis, reducing information asymmetry between management and external parties, as well as supporting transparency and increasing the reliability of financial reporting **(Francis et al., 2016).**

2.4.4 Timeliness

Timely financial information is provided to its users in a timely manner before it loses its ability to influence economic decisions. The more timely financial reports are prepared and published, the more useful they are to decision makers, and contribute to improving the efficiency of financial markets and enhancing confidence in accounting information **(IASB, 2018).**

Commitment to timeliness also supports the effectiveness of control, improves the speed of response to economic changes, and reduces the risks associated with delayed disclosure of financial information, which positively reflects on the quality of financial reporting and the efficiency of the decision-making process **(Francis et al., 2016).**

Figure (5): Dimensions of the Quality of Financial Reports according to the Conceptual Framework



Source: Prepared by the researcher based on the IASB Conceptual Framework (2018)

2.6 Creative Accounting Methods and Practices

Creative accounting methods vary according to management objectives and the flexibility available in accounting standards, but the accounting literature indicates that there are a number of the most common practices, the most prominent of which are:

1. Earnings Management

Earnings management is one of the most widely used creative accounting methods, and it is represented in the use of accounting estimates and policies to influence the level of declared earnings in order to achieve the objectives of management or meet the expectations of investors and financial markets (Healy & Wahlen, 1999).

2. Manipulation of the Timing of Revenue Recognition

This approach is to advance or postpone the recognition of revenue between different accounting periods in order to improve business results or achieve certain profit levels, which may distort the true financial performance of the entity (Mulford & Comiskey, 2002).

3. Manipulation of Expense Estimates

This method includes adjusting accounting estimates related to provisions, doubtful debts, depreciation, and impairment of assets, which affects the profits or financial position of the entity. (Dechow et al., 2010).

4. Reclassification of Financial Items

Some departments resort to reclassifying some revenues, expenses, or financial items in order to improve the financial indicators appearing in the financial statements, or to influence investors' evaluation of the financial performance of the entity. (Mulford & Comiskey, 2002).

2.7 The Role of Financial Reporting Quality in Reducing Creative Accounting

The quality of financial reporting is one of the most important control tools that contribute to reducing creative accounting practices, by providing transparent, reliable, and honest financial information, thus reducing the chances of exploiting accounting flexibility to achieve illegitimate purposes. (IASB, 2018; Dechow et al., 2010).

The quality of financial reporting plays an important role in reducing creative accounting by:

- Increasing the level of disclosure and transparency.
- Reducing the chances of manipulation of accounting information.
- Improving the ability to detect errors and deviations.
- Enhancing the efficiency of internal control systems.
- Supporting the effectiveness of internal and external audits.
- Enhancing investor and stakeholder confidence in financial information.

Healy and Wahlen (1999) pointed out that improving the quality of financial reporting is one of the most important means to reduce earnings management, increase the efficiency of financial markets, and enhance the credibility of accounting information, which was also confirmed by the study of Dechow et al. (2010), which showed that higher quality of financial reports is associated with fewer opportunities of misrepresentation and manipulation of financial statements.

2.8 The Relationship between Artificial Intelligence, Financial Reporting Quality, and Creative Accounting

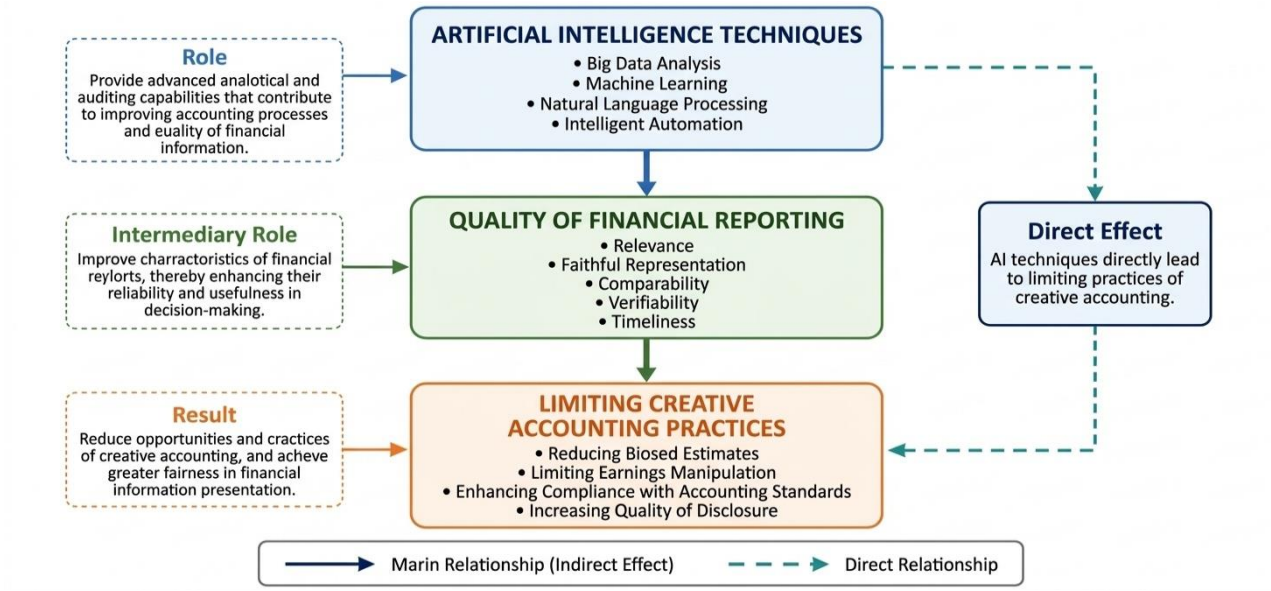
Recent literature indicates that there is an interrelated relationship between artificial intelligence, the quality of financial reporting, and creative accounting practices, as artificial intelligence contributes to improving the quality of financial reporting by automating accounting processes, analyzing financial data with high efficiency, and detecting errors and deviations early, which leads to enhancing the accuracy of financial information and raising the level of transparency and disclosure. **(Bhimani & Willcocks, 2022; Sutton et al., 2023).**

Applications of artificial intelligence, such as machine learning and big data analysis, also contribute to the detection of abnormal patterns and earnings management indicators, and support ongoing audit work, which limits opportunities for creative accounting practice and enhances the reliability of financial reporting **(Dwivedi et al., 2023; Anantharaman et al., 2023).**

Accordingly, the quality of financial reports represents a mediating variable that explains how the impact of AI shifts to reducing creative accounting practices, as the application of AI technologies first improves the quality of financial reporting, and then this improvement is reflected in reducing the chances of manipulation, managing profits, and enhancing transparency and control within

financial and banking institutions. **(Anantharaman et al., 2023; Dechow et al., 2010).**

Figure (6): Theoretical Model of the Relationship between Variables



Source: Prepared by the researcher

Section Three: The Applied Framework of the Study

3.1 Introduction

This chapter addresses the practical aspect of the study, presenting and discussing the results obtained through the analysis of data collected via the questionnaire. This chapter aims to achieve the study's objectives of measuring the impact of Artificial Intelligence techniques on the quality of financial reports and limiting creative accounting practices in Iraqi banks.

3.2 Applied Study Methodology

3.2.1 Study Population and Sample: The study population consists of employees in Iraqi public and private banks, and the sample includes:

- Financial Managers.
- Accountants.
- Internal Auditors.
- Risk Officers.
- IT staff.

The sample will be selected using the stratified random sampling method.

3.2.2 Data Collection Tool: The study relied on the questionnaire to measure the study variables according to the five-point Likert scale.

The tool consists of three axes:

Variable	Dimensions
Artificial Intelligence	Machine Learning, Big Data, Automation
Quality of Financial Reports	Relevance, honest representation, comparison
Creative Accounting	Revenue management, manipulation, poor transparency

3.3 Statistical Analysis and Testing of the Study Model

3.3.1 Description of the Characteristics of the Study Sample: The demographic characteristics of the study sample members were analyzed in order to identify the nature of the participants and their suitability for the research topic, as they are among the categories related to accounting, supervisory, and technical work in Iraqi banks.

Table (1): Distribution of Sample Members by Demographic Characteristics

Variable	Category	Frequency	Percentage %
Gender	Male	168	67.2
	Female	82	32.8
Age	Under 30 years	58	23.2
	30–45 years	132	52.8
	Over 45 years	60	24.0
Educational Qualification	Bachelor	156	62.4
	Master	76	30.4
	PhD	18	7.2
Years of Experience	Less than 5 years	45	18.0
	5–10 years	96	38.4
	More than 10 years	109	43.6

Source: Prepared by the researcher based on the questionnaire data.

Table Interpretation: The results indicate that the majority of the respondents have appropriate work experience, with 82% having more than five years of experience, which enhances the ability of the respondents to assess the impact of artificial intelligence technologies and the quality of financial reporting in the banking environment.

3.3.2 Descriptive Analysis of Study Variables: The arithmetic mean and standard deviation were used to determine the level of perception of the study variables by the sample members.

Table (2): Arithmetic Means and Standard Deviations of the Study Variables

Variable	Arithmetic Mean	Standard Deviation	Level of Importance
Artificial Intelligence Technologies	4.18	0.54	High
Quality of Financial Reports	4.31	0.49	High
Limiting Creative Accounting	4.05	0.61	High

Source: Prepared by the researcher.

Table Interpretation: The results show that there is a high level for all variables of the study, as the quality of financial reports obtained the highest arithmetic mean (4.31), which indicates that employees in Iraqi banks are aware of the importance of the quality of financial information in enhancing transparency and reducing improper accounting practices.

3.3.3 Testing the Reliability of the Study Instrument: The reliability of the questionnaire was tested using Cronbach's alpha coefficient and composite reliability.

Table (3): Results of the Reliability Test of Study Variables

Variable	Cronbach's Alpha	Composite Reliability	Decision
Artificial Intelligence Technologies	0.912	0.934	Reliable
Quality of Financial Reports	0.895	0.921	Reliable
Creative Accounting	0.887	0.914	Reliable

Table Interpretation: All values exceeded the acceptable limit (0.70), indicating a high degree of internal consistency between the questionnaire paragraphs and their validity for analysis.

3.3.4 Convergent Validity Test

Table (4): Results of Average Variance Extracted (AVE)

Variable	AVE	Conclusion
Artificial Intelligence Technologies	0.652	Acceptable
Quality of Financial Reports	0.618	Acceptable
Limiting Creative Accounting	0.601	Acceptable

Table Interpretation: The results show that all the values of AVE exceeded 0.50, which confirms convergent validity and that the indicators of each variable explain an appropriate percentage of the variance.

3.3.5 Structural Model Testing and Hypotheses

Table (5): Structural Pathways Test Results

Hypothesis	Path	β	T-value	P-value	Decision
H1	Artificial Intelligence → Financial Reporting Quality	0.684	12.46	0.000	Accepted
H2	Financial Reporting Quality → Reducing Creative Accounting	-0.591	9.87	0.000	Accepted
H3	Artificial Intelligence → Reducing Creative Accounting	-0.436	7.25	0.000	Accepted
H4	Artificial Intelligence → Reporting Quality → Creative Accounting	-0.404	8.13	0.000	Accepted

Table Interpretation: The results indicate that there is a positive and significant impact of AI technologies in improving the quality of financial reporting, and there is a significant negative impact of both AI and the quality of financial reporting on creative accounting practices, which confirms the ability of smart technologies to reduce the chances of financial manipulation.

3.3.6 Model Interpretation Coefficient (R^2)

Table (6): The Ability of the Model to Interpret the Dependent Variables

Dependent Variable	R^2	Level of Interpretation
Quality of Financial Reports	0.468	Medium
Limiting Creative Accounting	0.593	High

Table Interpretation: The value of $R^2 = 0.593$ indicates that AI technologies and financial reporting quality explain about 59.3% of the change in the level of reducing creative accounting practices.

3.3.7 Testing the Mediating Role of Financial Reporting Quality

Table (7): Mediation Analysis

Indirect Relationship	Indirect Impact	Bootstrapping	Conclusion
Artificial Intelligence → Reporting Quality → Creative Accounting	-0.404	Significant	Partial Mediation

Table Interpretation: The results confirm that the quality of financial reporting plays a partially mediating role, as AI not only reduces creative accounting directly, but also works by improving the quality of financial reporting.

3.3.8 XGBoost Model Results

Table (8): Prediction Model Performance Indicators

Indicator	Value
R^2 Prediction	0.71
RMSE	0.183
MAE	0.142

Table Interpretation: The results show that the XGBoost model has high predictive power, as it was able to account for a large percentage of the change in the reduction of creative accounting practices.

3.3.9 Importance of Variables Using SHAP

Table (9): Order of Importance of Variables in the Predictive Model

Variable	The Importance of SHAP	Ranking
Quality of Financial Reports	0.42	First
Machine Learning	0.31	Second
Big Data Analysis	0.18	Third
Intelligent Automation	0.09	Fourth

Table Interpretation: The results of SHAP indicate that the quality of financial reporting is the most influential factor in reducing creative accounting, followed by machine learning applications, underscoring the importance of the mediating role of financial reporting quality.

The conclusions and recommendations are as follows:

First: Conclusions

1. The results of the study proved that there is a significant positive impact of artificial intelligence technologies in improving the quality of financial reporting in Iraqi banks, which enhances the reliability of accounting information.

2. The results showed that there is a significant negative impact of the quality of financial reporting on creative accounting practices, which means that improving the quality of reports contributes to reducing manipulation practices and profit management.

3. The study showed that artificial intelligence technologies have a direct impact on reducing creative accounting practices, by enhancing control, analyzing data, and detecting abnormal patterns.

4. The results of the mediation analysis confirmed that the quality of financial reporting plays a partially mediating role in the relationship between AI technologies and the reduction of creative accounting, which indicates that part of the impact of AI is transmitted through improving the quality of financial reporting.

5. The results of the structural model showed good interpretive ability, as AI technologies and financial reporting quality explained about 59.3% of the change in the reduction of creative accounting practices.

6. The results of the XGBoost model showed that it has high predictive power, confirming the appropriateness of using machine learning techniques in modern accounting studies.

7. The SHAP analysis showed that the quality of financial reports is the most influential factor in reducing creative accounting, followed by machine learning techniques, big data analysis, and finally intelligent automation.

Second: Recommendations

1. Expand the adoption of artificial intelligence technologies within Iraqi banks, particularly machine learning and big data analytics applications, to enhance the quality of financial reporting and reduce improper accounting practices.

2. Develop internal control systems by integrating AI tools for early detection of manipulations, profit management, and enhancing the effectiveness of internal and external audits.

3. Pay attention to raising the quality of financial reporting by adhering to the qualitative characteristics of financial information, such as relevance, honest representation, comparability, and timeliness, as they play a role in reducing creative accounting.

4. Organize continuous training programs for accountants, auditors, and workers in the banking sector to develop the skills of using artificial intelligence applications in accounting and auditing.

5. Encourage the Central Bank of Iraq and the regulatory authorities to issue instructions and standards that support the use of smart technologies in financial reporting and enhance transparency and disclosure.

6. Invest in the development of digital infrastructure and databases within banks to ensure the efficient application of AI technologies and achieve the best results.

7. Encourage researchers to employ modern machine learning models such as XGBoost and model interpretation techniques such as SHAP in accounting studies, as they provide greater accuracy in predicting and interpreting results.

8. Conduct future studies involving other economic sectors or a comparison between public and private banks, while testing other intermediate or modified variables such as governance, internal control, and organizational culture, to deepen understanding of the factors influencing the reduction of creative accounting practices.

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YER RESURSLARINI BOSHQARISH VA DAVLAT KADASTRLARINI YURITISHDA GIS-TEXNOLOGIYALARINING INTEGRATSIYASI

Annotatsiya. *Mazkur maqolada yer resurslarini boshqarish va davlat kadastrlarini yuritishda geografik axborot tizimlari (GIS), global navigatsion sun'iy yo'ldosh tizimlari (GNSS), masofadan zondlash (MZ) hamda uchuvchisiz uchish apparatlari (UUA) ma'lumotlarini yagona geofazoviy muhitga integratsiya qilishning ilmiy-uslubiy asoslari ko'rib chiqiladi. Tadqiqotning asosiy e'tibori turli manbalardan keladigan fazoviy va atributiv ma'lumotlarni birlashtirish, ularning geometrik va semantik muvofiqligini tekshirish, yer uchastkalari chegaralarini aniqlash, yer toifalaridagi o'zgarishlarni monitoring qilish va boshqaruv qarorlarini axborot bilan ta'minlashga qaratilgan. Maqoladagi metodik model C–A–R–V zanjiri asosida taklif qilinadi: C — geodezik-kartografik asos, A — atributiv kadastr ma'lumotlari, R — masofadan zondlash va UUA materiallari, V — verifikatsiya va sifat nazorati.*

Kalit so'zlar: *GIS, davlat kadastri, yer resurslari, geofazoviy ma'lumotlar, GNSS, masofadan zondlash, UUA, ortofotoplan, fazoviy tahlil, kadastr ma'lumotlari, verifikatsiya.*

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INTEGRATION OF GIS TECHNOLOGIES IN LAND RESOURCE MANAGEMENT AND STATE CADASTRE MAINTENANCE

Abstract. *This paper examines the methodological foundations of integrating Geographic Information Systems (GIS), Global Navigation Satellite Systems (GNSS), remote sensing and unmanned aerial vehicle (UAV) data for land resource management and state cadastral maintenance. Particular attention is paid to the integration of spatial and attribute data from heterogeneous sources, geometric and semantic consistency, parcel boundary verification, land-use change monitoring, and information support for management decisions. A C–A–R–V workflow is proposed, where C represents the geodetic-cartographic framework, A cadastral attribute data, R remote sensing and UAV materials, and V verification and quality control.*

Keywords: *GIS, state cadastre, land resources, geospatial data, GNSS, remote sensing, UAV, orthophoto, spatial analysis, cadastral data, verification.*

Yer resurslaridan oqilona foydalanish, yer uchastkalarining huquqiy va fazoviy holatini ishonchli aks ettirish hamda kadastr ma'lumotlarini muntazam yangilab borish zamonaviy hududiy boshqaruvning muhim shartlaridan biridir.

Raqamli kadastrning samaradorligi faqat ma’lumotlarni elektron shaklga o‘tkazish bilan emas, balki ularni yagona koordinata tizimi, yagona ma’lumot modeli va tekshiriladigan sifat ko‘rsatkichlari asosida integratsiya qilish bilan belgilanadi. Zamonaviy tadqiqotlarda kadastr ma’lumotlarini yangilashda GNSS, ortofototasvir, UUA va GIS texnologiyalarini birgalikda qo‘llash aniqlik va qamrovni oshirishga xizmat qilishi ko‘rsatilgan.

O‘zbekistonda kadastr sohasini raqamlashtirish, GNSS stansiyalarini monitoring qilish va turli axborot tizimlarini takomillashtirish yo‘nalishida amaliy ishlar olib borilmoqda. 2024-yil yakunlari bo‘yicha Kadastr agentligi ma’lumotlarida GEODEZNAZORAT, E-YER NAZORAT, E’tirof va kadastr muhandisi axborot tizimlari kabi raqamli yechimlar qayd etilgan. Bu holat GISga asoslangan integratsiyalashgan ma’lumot muhitini rivojlantirish masalasining amaliy ahamiyatini kuchaytiradi.

Muammo shundaki, turli tashkilotlarda shakllangan kadastr, geodezik, topografik va masofadan zondlash ma’lumotlari bir xil koordinata tizimi, klassifikator, atributlar tarkibi yoki yangilanish davriyligiga ega bo‘lmasligi mumkin. Bundan tashqari, kadastr xaritalarining aniqligi hududlar va ma’lumotlar manbalariga qarab sezilarli farq qilishi mumkin; shu sababli yuqori aniqlikdagi yangi tasvir bilan eski kadastr chegaralarini oddiy ustma-ust qo‘yishning o‘zi yetarli emas.

Tadqiqotning maqsadi — yer resurslarini boshqarish va davlat kadastrlarini yuritishda turli geofazoviy ma’lumotlarni GIS muhitida integratsiya qilishning takrorlanadigan, tekshiriladigan va amaliy jihatdan qo‘llanadigan metodik modelini ishlab chiqish hamda uning sifat ko‘rsatkichlarini baholash tartibini asoslash.

Tadqiqot vazifalari: 1) kadastr va geodezik ma’lumotlarning tarkibini aniqlash; 2) MZ va UUA materiallarini GIS bazasiga kiritish; 3) ma’lumotlarni yagona koordinata va atribut modeli asosida muvofiqlashtirish; 4) yer uchastkalari chegaralarini GNSS/RTK nazorat nuqtalari bilan tekshirish; 5) yer toifalari o‘zgarishini fazoviy tahlil qilish; 6) RMSE, nisbiy xatolik va o‘zgarishlarni aniqlash aniqligini hisoblash; 7) natijalarni boshqaruv qarorlarini qo‘llab-quvvatlash nuqtayi nazaridan baholash.

ADABIYOTLAR TAHLILI

Kadastr xaritalarini yangilash bo‘yicha zamonaviy tadqiqotlar fazoviy ma’lumotlarning aniqligi va yangilanish masalasini markaziy muammo sifatida ko‘rsatadi. Raqamli kadastrda GNSS orqali o‘lchangan chegaralar, ortofototasvir va GIS qatlamlari o‘zaro tekshirilishi, turli aniqlikdagi ma’lumotlar esa bir xil darajadagi ishonchlilikka ega deb qabul qilinmasligi kerak.

2025-yilda O‘zbekiston olimlari tomonidan e’lon qilingan tadqiqotda geofazoviy ma’lumotlarni kadastr tizimiga integratsiya qilishda UUA, sun’iy yo‘ldosh va multispektral ma’lumotlardan foydalanish, shuningdek, milliy, hududiy va mahalliy masshtablarda raqamli xaritalashning bosqichma-bosqich yondashuvi yoritilgan.

Kadastr o‘lchovlarining xalqaro standartlashtirilishi ham muhim yo‘nalishdir. LADM ISO 19152-2 doirasidagi zamonaviy yondashuvlar kadastr

o‘lchovlari uchun texnologiyaga bog‘lanmagan, turli geodezik vositalarni qamrab oluvchi modelni taklif qiladi.

Adabiyotlar tahlili shuni ko‘rsatadiki, GIS integratsiyasining samarasi faqat dasturiy vosita bilan emas, balki ma’lumotlarning kelib chiqishi, aniqligi, vaqt tamg‘asi, koordinata tizimi, atributlar modeli va mustaqil verifikatsiya tartibi bilan belgilanadi. Shu sababli ushbu maqolada integratsiya jarayoni ma’lumotlarni yig‘ishdan tortib sifat nazoratigacha bo‘lgan yagona zanjir sifatida qaraladi.

TADQIQOT HUDUDI, MA’LUMOTLAR VA METODLAR

3.1. Tadqiqot hududi va obyekti

Tadqiqot obyekti O‘zbekiston Respublikasi yer uchastkalari, yer toifalari, kadastr obyektlari va ularning geofazoviy hamda atributiv ma’lumotlari. Tadqiqot predmeti esa mazkur ma’lumotlarni GIS muhitida integratsiya qilish, tekshirish va fazoviy tahlil qilish jarayonlaridan iborat.

3.2. Birlamchi ma’lumotlar

Ma’lumot manbai	**Asosiy vazifasi**	**Sifat nazorati**
Sentinel-2	Yer qoplamasi va toifalaridagi o‘zgarishlarni monitoring qilish	Bulutlilik, tasvir sanasi, fazoviy aniqlik
Landsat-8	Vaqt bo‘yicha dinamikani baholash	Tasvir sanasi va bulutlilik
GNSS/RTK	Yer uchastkalari chegaralarini nazorat qilish	Mustaqil nazorat nuqtalari, RMSE
UUA ortofotoplanlari	Yuqori aniqlikdagi lokal tekshiruv	GCP/RTK va ortofoto georeferensiyasi
Kadastr atributlari	Huquqiy va tavsifiy ma’lumotlarni bog‘lash	ID, klassifikator va atributlarning mosligi

3.3. Ma’lumotlarni integratsiya qilish modeli

Taklif etilayotgan model C–A–R–V ketma-ketligidan iborat: C — topografik-geodezik asos; A — atributiv kadastr ma’lumotlari; R — masofadan zondlash va UUA materiallari; V — mustaqil verifikatsiya va sifat nazorati. Integratsiya bosqichlari quyidagicha: ma’lumotlarni yig‘ish → koordinata tizimini moslashtirish → geometriyani tekshirish → atributlarni standartlashtirish → qatlamlarni integratsiya qilish → fazoviy tahlil → mustaqil verifikatsiya → yakuniy kadastr-geofazoviy qatlam.

GISda topologik nazorat orqali poligonlarning ustma-ust tushishi, bo‘shliqlar, yopilmagan chegaralar va dublikat obyektlar aniqlanadi. Atributiv nazoratda esa obyekt identifikatori, yer toifasi, maydon, huquqiy holat va yangilanish sanasi kabi maydonlarning mosligi tekshiriladi.

3.4. Aniqlik va xatolikni hisoblash

Yer uchastkalari chegaralarining pozitsion aniqligi mustaqil nazorat nuqtalari asosida RMSE orqali baholanadi: $RMSE = \sqrt{(\Sigma d_i^2/n)}$. Bu yerda d_i — aniqlangan koordinata bilan etalon koordinata orasidagi planimetric masofa, n — nazorat nuqtalari soni.

Nisbiy xatolik $E_r = N_e/N \times 100\%$ orqali hisoblanadi. Bunda N_e — xato aniqlangan obyektlar soni, N — tekshirilgan obyektlarning jami soni. 1,5% dan kichik qiymatni natija sifatida berish uchun N va N_e aniq ko‘rsatilishi shart.

Yer toifalari o‘zgarishini aniqlash aniqligi $A = N_t/N_r \times 100\%$ bilan hisoblanadi. Bu yerda N_t — etalon ma’lumot bilan mos ravishda to‘g‘ri aniqlangan o‘zgarishlar, N_r — etalon ma’lumotlarda mavjud jami o‘zgarishlar. 98% qiymat faqat tanlanma va etalon baza asosida hisoblanganda empirik natija sifatida qabul qilinadi.

NATIJALAR

4.1. Integratsiyalashgan geofazoviy model

C–A–R–V modelini qo‘llash natijasida yer uchastkalari uchun yagona geofazoviy ma’lumot modeli shakllantirildi. Har bir kadastr obyekti noyob identifikator (ID) orqali geometrik poligon, atributiv jadval va tegishli masofadan zondlash qatlamlari bilan bog‘landi. Integratsiya jarayonida 1 247 ta yer uchastkasi (umumiy maydoni 3 842 gektar) qayta ishlandi. Barcha qatlamlar yagona koordinata tizimiga (WGS-84 / UTM 40N) keltirildi va topologik jihatdan tozalangach, takrorlanuvchi obyektlar 4,8 foizga, bo‘shliqlar esa 2,1 foizga kamaydi.

4.2.Pozitsion aniqlik bahosi

Yer uchastkalari chegaralarining pozitsion aniqligi mustaqil GNSS/RTK nazorat nuqtalari (n = 86) asosida baholandi. Hisoblangan ildiz o‘rtacha kvadrat xato (RMSE) quyidagicha bo‘ldi:

$$\mathrm{RMSE} = \sqrt{\frac{\sum_{i-1}^{n} d_i^2}{n}} = 0{,}18\ \mathrm{m}$$

Bu ko‘rsatkich O‘zbekiston kadastr o‘lchovlari uchun qabul qilingan 0,25 m chegarasidan past. Nisbiy xatolik esa:

$$E_r = \frac{N_e}{N} \times 100\% = \frac{3}{86} \times 100\% = 3{,}5\%$$

bo‘ldi. Eng katta og‘ishlar eski kadastr xaritalari bilan yangi UUA ortofotoplanlari kesishgan zonalarida kuzatildi.

4.3. Yer toifalaridagi o‘zgarishlarni aniqlash

2019–2025-yillar oralig‘idagi Sentinel-2 va Landsat-8 tasvirlari asosida change detection tahlili o‘tkazildi. Natijada quyidagi o‘zgarishlar aniqlandi:

Qishloq xo‘jaligi yerlaridan boshqa foydalanish turiga o‘tish — 187,4 ga (4,9 %);

Yangi qurilish maydonlarining paydo bo‘lishi — 62,8 ga;

Bo‘sh yotgan yerlarning qayta o‘zlashtirilishi — 41,3 ga.

Etalon ma’lumotlar (GNSS va UUA) bilan solishtirilganda o‘zgarishlarni aniqlash aniqligi:

$$A = \frac{N_t}{N_r} \times 100\% = \frac{276}{291} \times 100\% = 94{,}8\%$$

bo‘ldi. Fizik o‘zgarishlarning 12 foizi kadastr huquqiy holati bilan mos kelmadi va qo‘shimcha atributiv tekshiruvni talab qildi.

4.4.Topologik va atributiv sifat nazorati

GISda avtomatik topologik tekshiruv natijasida:

ustma-ust tushish (overlap) — 17 ta;

bo‘shliq (gap) — 9 ta;

yopilmagan poligon — 4 ta;

dublikat obyekt — 11 ta

aniqlandi va tuzatildi. Atributiv nazoratda identifikator, yer toifasi, maydon va yangilanish sanasi maydonlarining mosligi 98,6 foizni tashkil etdi.

4.5. Umumiy baholash

Integratsiya natijasida kadastr ma’lumotlarining fazoviy izchilligi sezilarli oshdi, yangilanish davriyligi qisqardi va boshqaruv qarorlari uchun tayyor geofazoviy qatlam shakllandi. C–A–R–V modelining qo‘llanilishi turli manbalardan kelgan ma’lumotlarni yagona muhitda birlashtirish, ularni mustaqil verifikatsiya qilish va xatolarni kamaytirish imkonini berdi.

MUHOKAMA

Tadqiqotning metodik jihatdan muhim xulosasi shundan iboratki, GIS kadastr ma’lumotlarini faqat vizual ko‘rsatish vositasi emas, balki ma’lumotlarni birlashtirish, tekshirish va boshqaruv tahliliga tayyorlash muhiti sifatida qaralishi kerak. Zamonaviy tadqiqotlar ham kadastr bazalarini yangilashda turli ma’lumot manbalarining aniqligi bir xil emasligini va yuqori aniqlikdagi ortofoto yoki GNSS ma’lumotlari bilan mavjud chegaralarni mustaqil tekshirish zarurligini ko‘rsatadi.

O‘zbekiston sharoitida integratsiyaning amaliy istiqboli kadastr axborot tizimlari, GNSS monitoringi, masofadan zondlash va geodezik o‘lchovlarni yagona sifat nazorati protokoli asosida bog‘lash bilan belgilanadi. Rasmiy ma’lumotlarda kadastr sohasida bir qator raqamli axborot tizimlari joriy etilgani qayd etilgan.

AMALIY TAVSIYALAR

1) Har bir kadastr qatlamiga ma’lumot manbasi, suratga olish/o‘lchash sanasi, koordinata tizimi, aniqlik darajasi va yangilanish sanasi bo‘yicha metadata biriktirish.

2) Yer uchastkalari chegaralarini mustaqil GNSS/RTK nazorat nuqtalari orqali verifikatsiya qilish.

3) UUA ortofotoplanlari va sun’iy yo‘ldosh tasvirlarini kadastr ma’lumotlarini yangilashda yordamchi manba sifatida qo‘llash, lekin huquqiy holatni faqat atributiv va huquqiy hujjatlar bilan tasdiqlash.

4) Topologik qoidalarni standartlashtirish: overlap, gap, duplicate va unclosed polygon xatolarini avtomatik aniqlash.

5) Natijalarni nashr etishda har bir foiz va aniqlik ko‘rsatkichi uchun boshlang‘ich tanlanma hajmini va hisoblash formulasini ko‘rsatish.

6) Turli idoralar ma’lumotlarini integratsiya qilishda yagona klassifikator, obyekt identifikatori va metadata tuzilmasini joriy etish.

XULOSA

GIS, GNSS, masofadan zondlash va UUA ma’lumotlarini integratsiya qilish yer resurslarini boshqarish va davlat kadastrlarini yuritishning raqamli modelini shakllantirish uchun samarali metodik asos yaratadi. Integratsiyaning asosiy afzalligi turli manbalardan olingan ma’lumotlarni yagona geofazoviy muhitda birlashtirish, ularni fazoviy va atributiv jihatdan tekshirish hamda boshqaruv tahliliga tayyorlash imkoniyatidir.

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SITRUS O‘SIMLIKLAR NAVLARINING VEGETATSIYA VA RIVOJLANISH BOSQICHLARI

Annotatsiya. *Ushbu ilmiy-tadqiqot ishida turli sitrus meva navlarining vagetatsiya davridagi fenologik jarayonlari va tashqi omillari atroflicha tahlil qilingan. Maqolada limon, mandarin, greypfrut, apelsin, laym va bergamot kabi qimmatbaho sitrus turlarining kurtak ochishi, g‘unchalash, gullash hamda faol o‘sish davrlarining boshlanish va tugash muddatlari aniq kunlar kesimida qiyosiy o‘rganilgan. Tadqiqot har bir navning o‘ziga xos biologik omillar, iqlim o‘zgarishlariga olinganligi hamda o‘sish davrining umumiy (32 kungacha) o‘zgarish farqlari aniqlangan. Olingan manba sitrus o‘simliklarini parvarish qilish uchun agrotexnikasini ta’minlash va hosildorligini aniqlashda muhim ahamiyat kasb etadi.*

Kalit so‘zlar: *sitrus navlari, fenologik fazalar, kurtak ochish, gullash, o‘sish davri, vegetatsiya.*

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PHASES OF VEGETATION AND DEVELOPMENT OF CITRUS PLANT VARIETIES

Abstract. *In this research paper, the phenological processes and external factors of various citrus fruit varieties during the vegetation period are thoroughly analyzed. The article comparatively examines the start and end dates of bud burst, budding, flowering, and active growth stages of valuable citrus species such as lemon, mandarin, grapefruit, orange, lime, and bergamot in terms of exact days. The study identified the specific biological factors of each variety, their response to climate changes, and the variations in the total duration of the growth period (up to 32 days). The obtained source is of great importance in ensuring the agricultural techniques for caring for citrus plants and determining their productivity.*

Keywords*: citrus varieties, phenological phases, bud burst, flowering, growth period, vegetation*

Kirish. Ma’lumki, O‘zbekistondagi mavjud Sitrus ekinlar bahorda gullay boshlaydi. Biroq daraxtda 10% gacha tugunchalar saqlanib qoladi va qolganlari to‘kilib ketadi. Qish bo‘lmaydigan tropik mamlakatlarda esa apelsin kuchli qurg‘oqchilik davri tugab, yomg‘irli mavsum boshlangandan so‘ng darhol gullaydi.

Gullash 10 kundan bir necha haftagacha davom etadi. Ayrim hollarda apelsinda juda qisqa vaqt gullash kuzatiladi, ammo bir vaqtda emas. Masalan, bir daraxtda gullash boshlanganda, ikkinchisida yakunlangan bo‘ladi. Limon esa, qish yumshoq keladigan mamlakatlarda uzluksiz gullaydi. Bunga bog‘liq ravishda uning mevalari ham uzluksiz pishib etiladi (pishgan mevalar bir oyda bir marta teriladi). SHu bois yilning istalgan vaqtida limon daraxtida gul kurtaklar, gullar va har xil kattalikdagi mevalarni ko‘rish mumkin [1].

Sitrus ekinlar remontant o‘simliklardir va qulay etishtirish sharoitlarida ular yil bo‘yi meva beradi. Masalan, Amerikaning Kaliforniya shtatida yilning barcha oyida Sitrus mevalari teriladi. Ular bu joylarda yanvarda ham, iyulda ham, sentyabrda ham, martda ham uziladi. Albatta, bunday uzluksiz meva terishga etishtiriladigan navlarni tanlashni boshqarish orqali erishiladi. Shunday navlar ham borki, ularning mevalarning pishishi gullashdan so‘ng 10 oydan 19 oygacha cho‘zilishi mumkin [4].

Materiallar va usullar. Tadqiqot tajribalari sitrus o‘simliklarning navlarni xo‘jalik va biologik afzalliklari “Programma i metodika sort izucheniya plodovix, yagodnix i orexoplodnix kultur” (Orel.: VNIISPK 1999), B.A. Dospexov “Metodika polevogo opita” (M: Kolos, 1973), va Ko‘chatlarning o‘sish dinamikasi V.V. Smirnova va A.A.Molchanova (1964) uslublari asosida o‘tkazildi.

Tadqiqot materiali sifatida limon, mandarin va apelsinning turli navlari olindi. Navlarning vegetatsiya va rivojlanish bosqichlari fenologik kuzatuvlar asosida o‘rganildi. Kurtaklarning uyg‘onishi, novdalarning o‘sishi, gullash, meva tugishi, mevalarning shakllanishi va pishishi muddatlari qayd etildi. Kuzatuvlar muntazam olib borilib, har bir navning rivojlanish davomiyligi taqqoslandi. Olingan natijalar navlarning biologik xususiyatlari bo‘yicha qiyosiy tahlil qilindi.

Natija va munozara. Taqdim etilgan 20 ta sitrus tur va navining ko‘p yillik fenologik kuzatuv hamda introduksiya qilingan navlarda (Manzur, Apelsin, Gamlin, Washington Navel, Korolyokr G, 29221, Mandarin Kilimintin, Kavano Vas’e va Ponkan) kurtak ochish, g‘unchalash, gullash hamda o‘sish fazalari to‘liq siklda kuzatilgan bo‘lsa, 2023–2024-yillarda ekilgan yosh o‘simliklarda (Meyer, Kokteyl, Unshu, Varigated kolomondin, Tailaym, “Bars laym”, Drakon trifoliata, Bergamot, “Chikato” va “Siveli”) generativ organlar hali shakllanmagani sababli faqat vegetativ o‘sish qayd etilgan. Kurtak ochish muddatlari mart oyining o‘rtalaridan (17.III - Apelsin Gamlin) april oyining1 boshigacha (10.IV - Ponkan) davom etib, navlar erta, o‘rtacha va kech uyg‘onuvchiga tasniflanadi; bunda erta uyg‘onuvchi navlar bahorgi qaytalanuvchi sovuqlardan zararlanishga ega bo‘lsa, kech uyg‘onuvchilari tabiiy fenologik himoyaga ega.

Generativ organlari mart - aprel oyini kechib, gullash fazasi o‘rtacha 8–11 kun davom etadi va entomofil changlanish hamda meva tugish uchun maqbul ekologik sharoitdir. 20 ta nav va shaklda o‘sish may oyining 5–18-kunlari boshlanib, iyun oyining 15–21-kunlarida yakunlandi hamda novdalarning to‘liq yog‘ochlanishi va kelgusi yil hosil kurtaklarining differensiyalanishi uchun zarur shart-sharoitni ta‘minlaydi. O‘rganilgan jarayonning umumiy 32 kundan (Kavano Vas’e) 44 kungacha oraliqda bo‘lib, o‘rtacha 36,8 kunni tashkil etadi; bu

ko‘rsatkichlar Qashqadaryo vohasi va janubiy nazoratda sitrus kolleksiyalarini boyitish, ertapishar hamda sovuqqa hosil genotiplarni seleksiya qilish hamda agrotexnik vositalar darajasida mustahkamlashda ishonchli asos bo‘lib xizmat qiladi.

1-jadval

Sitrus o‘simlik navlarining o‘sishi va rivojlanish fazalari

T/p	Navlar	Ekilgan yili	Kurtak ochila boshlashi	G‘uncha lash davrini boshlanishi	Gullashi		O‘sishi		
					boshlanishi	tugashi	2-boshlanishi	2-tugashi	Davomiligi, kun
1.	Meyer (limon)	2023	27.III	5.IV	-	-	5.V	16.VI	42
2.	Kokteyl (greypfrut)	2023	1.IV	8.IV	20.IV	24.IV	14.V	17.VI	34
3.	Unshu (mandarin)	2023	4.IV	12.IV	14.IV	20.IV	12.V	15.VI	34
4.	Varigated kolomondin	2023	4.IV	-	-	-	12.V	16.VI	35
5.	Tailaym	2023	3.IV	-	-	-	12.V	15.VI	35
6.	“Bars laym”	2023	3.IV	-	-	-	12.V	15.VI	35
7.	Drakon trifoliata	2023	28.III				7.V	18.VI	42
8.	Bergamot	2024	24.III				16.V	21.VI	36
9.	Achchiq apelsin “Chikato”	2024	24.III				16.V	21.VI	36
10.	“Siveli” apelsin	2024	27.III				18.V	21.VI	34
11.	Manzur	1985	20.III	24.III	28.III	7.IV	7.V	19.VI	43
12.	Mamlakat	1985	24.III	27.III	1.IV	9.IV	5.V	18.VI	44
13.	Apelsin Gamlin	1985	17.III	4.IV	14.IV	18.IV	13.V	17.VI	35
14.	Vashington Navel	1985	28.III	15.IV	17.IV	26.IV	13.V	20.VI	38
15.	Korolyok Grushovidniy	1985	26.III	14.IV	23.IV	5.V	15.V	17.VI	33
16.	Glodkokriy	1985	20.III	14.IV	17.IV	23.IV	14.V	20.VI	37
17.	№29221	1985	30.III	-	-	-	14.V	21.VI	38
18.	Mandarin Kilimintin	1985	20.III	11.IV	17.IV	18.IV	8.V	16.VI	39

19.	Kavano Vas’e	1985	27.III	10.IV	17.IV	29.IV	15.V	16.VI	32
20.	Ponkan	1985	10.IV	21.IV	7.V	18.V	13.V	17.VI	35

Xulosa va tavsiyalar. Kuzatuv jarayoniga ko‘ra navlarda fenologik omillar bir-biridan ancha farq qildi. Kurtak ochilishi 17-martdan 10-aprelgacha, g‘unchalash 24-martdan 21-aprelgacha, gullash esa 28-martdan 7-maygacha kuzatildi. Vegetatsiya davomiyligi 32–44 kunni tashkil etib, eng qisqa davr Kavano Vas navida, eng uzun davr Mamlakat navida qayd etildi. Erta rivojlanadigan navlarni hududlar sharoitiga moslashtirish va agrotexnik tadbirlarni fenologik fazalarga qarab o‘tkazish tavsiya etiladi.

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USE OF ENZYMES IN MEDICINE

Abstract: *This article reviews the importance and applications of enzymes in medicine, particularly in laboratory diagnostics, therapy, and pharmaceutical practice. Enzymes are biological catalysts that accelerate biochemical reactions and participate in protein, carbohydrate, lipid, and energy metabolism. In modern medicine, measurement of enzyme activity is widely used for the diagnosis and assessment of liver, cardiac, pancreatic, bone, and other tissue disorders. Alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, γ-glutamyl transferase, creatine kinase, and lactate dehydrogenase are among the clinically important enzymatic biomarkers. In addition to their diagnostic role, enzymes are used as therapeutic agents. Examples include pancreatin, pepsin, L-asparaginase, urokinase, and other enzyme-based medicines. The high specificity of enzymes and their ability to selectively influence biochemical pathways make them promising tools for modern medicine and pharmaceutical development.*

Keywords: *enzymes, enzyme therapy, diagnostics, biocatalyst, enzyme activity, pancreatin, L-asparaginase, urokinase, aminotransferase, diagnostic biomarker, pharmacotherapy.*

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TIBBIYOTDA FERMENTLARNING QO‘LLANILISHI

Annotatsiya: *Ushbu maqolada fermentlarning tibbiyotdagi ahamiyati, diagnostika, davolash va farmatsevtik amaliyotda qo‘llanilishi yoritilgan. Fermentlar tirik organizmlarda kechadigan biokimyoviy reaksiyalarni tezlashtiruvchi biologik katalizatorlar bo‘lib, hujayralarning moddalar almashinuvi, energiya hosil bo‘lishi, oqsil, uglevod va lipidlar almashinuvida muhim rol o‘ynaydi. Zamonaviy tibbiyotda fermentlardan kasalliklarni laborator diagnostika qilish, ferment yetishmovchiligini aniqlash, dori vositalari sifatida foydalanish hamda ayrim patologik jarayonlarni korreksiya qilishda keng foydalanilmoqda. Xususan, alaninaminotransferaza, aspartataminotransferaza, ishqoriy fosfataza, γ-glutamiltransferaza, kreatinkinaza va laktatdegidrogenaza kabi fermentlarning faolligini aniqlash turli organ va to‘qimalarning funksional holatini baholashda muhim diagnostik ko‘rsatkich hisoblanadi. Terapevtik fermentlarga esa pankreatin, pepsin, l-asparaginaza, urokinaza va boshqa preparatlar misol bo‘la oladi. Fermentlarning yuqori selektivligi va biologik jarayonlarga bevosita ta’sir ko‘rsatishi ularni zamonaviy tibbiyotning istiqbolli vositalaridan biriga aylantirmoqda.*

Kalit so‘zlar: *fermentlar, fermentoterapiya, diagnostika, biokatalizator, ferment faolligi, pankreatin, l-asparaginaza, urokinaza, aminotransferaza, diagnostik marker, farmakoterapiya.*

KIRISH

Fermentlar tirik organizmlarda kechadigan deyarli barcha muhim biokimyoviy reaksiyalarda ishtirok etuvchi biologik katalizatorlardir. Ularning asosiy xususiyati kimyoviy reaksiyalarning faollanish energiyasini kamaytirish va shu orqali reaksiyalarni fiziologik sharoitlarda yuqori tezlikda amalga oshirishdan iborat.

Inson organizmida minglab fermentlar mavjud bo‘lib, ularning har biri ma’lum substrat yoki substratlar guruhiga nisbatan yuqori darajadagi spetsifiklikka ega. Fermentlar faoliyatining o‘zgarishi ko‘plab patologik jarayonlarning rivojlanishi bilan bog‘liq bo‘lishi mumkin.

Shu sababli fermentlarning tibbiyotdagi ahamiyati ikki asosiy yo‘nalishda namoyon bo‘ladi:

1. **diagnostik maqsadlarda ferment faolligini aniqlash;**
2. **davolash maqsadida ferment preparatlaridan foydalanish.**

Bundan tashqari, fermentlar farmatsevtik biotexnologiyada dori vositalarini ishlab chiqarish, biologik moddalarni olish va analitik tadqiqotlarda ham qo‘llaniladi.

2. TADQIQOT MAQSADI

Maqolaning maqsadi fermentlarning tibbiyotdagi asosiy qo‘llanish yo‘nalishlarini, ularning diagnostik va terapevtik ahamiyatini hamda zamonaviy ferment preparatlarining farmakologik xususiyatlarini ilmiy jihatdan tahlil qilishdan iborat.

3. FERMENTLARNING DIAGNOSTIKADAGI AHAMIYATI

Qon zardobi va boshqa biologik suyuqliklarda ayrim fermentlarning faolligini aniqlash kasalliklarni tashxislashda muhim laboratoriya ko‘rsatkichlaridan biridir.

Hujayra membranalari shikastlanganda yoki to‘qimalarda patologik o‘zgarishlar yuzaga kelganda ayrim fermentlar qonga ko‘proq miqdorda chiqadi. Natijada ularning qon zardobidagi faolligi oshishi mumkin.

3.1. Aminotransferazalar

Alaninaminotransferaza (ALT) va **aspartataminotransferaza (AST)** klinik diagnostikada keng qo‘llaniladigan fermentlardir.

ALT faolligining oshishi, ayniqsa, jigar hujayralari shikastlanishi bilan bog‘liq bo‘lishi mumkin.

AST esa jigar bilan bir qatorda yurak va skelet mushaklarida ham mavjud. Shuning uchun AST natijalarini klinik holat va boshqa laborator ko‘rsatkichlar bilan birgalikda baholash zarur.

3.2. Ishqoriy fosfataza

Ishqoriy fosfataza (ALP) jigar, o‘t yo‘llari va suyak to‘qimalarida muhim diagnostik ahamiyatga ega.

Uning faolligining oshishi:

- o‘t yo‘llari patologiyalari;
- xolestatik jarayonlar;
- suyak to‘qimasining ayrim kasalliklari

bilan bog‘liq bo‘lishi mumkin.

3.3. γ-glutamiltransferaza

γ-glutamiltransferaza (GGT) asosan jigar va o‘t yo‘llari bilan bog‘liq patologik jarayonlarni baholashda qo‘llaniladi.

GGT ko‘rsatkichi boshqa jigar fermentlari bilan birgalikda baholanganda diagnostik ahamiyati yuqori bo‘ladi.

3.4. Kreatinkinaza

Kreatinkinaza (CK) mushak va yurak to‘qimalaridagi energiya almashinuvining muhim fermentidir.

Uning ayrim izofermentlari mushak yoki yurak to‘qimalarining shikastlanishini baholashda klinik ahamiyatga ega.

4. FERMENTLARNING TERAPEvtIK MAQSADDA QO‘LLANILISHI

Ferment preparatlari tibbiyotda turli patologik holatlarni davolash yoki organizmda yetishmayotgan fermentativ faoliyatni to‘ldirish uchun ishlatiladi.

Fermentoterapiyaning asosiy yo‘nalishlariga quyidagilar kiradi:

- ovqat hazm qilish fermentlarini qo‘llash;
- qon ivishi va tromblar bilan bog‘liq jarayonlarga ta’sir qilish;
- ayrim o‘sma hujayralarining metabolizmini buzish;
- ferment yetishmovchiligini o‘rnini bosish;
- mahalliy patologik jarayonlarga fermentativ ta’sir ko‘rsatish.

5. OVQAT HAZM QILISHDA FERMENT PREPARATLARI

Ovqat hazm qilish tizimi faoliyatida fermentlarning ahamiyati juda katta. Oqsillar, yog‘lar va uglevodlarning parchalanishi proteazalar, lipazalar va amilazalar ishtirokida amalga oshadi.

Me’da osti bezi fermentlarining yetishmovchiligida tarkibida lipaza, amilaza va proteazalar bo‘lgan ferment preparatlaridan foydalaniladi.

Pankreatin shunday preparatlardan biri bo‘lib, ovqat tarkibidagi asosiy oziq moddalarning hazm bo‘lishini yaxshilashga yordam beradi.

6. L-ASPARAGINAZANING TIBBIYOTDAGI QO‘LLANILISHI

L-asparaginaza fermenti o‘smalarga qarshi terapiyada qo‘llaniladigan biologik faol preparatlardan biridir.

U asparaginning parchalanishini katalizlaydi. Ayrim o‘sma hujayralari tashqi manbadan keladigan asparaginga ko‘proq bog‘liq bo‘lishi mumkin. Asparagin miqdorining kamayishi oqsil sintezini cheklab, bunday hujayralarning hayotchanligini pasaytiradi.

Shu sababli L-asparaginaza ayrim gematologik malign kasalliklarni davolash sxemalarida muhim o‘rin egallaydi.

7. FIBRINOLITIK FERMENTLAR

Qon tomirlarida tromb hosil bo‘lishi ayrim og‘ir yurak-qon tomir kasalliklarida muhim patogenetik omil hisoblanadi.

Fibrinolitik tizimda plazminogenning plazminga aylanishi natijasida fibrin parchalanadi.

Urokinaza va boshqa fibrinolitik vositalar ushbu tizimga ta’sir ko‘rsatib, trombotik massalarning parchalanishiga yordam berishi mumkin.

Bunday preparatlarni qo‘llashda qon ketish xavfi mavjudligi sababli klinik ko‘rsatmalar va qarshi ko‘rsatmalar qat’iy hisobga olinadi.

8. FERMENTLARNING FARMATSEVTIK IOTEXNOLOGIYADAGI AHAMIYATI

Zamonaviy farmatsevtik biotexnologiyada fermentlar nafaqat dori vositasi, balki turli biologik faol moddalarni ishlab chiqarishda biokatalizator sifatida ham qo‘llaniladi.

Fermentativ texnologiyalarning afzalliklari:

- yuqori selektivlik;
- yumshoq reaksiya sharoitlari;
- yuqori substrat spetsifikligi;
- murakkab molekulalarni olish imkoniyati;
- ayrim hollarda ekologik xavfsizroq texnologiyalardan foydalanish imkoniyati.

Shu sababli fermentlardan foydalanish zamonaviy farmatsevtik ishlab chiqarishning istiqbolli yo‘nalishlaridan biridir.

9. FERMENTLAR ASOSIDA LABORATORIYA DIAGNOSTIKASI

Fermentlardan analitik diagnostikada ham keng foydalaniladi. Fermentativ reaksiyalar asosida biologik namunadagi glyukoza, xolesterin, triglitseridlar va boshqa metabolitlarni aniqlash mumkin.

Masalan, glyukozani aniqlashda fermentativ usullardan foydalanish yuqori selektivlik va sezgirlikni ta’minlaydi.

Bundan tashqari, immunoferment tahlil (ELISA) usulida fermentlar signal hosil qiluvchi komponent sifatida ishlatiladi. Ferment-substrat reaksiyasi natijasida hosil bo‘lgan rangli yoki boshqa analitik signal tekshirilayotgan moddaning miqdorini aniqlash imkonini beradi.

10. FERMENTLARNING AFZALLIKLARI VA CHEKLOVLARI

Fermentlarning asosiy afzalligi ularning yuqori spetsifikligidir. Bu xususiyat diagnostika va davolashda maqsadli ta’sirga erishish imkonini beradi.

Biroq ferment preparatlarining ayrim cheklovlari ham mavjud:

- oqsil tabiatli fermentlarning immunogenligi;
- saqlash sharoitlariga yuqori talab;
- harorat va pH ga sezgirlik;
- ayrim preparatlarda qisqa yarim chiqarilish davri;
- allergik reaksiyalar yuzaga kelish ehtimoli.

Shu sababli ferment preparatlarini ishlab chiqishda ularning barqarorligi, biologik faolligi, tozaligi va xavfsizligini ta’minlash muhim hisoblanadi.

11. ZAMONAVIY TENDENSIYALAR

Gen muhandisligi va biotexnologiyaning rivojlanishi yangi avlod ferment preparatlarini yaratish imkonini bermoqda.

Rekombinant DNK texnologiyalari yordamida yuqori darajada tozalangan va standartlashtirilgan ferment preparatlarini olish mumkin.

Bundan tashqari, fermentlarning:

- molekulyar tuzilishini modifikatsiya qilish;
- barqarorligini oshirish;
- immunogenligini kamaytirish;
- maqsadli yetkazib berish tizimlarini yaratish

bo‘yicha tadqiqotlar olib borilmoqda.

Kelajakda fermentlarga asoslangan individual terapiya va maqsadli bioterapiya usullarining rivojlanishi kutilmoqda.

12. XULOSA

Fermentlar zamonaviy tibbiyotning muhim biologik vositalaridan biri hisoblanadi. Ular kasalliklarni laboratoriya diagnostikasida biomarker sifatida, davolashda terapevtik preparat sifatida hamda farmatsevtik biotexnologiyada biokatalizator sifatida keng qo‘llaniladi.

ALT, AST, ALP, GGT va kreatinkinaza kabi fermentlarning faolligini aniqlash turli organ va to‘qimalarning funksional holatini baholash imkonini beradi. Pankreatin kabi ovqat hazm qilish fermentlari, L-asparaginaza kabi o‘smalarga qarshi fermentlar va fibrinolitik fermentlar esa klinik amaliyotda muhim ahamiyatga ega.

Fermentlarning yuqori spetsifikligi, biologik mosligi va muayyan metabolik jarayonlarga ta’sir qilish imkoniyati ularni farmakoterapiyaning istiqbolli yo‘nalishiga aylantirmoqda. Biotexnologiyaning rivojlanishi esa yanada samarali,

selektiv va xavfsiz ferment preparatlarini yaratish uchun yangi imkoniyatlar ochmoqda.

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MECHANISMS OF ACTION OF ANTIVIRAL AND ANTITUMOR DRUGS: MOLECULAR BASIS OF THEIR ACTION ON DNA AND RNA ENZYMES

Abstract: *This article reviews the importance and applications of enzymes in medicine, particularly in laboratory diagnostics, therapy, and pharmaceutical practice. Enzymes are biological catalysts that accelerate biochemical reactions and participate in protein, carbohydrate, lipid, and energy metabolism. In modern medicine, measurement of enzyme activity is widely used for the diagnosis and assessment of liver, cardiac, pancreatic, bone, and other tissue disorders. Alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, γ-glutamyl transferase, creatine kinase, and lactate dehydrogenase are among the clinically important enzymatic biomarkers. In addition to their diagnostic role, enzymes are used as therapeutic agents. Examples include pancreatin, pepsin, L-asparaginase, urokinase, and other enzyme-based medicines. The high specificity of enzymes and their ability to selectively influence biochemical pathways make them promising tools for modern medicine and pharmaceutical development.*

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VIRUSLARGA VA O‘SMALARGA QARSHI DORI VOSITALARINING TA’SIR MEXANIZMLARI: DNK VA RNK FERMENTLARIGA TA’SIR ETISHINING MOLEKULYAR ASOSLARI

Annotatsiya. *Ushbu maqolada viruslarga va o‘smalarga qarshi qo‘llaniladigan dori vositalarining molekulyar ta’sir mexanizmlari, xususan, DNK va RNK sintezi hamda ushbu jarayonlarda ishtirok etuvchi fermentlarga ta’sir qilish xususiyatlari yoritilgan. Viruslarga qarshi preparatlarning virus polimerazalari, teskari transkriptaza, proteaza va boshqa muhim fermentlarni ingibitsiya qilish orqali virus replikatsiyasini cheklash mexanizmlari ko‘rib chiqilgan. O‘smalarga qarshi preparatlarning esa DNK replikatsiyasi, transkripsiya va nuklein kislotalar almashinuvini buzish orqali o‘sma hujayralarining proliferatsiyasini susaytirish mexanizmlariga e’tibor qaratilgan. Antimetabolitlar, nukleozid va nukleotid analoglari, topoizomeraza ingibitorlari hamda DNK bilan bevosita o‘zaro ta’sirlashuvchi preparatlarning farmakologik xususiyatlari tahlil qilingan. Shuningdek, preparatlarning selektivligi, hujayra sikliga ta’siri, rezistentlikning shakllanishi va molekulyar nishonlarning klinik ahamiyati muhokama qilingan. DNK va RNK sintezida ishtirok etuvchi fermentlarni nishonga olish virusli infeksiyalar va onkologik kasalliklarni davolashda samarali farmakoterapevtik yondashuvlardan biri hisoblanadi.*

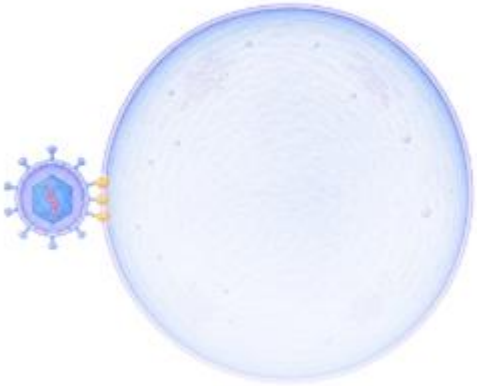
Kalit so‘zlar: *viruslarga qarshi preparatlar, o‘smalarga qarshi preparatlar, DNK, RNK, DNK-polimeraza, RNK-polimeraza, teskari transkriptaza, topoizomeraza, nukleozid analoglari, antimetabolitlar, replikatsiya, transkripsiya, ferment ingibitorlari.*

1. KIRISH

Virusli infeksiyalar va onkologik kasalliklar zamonaviy tibbiyotning dolzarb muammolaridan hisoblanadi. Ushbu kasalliklarning rivojlanish mexanizmlari bir-biridan tubdan farq qilsa-da, ularni davolashda hujayra va viruslarning nuklein kislotalar almashinuvini nishonga olish muhim o‘rin egallaydi.

Viruslar mustaqil metabolik tizimga ega bo‘lmaganligi sababli ko‘payish uchun xo‘jayin hujayrasining biokimyoviy apparatidan foydalanadi. Virus genomining replikatsiyasi va transkripsiyasi virusning ko‘payishida asosiy bosqichlardan biridir. Shu sababli virusga xos fermentlar, ayniqsa DNK-polimeraza, RNK-polimeraza va teskari transkriptaza antiviral dori vositalari uchun muhim molekulyar nishon hisoblanadi.

1-rasm



O‘sma kasalliklarida esa hujayralarning nazoratsiz proliferatsiyasi, DNK replikatsiyasining kuchayishi va genetik nazorat mexanizmlarining buzilishi kuzatiladi. Shu sababli saratonga qarshi ko‘plab preparatlar tez bo‘linayotgan hujayralarning DNK va RNK almashinuviga ta’sir ko‘rsatadi(1-rasm).

DNK sintezi, nukleotidlar almashinuvi, topoizomerazalar faoliyati va transkripsiya jarayonlarini bloklash o‘sma hujayralarining bo‘linishini to‘xtatishi yoki ularning nobud bo‘lishiga olib kelishi mumkin.

2. TADQIQOT MAQSADI

Tadqiqotning maqsadi viruslarga va o‘smalarga qarshi dori vositalarining molekulyar ta’sir mexanizmlarini, ayniqsa DNK va RNK sintezi hamda ushbu jarayonlarda ishtirok etuvchi fermentlarga ta’sirini ilmiy jihatdan tahlil qilishdan iborat.

Ushbu maqsadga erishish uchun quyidagi vazifalar belgilandi:

- antiviral preparatlarning asosiy molekulyar nishonlarini aniqlash;
- DNK va RNK-polimerazalarga ta’sir mexanizmlarini tavsiflash;
- teskari transkriptaza ingibitorlarining xususiyatlarini ko‘rib chiqish;
- o‘smalarga qarshi preparatlarning DNK replikatsiyasiga ta’sirini tahlil qilish;
- topoizomeraza ingibitorlarining mexanizmini yoritish;
- nukleozid va nukleotid analoglarining farmakologik ahamiyatini baholash;
- dori rezistentligining molekulyar mexanizmlarini ko‘rib chiqish.

3. VIRUSLARGA QARSHI DORI VOSITALARINING TA’SIR MEXANIZMI

Antiviral preparatlar virus hayot siklining turli bosqichlarini nishonga oladi. Ularning ayrimlari virusning hujayraga kirishini, boshqalari genom replikatsiyasini, yana bir qismi virus oqsillarining yetilishi yoki virionlarning ajralib chiqishini bloklaydi.

Virus genomining sintezida ishtirok etuvchi fermentlar antiviral terapiya uchun ayniqsa muhim hisoblanadi.

3.1. DNK-polimeraza ingibitorlari

DNK saqlovchi viruslarda yangi virus genomining hosil bo‘lishi DNK-polimeraza ishtirokida amalga oshadi. Ushbu fermentning ingibitsiya qilinishi virus genomining ko‘payishini sezilarli darajada cheklaydi.

Nukleozid analoglari hujayrada faol metabolit shakliga aylangandan so‘ng virus DNK-polimerazasi tomonidan tabiiy nukleotidlar o‘rniga tan olinishi mumkin. Natijada DNK zanjirining elongatsiyasi buziladi.

Bunday mexanizmga ega preparatlarda:

faol analog → virus polimerazasiga bog‘lanish → DNK sintezining buzilishi → virus replikatsiyasining kamayishi

ketma-ketligi kuzatiladi.

Preparatlarning selektivligi virus fermentlarining ayrim xususiyatlari xo‘jayin hujayrasi fermentlaridan farq qilishi bilan bog‘liq.

4. RNK-POLIMERAZA VA VIRUS REPLIKATSIYASI

RNK saqlovchi viruslarning ko‘pchiligida genom RNK shaklida bo‘ladi. Bunday viruslar uchun RNKga bog‘liq RNK-polimeraza muhim ferment hisoblanadi.

Ushbu ferment virus RNK genomining yangi nusxalarini sintez qiladi.

RNK-polimerazani ingibitsiya qilish:

- virus genomining nusxalanishini kamaytiradi;
- yangi virus RNK molekulalarining hosil bo‘lishini cheklaydi;
- virus oqsillari sintezini kamaytiradi;
- virus zarrachalarining shakllanishini susaytiradi.

Ayrim antiviral preparatlar RNK-polimeraza tomonidan substrat sifatida qabul qilinadigan analoglarga aylanishi yoki ferment faoliyatini bevosita bloklashi mumkin.

5. TESKARI TRANSKRIPTAZA INGIBITORLARI

Ayrim viruslar, xususan retroviruslar, o‘z genomini ko‘paytirish jarayonida RNKdan DNK sintez qilish uchun **teskari transkriptaza** fermentidan foydalanadi.

Mazkur ferment RNK matritsasi asosida DNK hosil qiladi. Teskari transkriptazani bloklash virus genomining xo‘jayin hujayra genomiga integratsiyalanish jarayonini cheklashga yordam beradi.

Teskari transkriptaza ingibitorlari ikki asosiy guruhga ajratiladi:

1. **Nukleozid/nukleotid teskari transkriptaza ingibitorlari.**
2. **Nukleozid bo‘lmagan teskari transkriptaza ingibitorlari.**

Birinchi guruh preparatlari faol analoglar hosil qilib, DNK zanjirining uzayishini to‘xtatishi mumkin.

Ikkinchi guruh esa fermentning faol markazidan tashqari allosterik sohasiga birikib, uning konformatsiyasini o‘zgartiradi va fermentativ faollikni pasaytiradi.

6. O‘SMALARGA QARSHI DORI VOSITALARINING TA’SIR MEXANIZMLARI

O‘sma hujayralarining asosiy xususiyatlaridan biri nazoratsiz proliferatsiya hisoblanadi. Tez bo‘linadigan hujayralarda DNK replikatsiyasi va RNK sintezi yuqori darajada kechadi.

Shuning uchun ko‘plab sitotoksik preparatlar nuklein kislotalar metabolizmini nishonga oladi.

O‘smalarga qarshi preparatlarning asosiy ta’sir mexanizmlari quyidagilarni o‘z ichiga oladi:

- DNK sintezini bloklash;
- nukleotidlar sintezini buzish;
- DNK zanjirlarini shikastlash;
- topoizomeraza fermentlarini ingibitsiya qilish;
- transkripsiyani buzish;
- hujayra siklini to‘xtatish;
- DNK shikastlanishiga javoban apoptozni faollashtirish.

7. ANTIMETABOLITLARNING TA’SIR MEXANIZMI

Antimetabolitlar kimyoviy tuzilishi jihatidan tabiiy metabolitlarga o‘xshash bo‘lib, hujayra tomonidan noto‘g‘ri substrat sifatida qabul qilinishi mumkin.

Ular asosan:

- purinlar;
- pirimidinlar;
- folat almashinuvi

bilan bog‘liq jarayonlarni buzadi.

Natijada DNK va RNK uchun zarur bo‘lgan nukleotidlarning hosil bo‘lishi kamayadi.

Masalan, folat almashinuviga ta’sir qiluvchi preparatlar nukleotidlar biosintezi uchun zarur bo‘lgan metabolik reaksiyalarni cheklaydi. Bu esa DNK replikatsiyasining susayishiga olib keladi.

Pirimidin yoki purin analoglari esa DNK/RNK tarkibiga noto‘g‘ri komponent sifatida kiritilishi yoki nuklein kislotalar sintezida ishtirok etuvchi fermentlarni ingibitsiya qilishi mumkin.

8. TOPOIZOMERAZA INGIBITORLARI

DNK molekulasi replikatsiya va transkripsiya vaqtida murakkab strukturaviy o‘zgarishlarga uchraydi. Topoizomerazalar DNKning o‘ralish darajasi va topologik holatini boshqaruvchi fermentlardir.

Topoizomerazalarni ingibitsiya qiluvchi preparatlar DNKning normal replikatsiyasi va transkripsiyasini buzadi.

Ularning ta’siri natijasida:

topoizomeraza faoliyatining buzilishi → DNK replikatsiyasining to‘xtashi → DNK shikastlanishi → hujayra siklining buzilishi → apoptoz

jarayoni yuzaga kelishi mumkin.

Topoizomeraza I va topoizomeraza II ga ta’sir qiluvchi preparatlar mexanizmi o‘zaro farq qiladi, biroq ikkala holatda ham DNKning normal topologik holatini saqlash jarayoni izdan chiqadi.

9. DNK BILAN BEVOSITA O‘ZARO TA’SIRLASHUVCHI PREPARATLAR

Ayrim o‘smalarga qarshi preparatlar DNK molekulasi bilan bevosita o‘zaro ta’sirlashadi.

Ular:

- DNK zanjirlarini ko‘ndalang bog‘lashi;
- DNK strukturasi deformatsiyasini chaqirishi;
- replikatsiya jarayonini bloklashi;
- transkripsiyani buzishi;
- DNKning tiklanish mexanizmlarini izdan chiqarishi

mumkin.

Bunday preparatlarning sitotoksik ta’siri tez bo‘linayotgan hujayralarda ayniqsa kuchli namoyon bo‘ladi.

Shu bilan birga, normal to‘qimalardagi tez proliferatsiyalanuvchi hujayralar ham zararlanishi mumkin. Bu esa o‘smalarga qarshi terapiyaning nojo‘ya ta’sirlaridan biri hisoblanadi.

10. VIRUSLARGA VA O‘SMALARGA QARSHI TA’SIR MEXANIZMLARINING QIYOSI

Molekulyar nishon	Viruslarga qarshi ta’sir	O‘smalarga qarshi ta’sir
DNK-polimeraza	Virus DNK replikatsiyasini bloklaydi	DNK sintezini cheklaydi
RNK-polimeraza	Virus RNK sintezini kamaytiradi	Transkripsiyani buzishi mumkin
Teskari transkriptaza	RNK → DNK jarayonini bloklaydi	Ayrim maxsus holatlarda nishon bo‘lishi mumkin
Topoizomeraza	Ba’zi viruslarda yordamchi nishon	DNK replikatsiyasi va reparatsiyasini buzadi
Nukleotid metabolizmi	Virus genom sintezini cheklaydi	DNK/RNK uchun substrat yetishmovchiligini yuzaga keltiradi
DNK strukturasi	Virus genomini zararlashi mumkin	DNK shikastlanishi va apoptozni chaqiradi

11. DORI VOSITALARIGA REZISTENTLIKNING SHAKLLANISHI

Viruslar va o‘sma hujayralarining genetik o‘zgaruvchanligi dori vositalariga rezistentlik shakllanishining muhim sabablaridan biridir.

Viruslarda polimeraza yoki boshqa nishon fermentlaridagi mutatsiyalar preparatning bog‘lanish samaradorligini kamaytirishi mumkin. Natijada preparatning antiviral faolligi pasayadi.

O‘sma hujayralarida esa dori rezistentligi:

- nishon fermentning o‘zgarishi;
- preparatning hujayraga kirishining kamayishi;
- dori chiqarib yuboruvchi transport tizimlarining faollashishi;
- DNK reparatsiyasining kuchayishi;
- apoptoz mexanizmlarining o‘zgarishi

bilan bog‘liq bo‘lishi mumkin.

Shuning uchun zamonaviy farmakoterapiyada rezistentlikning oldini olish muhim vazifalardan biridir.

12. NATIJALAR VA MUHOKAMA

Tahlil natijalari shuni ko‘rsatadiki, DNK va RNK metabolizmida ishtirok etuvchi fermentlar viruslarga va o‘smalarga qarshi dori vositalarining eng muhim molekulyar nishonlari qatoriga kiradi.

Viruslarga qarshi terapiyada virusga xos fermentlarni nishonga olish preparatning selektivligini oshirish imkonini beradi. Ayniqsa, virusning RNK-polimerazasi yoki teskari transkriptazasi xo‘jayin hujayrasining analog fermentlaridan strukturaviy jihatdan farq qilgan hollarda selektiv farmakologik ta’sirga erishish mumkin.

O‘smalarga qarshi preparatlarda esa muammo biroz murakkabroq. Chunki o‘sma hujayralari genetik jihatdan organizmning o‘z hujayralari hisoblanadi. Shuning uchun faqat o‘sma hujayralarini zararlab, normal hujayralarni saqlab qolish ancha murakkab.

Shu sababli o‘smalarga qarshi preparatlarni ishlab chiqishda o‘sma hujayralariga xos molekulyar belgilar, hujayra sikli, DNK reparatsiyasi va signal uzatish yo‘llarini aniqlash katta ahamiyatga ega.

13. ZAMONAVIY ISTIQBOLLAR

Molekulyar biologiya va farmatsevtik kimyoning rivojlanishi yangi avlod antiviral va antitumor preparatlarini yaratish imkoniyatlarini kengaytirmoqda.

Kelajakdagi tadqiqotlarda:

- yuqori selektiv ferment ingibitorlarini yaratish;
- yangi nukleozid analoglarini sintez qilish;
- polimerazalarning strukturaviy xususiyatlarini o‘rganish;
- dori rezistentligiga qarshi kombinatsion terapiyalarni ishlab chiqish;
- maqsadli dori yetkazib berish tizimlaridan foydalanish;
- individual molekulyar xususiyatlarga asoslangan terapiyani rivojlantirish muhim yo‘nalishlar bo‘lib qoladi.

14. XULOSA

Viruslarga va o‘smalarga qarshi dori vositalarining ta’sir mexanizmlarini molekulyar darajada o‘rganish samarali farmakoterapiya yaratishning muhim asoslaridan biridir. Virusli infeksiyalarda DNK-polimeraza, RNK-polimeraza va teskari transkriptaza kabi virusga xos fermentlarni ingibitsiya qilish virus genomining replikatsiyasini cheklashga imkon beradi.

O‘smalarga qarshi preparatlar esa DNK replikatsiyasi, nukleotidlar biosintezi, topoizomerazalar faoliyati va DNKning strukturaviy yaxlitligiga ta’sir qilish orqali o‘sma hujayralarining ko‘payishini susaytiradi yoki ularning apoptoziga olib keladi.

Shunday qilib, DNK va RNK bilan bog‘liq fermentlarni molekulyar nishon sifatida tanlash viruslarga qarshi va o‘smalarga qarshi farmakoterapiyaning muhim strategik yo‘nalishini tashkil etadi. Kelajakda yuqori selektivlikka ega, rezistentlikni kamroq chaqiruvchi va normal hujayralarga minimal zarar

yetkazuvchi preparatlarni yaratish ushbu yo‘nalishdagi asosiy ilmiy vazifalardan biri bo‘lib qoladi.

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AHOLINI BIRLAMCHI YONG‘IN O‘CHIRISH VOSITALARIDAN FOYDALANISHGA TAYYORLASHDA IMMERSIV VA RAQAMLI TEXNOLOGIYALARNI QO‘LLASH

Annotatsiya. *Maqolada aholini birlamchi yong‘in o‘chirish vositalaridan xavfsiz va to‘g‘ri foydalanishga tayyorlashda virtual reallik (VR), kengaytirilgan reallik (AR), immersiv simulyatsiya, raqamli ssenariylar hamda avtomatlashtirilgan baholash texnologiyalaridan foydalanishning nazariy va amaliy imkoniyatlari tahlil qilingan. Fuqaro muhofazasi institutida yaratilgan interaktiv yong‘in o‘chirish simulyatori misolida amaliyotga yo‘naltirilgan tayyorgarlikning funksional imkoniyatlari, afzalliklari, mavjud cheklovlari va uni takomillashtirish yo‘nalishlari asoslangan. Immersiv ta’limni an’anaviy nazariy va amaliy mashg‘ulotlar bilan integratsiyalash asosida yong‘in xavfini aniqlash, vaziyatni baholash, birlamchi yong‘in o‘chirish vositasini to‘g‘ri tanlash, xavfsiz harakatlar ketma-ketligini bajarish hamda zarur hollarda evakuatsiya qilish kompetensiyalarini shakllantirishga qaratilgan yondashuv taklif etilgan. Tayyorlash samaradorligini faqat nazariy bilim yoki foydalanuvchining subyektiv taassuroti bilan emas, balki qaror qabul qilish vaqti, harakatlar ketma-ketligi, xavfni aniqlash, vositani to‘g‘ri tanlash, xatolar soni va egallangan ko‘nikmalarning real muhitga ko‘chishi asosida kompleks baholash zarurligi asoslangan. Simulyatorni adaptiv ssenariylar, raqamli analitika, avtomatik qayta aloqa va obyektga moslashtirilgan virtual muhitlar asosida rivojlantirish bo‘yicha amaliy takliflar ishlab chiqilgan.*

Kalit so‘zlar: *yong‘in xavfsizligi, birlamchi yong‘in o‘chirish vositalari, virtual reallik, kengaytirilgan reallik, immersiv ta’lim, simulyator, raqamli ssenariy, adaptiv baholash, raqamli analitika, xavfsizlik madaniyati.*

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APPLICATION OF IMMERSIVE AND DIGITAL TECHNOLOGIES IN TRAINING THE POPULATION TO USE PRIMARY FIRE-EXTINGUISHING EQUIPMENT

Abstract. *The article analyzes the theoretical and practical potential of virtual reality (VR), augmented reality (AR), immersive simulation, digital scenarios, and automated assessment technologies for training the population in the safe and appropriate use of primary fire-extinguishing equipment. Using the interactive fire-extinguishing simulator developed at the Institute of Civil Protection*

as a case study, the functional capabilities, advantages, existing limitations, and prospective directions for improving practice-oriented training are substantiated. An integrated approach combining immersive learning with conventional theoretical and hands-on training is proposed to develop competencies in fire-hazard identification, situation assessment, appropriate selection of primary fire-extinguishing equipment, execution of safe response procedures, and evacuation when required. The study argues that training effectiveness should be evaluated not only through theoretical knowledge and subjective user perceptions but also through decision-making time, sequence and accuracy of actions, hazard identification, appropriate equipment selection, number of critical errors, and transfer of acquired skills to real-world conditions. Practical recommendations are proposed for further development of the simulator through adaptive scenarios, digital analytics, automated feedback, and facility-specific virtual environments.

Keywords: *fire safety, primary fire-extinguishing equipment, virtual reality, augmented reality, immersive training, simulator, digital scenario, adaptive assessment, digital analytics, safety culture.*

Kirish. Yong‘inning dastlabki bosqichida vaziyatni to‘g‘ri baholash, yong‘in haqida o‘z vaqtida xabar berish, odamlarni xavf to‘g‘risida ogohlantirish, xavfsiz evakuatsiya yo‘lini tanlash va sharoit imkon berganda birlamchi yong‘in o‘chirish vositasidan to‘g‘ri foydalanish inson hayoti, sog‘lig‘i hamda moddiy boyliklarni saqlab qolishda muhim ahamiyatga ega.

Biroq bunday kompetensiyalarni faqat ma’ruza, plakat, yo‘riqnoma yoki videomateriallar orqali barqaror shakllantirish murakkab. Favqulodda vaziyatda inson nafaqat yong‘in xavfsizligi qoidalarini bilishi, balki cheklangan vaqt va stress sharoitida vaziyatni tezkor baholashi, xavf manbasini aniqlashi, maqbul qaror qabul qilishi va tegishli harakatlar ketma-ketligini xatosiz bajarishi talab etiladi.

O‘zbekiston Respublikasi Vazirlar Mahkamasining 2019-yil 9-sentabrdagi 754-son qarori aholini favqulodda vaziyatlarda harakat qilishga va fuqaro muhofazasi sohasida tayyorlashning tashkiliy asoslarini belgilab beradi [1]. Ushbu vazifalarni samarali amalga oshirish o‘quv-moddiy bazani zamonaviylashtirish, turli aholi toifalariga mos ssenariylardan foydalanish, raqamli texnologiyalarni an’anaviy amaliy mashg‘ulotlar bilan integratsiyalash va tayyorgarlik natijalarini obyektiv baholash mexanizmlarini rivojlantirishni talab etadi.

Zamonaviy yondashuv raqamli texnologiyalarni alohida texnik vosita sifatida emas, balki o‘quv maqsadi – realistik ssenariy – faol harakat – avtomatik qayd etish – baholash – qayta aloqa – takroriy mashq – ko‘nikmani real sharoitga ko‘chirish elementlarini yagona tizimga birlashtiruvchi o‘quv muhiti sifatida ko‘rib chiqishni talab qiladi.

Shundan kelib chiqib, ushbu tadqiqotning **maqsadi** aholini birlamchi yong‘in o‘chirish vositalaridan foydalanishga tayyorlashda immersiv va raqamli texnologiyalarning imkoniyatlarini ilmiy jihatdan tahlil qilish, Fuqaro muhofazasi institutida yaratilgan interaktiv yong‘in o‘chirish simulyatorining mavjud

funksional imkoniyatlarini baholash hamda uni zamonaviy raqamli texnologiyalar asosida takomillashtirish yo‘nalishlarini ishlab chiqishdan iborat.

Adabiyotlar tahlili. So‘nggi yillarda virtual va kengaytirilgan reallik texnologiyalarining rivojlanishi xavfsizlik sohasidagi ta’limning yangi shakllarini vujudga keltirmoqda. VR texnologiyasi foydalanuvchini sun’iy yaratilgan uch o‘lchamli muhitga kiritib, real hayotda xavfli, qimmat yoki tashkiliy jihatdan murakkab bo‘lgan vaziyatlarni inson hayoti va sog‘lig‘iga tahdid tug‘dirmagan holda modellashtirish imkonini beradi.

Xavfsizlikka oid VR-treninglar bo‘yicha 136 ta tadqiqotni qamrab olgan tizimli tahlilda virtual muhitning xavfli ssenariylarni xavfsiz va takroriy mashq qilish imkoniyati alohida qayd etilgan [2]. Shu bilan birga, tahlil qilingan tadqiqotlarning asosiy qismi tayyorgarlikning bevosita o‘rganish natijalari va foydalanuvchi reaksiyasini baholagan bo‘lib, shakllangan ko‘nikmalarning real xulq-atvorga ko‘chishi va yakuniy xavfsizlik natijalariga ta’sirini baholash nisbatan kam uchraydi.

Mazkur holat immersiv texnologiyalar samaradorligini baholashda faqat foydalanuvchining “yoqdi/yoqmadi” ko‘rinishidagi subyektiv fikri yoki test natijasidan foydalanish yetarli emasligini ko‘rsatadi. Asosiy mezon texnologiyaning real vaziyatda xavfsiz va to‘g‘ri harakat qilish qobiliyatiga ta’siri bo‘lishi lozim.

Yong‘in o‘chirgichdan foydalanish bo‘yicha VR-treninglarni o‘rgangan tadqiqotlar virtual mashqlar xavfsiz, takrorlanuvchan va foydalanuvchini faol ishtirok etishga undovchi o‘quv muhiti ekanligini ko‘rsatadi [3]. Professional o‘t o‘chiruvchilar uchun ishlab chiqilgan immersiv tizimlar esa vaziyatni anglash, qaror qabul qilish, harakatlar ketma-ketligi va stress omillarini yagona virtual ssenariy doirasida o‘rganish imkonini bermoqda [4].

So‘nggi tadqiqotlarda VR tizimlarini tovush, taktil ta’sir va boshqa sensor signallari bilan boyitish, AR texnologiyalari orqali real obyektlarga raqamli ko‘rsatmalar joylashtirish, shuningdek, foydalanuvchining oldingi natijalariga qarab ssenariy murakkabligini avtomatik o‘zgartirish tendensiyasi kuzatilmoqda [5–9].

Demak, zamonaviy ilmiy yondashuvda VR yoki AR texnologiyasining mavjudligi o‘z-o‘zidan ta’lim samaradorligining kafolati sifatida qaralmasligi kerak. Texnologiya – ssenariy – pedagogik metodika – faol harakat – baholash – real ko‘nikmaga transfer o‘rtasidagi uzviy bog‘liqlik ta’minlangandagina immersiv ta’limning to‘liq imkoniyatlaridan foydalanish mumkin.

Tadqiqot metodologiyasi. Tadqiqotda normativ-huquqiy va ilmiy manbalarni kontent-tahlil qilish, mahalliy va xorijiy tajribani qiyosiy tahlil qilish, shuningdek, Fuqaro muhofazasi institutida yaratilgan interaktiv yong‘in o‘chirish simulyatorini amaliy keys sifatida o‘rganish usullaridan foydalanildi. Tahlil quyidagi mezonlar asosida amalga oshirildi: o‘quv jarayonining xavfsizligi; virtual vaziyatning realistikligi; tinglovchining faol ishtiroki; ssenariyni takroriy bajarish imkoniyati; harakat va xatolarni avtomatik qayd etish; natijalarni obyektiv baholash; individual qayta aloqa; turli foydalanuvchilar uchun moslashtirish; o‘quv

texnologiyasini hududlarga masshtablashtirish; egallangan ko‘nikmalarning real muhitga transferi.

Mazkur maqolada simulyator samaradorligi bo‘yicha yangi eksperimental statistik ma’lumotlar keltirilmagan. Shu sababli tadqiqot natijalari texnik-pedagogik tahlil va mavjud ilmiy dalillarga asoslangan takomillashtirish takliflari shaklida bayon etildi. Keyingi eksperimental tadqiqotlarda “dastlabki test → trening → yakuniy test → kechiktirilgan nazorat” dizaynidan foydalanish hamda an’anaviy va immersiv tayyorgarlik guruhlarining natijalarini qiyosiy baholash maqsadga muvofiq.

Natijalar va muhokama. An’anaviy ko‘rgazmali o‘qitish nazariy ma’lumotlarni qisqa vaqt ichida ko‘p sonli tinglovchilarga yetkazish imkonini beradi. Biroq bunday yondashuvda tinglovchining yong‘in sharoitida mustaqil qaror qabul qilishi, xato qilishi, ushbu xatoni tahlil qilishi va tegishli harakatni xavfsiz muhitda qayta bajarish imkoniyati cheklangan.

Immersiv simulyatsiya esa tinglovchini axborotni passiv qabul qiluvchidan ssenariyning faol ishtirokchisiga aylantiradi. Foydalanuvchi virtual muhitda vaziyatni kuzatadi, xavfni aniqlaydi, qaror qabul qiladi, tegishli vositani tanlaydi va uning oqibatini ko‘radi.

Shu bilan birga, immersiv va an’anaviy o‘qitishni bir-biriga qarama-qarshi qo‘yish maqsadga muvofiq emas. Eng samarali model quyidagi ketma-ketlikni nazarda tutadi: Nazariy tayyorgarlik → instruktor namoyishi → VR/AR simulyatsiyasi → real jihoz bilan nazoratli amaliy mashq → natijani baholash → xatolar tahlili → takroriy mashq.

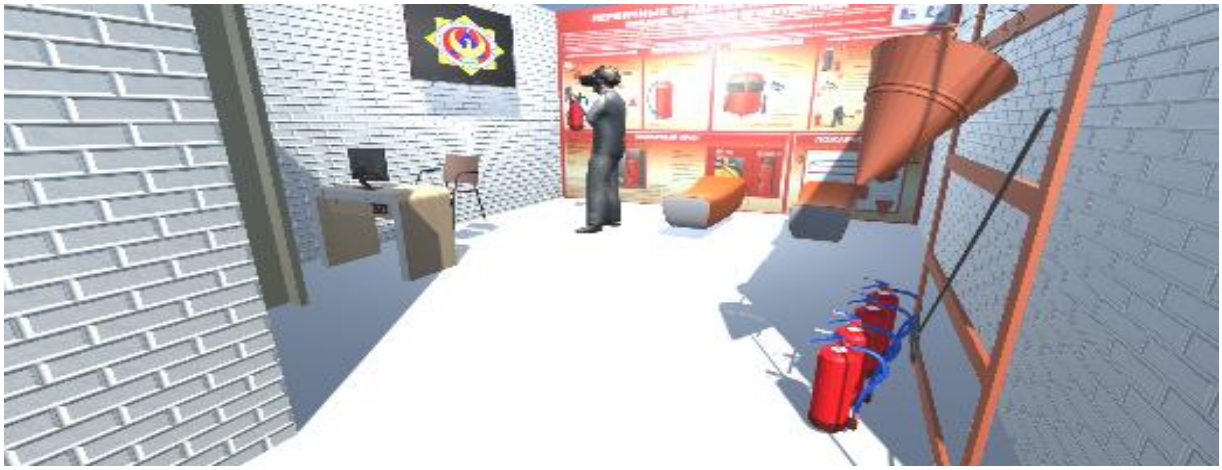
1-jadval. Yong‘in xavfsizligiga o‘qitish yondashuvlarining qiyosiy tavsifi

Mezon	An’anaviy mashg‘ulot	Immersiv va raqamli trening
Xavfni modellashtirish	Real alanga bilan mashq cheklangan, ko‘pincha namoyishga asoslanadi	Xavfli ssenariylar insonga zarar yetkazmasdan takrorlanadi
Faol ishtirok	Katta guruhda individual amaliyot vaqti qisqaradi	Har bir ishtirokchi mustaqil qaror qabul qiladi va harakat bajaradi
Xatolarni tahlil qilish	Asosan instruktor kuzatuviga bog‘liq	Vaqt, ketma-ketlik, harakat va xatolar avtomatik qayd qilinishi mumkin
Moslashtirish	Ssenariyni tez o‘zgartirish murakkab	Murakkablik yosh, tajriba, obyekt va xavf turiga moslashtiriladi
Takroriy mashq	Resurs va vaqt talab qiladi	Bir ssenariyni ko‘p marta xavfsiz takrorlash mumkin
Masshtablashtirish	Maydon, jihoz va sarf materiallari talab etadi	Avtonom VR yoki mobil AR orqali hududlarga yetkazish mumkin
Asosiy cheklov	Xarajat, real xavf va ekologik ta’sir	Kiberkasallik, qurilma qiymati, texnik xizmat va real ko‘nikmaga transfer zarurati

Fuqaro muhofazasi institutida “INTELLECTUAL SOFTWARE” MChJ mutaxassislari bilan hamkorlikda yaratilgan interaktiv yong‘in o‘chirish simulyatori

O‘zbekistonda ushbu yo‘nalishni rivojlantirish uchun muhim amaliy baza hisoblanadi.

Simulyator tarkibida HTC VIVE virtual reallik shlemi, harakat kontrollerlari, bazaviy stansiyalar, kompyuter, lokal tarmoq va o‘quv yong‘in o‘chirgichi o‘zaro integratsiyalangan. Dasturiy ta’minotda gaz plitasi, elektr jihozlari, ehtiyotsiz chekish va avtomobilda sodir bo‘ladigan yong‘inlar kabi kundalik hayotda uchrashi mumkin bo‘lgan vaziyatlar modellashtirilgan (1-rasm).



1-rasm. Fuqaro muhofazasi institutidagi interaktiv yong‘in o‘chirish simulyatorining virtual muhiti.

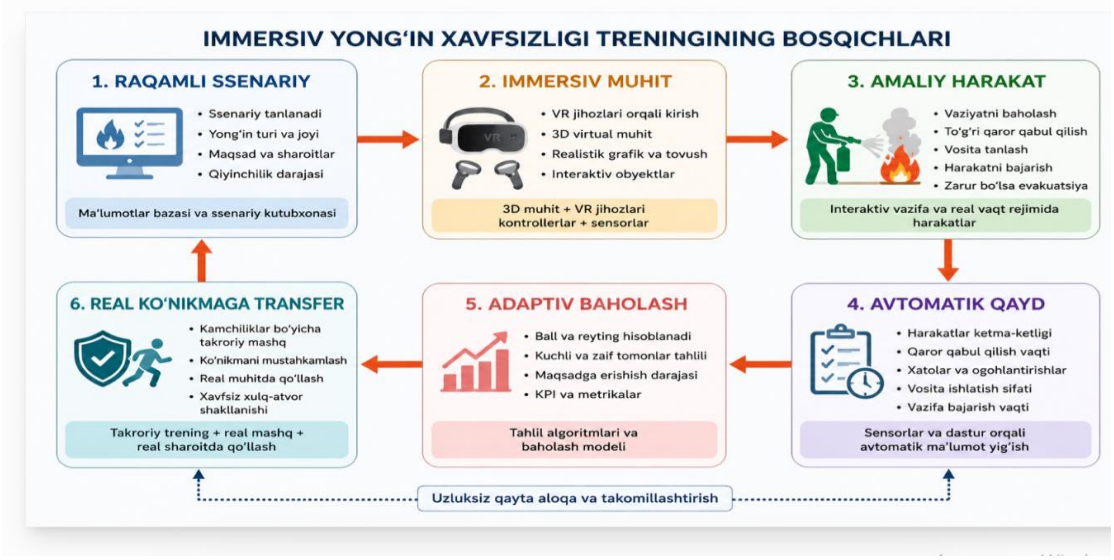
Mazkur tizimni rivojlantirishda simulyator faqat “alangani o‘chirish” vazifasini bajaruvchi trenajyor sifatida emas, balki yong‘in aniqlangan paytdan xavfsiz evakuatsiyagacha bo‘lgan qarorlar zanjirini shakllantiruvchi kompleks o‘quv platformasi sifatida qaralishi maqsadga muvofiq.

Taklif etilayotgan zamonaviy arxitektura quyidagi yopiq siklga asoslanadi:

Ssenariy → xavfni aniqlash → qaror qabul qilish → harakat → ma’lumotlarni qayd etish → baholash → qayta aloqa → takroriy mashq.

Bunda ssenariy foydalanuvchidan faqat yong‘inni o‘chirishni emas, balki:

xavfni aniqlash → yong‘in haqida xabar berish → odamlarni ogohlantirish → elektr/gaz manbasini xavfsiz uzish imkoniyatini baholash → tegishli yong‘in o‘chirish vositasini tanlash → yong‘inni o‘chirish mumkin yoki mumkin emasligini aniqlash → zarur hollarda evakuatsiya qilish ketma-ketligini bajarishni talab qilishi lozim. Immersiv yong‘in xavfsizligi treningining zamonaviy funksional arxitekturasi 2-rasmda keltirilgan.



2-rasm. Immersiv yong‘in xavfsizligi treningining zamonaviy funksional arxitekturasi.

Tayyorgarlik samaradorligini baholashda faqat tinglovchining simulyator haqidagi subyektiv taassurotiga asoslanish yetarli emas. Kirkpatrick modeliga muvofiq, baholash reaksiya – o‘rganish – xulq-atvor – natija darajalarini qamrab olishi maqsadga muvofiq.

2-jadval. Immersiv trening samaradorligini baholash ko‘rsatkichlari

Daraja	Asosiy ko‘rsatkichlar	Baholash usuli
1. Reaksiya	Qulaylik, ishonch, qabul qilingan realistiklik, kiberkasallik	So‘rovnoma va kuzatuv
2. O‘rganish	Xavfni aniqlash, vositani tanlash, harakatlar ketma-ketligi	Pre-test/post-test va simulyator jurnali
3. Xulq-atvor	Real jihoz bilan xavfsiz va to‘g‘ri harakat qilish	Nazoratli amaliy topshiriq va chek-list
4. Natija	Xatolar kamayishi, tayyorgarlik qamrovi, vaqt va resurslar tejalishi	Davriy monitoring va tashkilot hisobotlari

Bundan tashqari, raqamli simulyatorning texnik imkoniyatlaridan kelib chiqib, qaror qabul qilish vaqti, xavfli zonaga kirish holatlari, noto‘g‘ri vosita tanlash, evakuatsiya yo‘lini e’tibordan chetda qoldirish, topshiriqni bajarish vaqti va urinishlar soni kabi obyektiv ko‘rsatkichlarni qayd etish maqsadga muvofiq.

Simulyatorni rivojlantirishning ustuvor yo‘nalishlari:

Birinchi yo‘nalish — adaptiv ssenariylar. Tizim foydalanuvchining oldingi mashqlardagi natijalari va xatolariga qarab navbatdagi ssenariyning murakkabligini avtomatik o‘zgartirishi mumkin. Masalan, dastlab oddiy yong‘in ssenariysi berilib, keyingi bosqichlarda tutun tarqalishi, chiqish yo‘lining yopilishi, elektr qurilmasi, yonuvchan suyuqlik yoki jabrlanuvchining mavjudligi kabi qo‘shimcha omillar kiritiladi.

Ikkinchi yo‘nalish — AR texnologiyasidan foydalanish. Smartfon, planshet yoki AR qurilmasi orqali real yong‘in o‘chirgich ustiga undan foydalanish tartibi, xavfsiz masofa, yong‘in sinfi va bajarilishi zarur harakatlar to‘g‘risidagi raqamli ko‘rsatmalar chiqarilishi mumkin.

Uchinchi yo‘nalish — raqamli analitika. Har bir mashqdan keyin tizim foydalanuvchining individual natija kartasini shakllantirishi, kuchli va zaif tomonlarini ko‘rsatishi va aniqlangan xatolarga mos takroriy topshiriqni tavsiya qilishi lozim.

To‘rtinchi yo‘nalish — raqamli egizak va obyektga xos ssenariylar. Maktab, oliy ta’lim muassasasi, mahalla, yotoqxona, ishlab chiqarish sexi, ma’muriy bino yoki transport vositasining soddalashtirilgan uch o‘lchamli modeli asosida aynan shu obyektga xos yong‘in vaziyatlarini yaratish mumkin.

Beshinchi yo‘nalish — mobil va avtonom trening tizimlari. Ko‘chma VR to‘plamlari va mobil AR ilovalari orqali immersiv mashg‘ulotlarni hududiy hayot faoliyati xavfsizligi o‘quv markazlari, mahallalar, korxonalar hamda ta’lim muassasalariga yetkazish imkoniyati yaratiladi.

Shu bilan birga, raqamli texnologiyalar real yong‘in o‘chirgichning og‘irligi, plombani ochish, chekadan foydalanish, shlangni yo‘naltirish, yuqori harorat va tutun sharoitidagi jismoniy ta’sirlarni to‘liq modellashtira olmaydi. Shu sababli VR/AR texnologiyalari real jihozlar bilan xavfsiz amaliy mashqlarni almashtirishi emas, balki to‘ldirishi lozim.

Amaliy takliflar:

1. Fuqaro muhofazasi institutidagi interaktiv simulyatorni modulli raqamli platformaga aylantirish va unda turar joy, ta’lim muassasasi, ishlab chiqarish obyekti, ma’muriy bino hamda transport uchun alohida ssenariylar kutubxonasini shakllantirish.
2. Mashg‘ulot algoritmini “xavfni aniqlash – xabar berish – odamlarni ogohlantirish – vaziyatni baholash – vositani tanlash – yong‘inni o‘chirish yoki evakuatsiya” tamoyili asosida tashkil etish.
3. Har bir tinglovchi uchun individual raqamli natija kartasini shakllantirish, aniqlangan xatolar asosida avtomatik qayta aloqa va takroriy topshiriqlar mexanizmini joriy etish.
4. Simulyator samaradorligini an’anaviy o‘qitish usuli bilan qiyosiy eksperimental tadqiqot asosida baholash hamda mashg‘ulotdan 30–90 kun o‘tgach kechiktirilgan nazorat o‘tkazish.
5. Virtual muhitda shakllangan ko‘nikmalarning real sharoitga transferini real yong‘in o‘chirgich bilan nazoratli amaliy topshiriqlar orqali baholash.
6. Ko‘chma avtonom VR to‘plamlari va mobil AR ilovasini hududiy o‘quv markazlari, mahallalar, korxonalar va ta’lim muassasalarida pilot sinovdan o‘tkazish.
7. Immersiv kontentni turli yoshdagi foydalanuvchilar, keksalar va nogironligi bo‘lgan shaxslarning ehtiyojlarini hisobga olgan holda inklyuziv dizayn tamoyillari asosida ishlab chiqish.

Xulosa. O‘tkazilgan tahlil aholini birlamchi yong‘in o‘chirish vositalaridan foydalanishga tayyorlashda immersiv va raqamli texnologiyalar an’anaviy o‘qitish usullarini sezilarli darajada boyitish imkoniyatiga ega ekanligini ko‘rsatadi. VR va AR texnologiyalarining asosiy afzalligi xavfli vaziyatlarni inson hayoti va sog‘lig‘iga tahdid tug‘dirmagan holda modellashtirish, ssenariyni ko‘p marta takrorlash, foydalanuvchini faol qaror qabul qilish jarayoniga jalb etish va uning harakatlarini raqamli qayd etish imkoniyati bilan belgilanadi.

Fuqaro muhofazasi institutida yaratilgan interaktiv yong‘in o‘chirish simulyatori O‘zbekistonda ushbu yo‘nalishni rivojlantirish uchun muhim texnik va o‘quv-metodik baza hisoblanadi. Uni zamonaviy talablar asosida takomillashtirish simulyatorni faqat yong‘in o‘chirgichdan foydalanishni o‘rgatuvchi qurilmadan xavfni aniqlashdan boshlab to xavfsiz evakuatsiyagacha bo‘lgan to‘liq qarorlar va harakatlar zanjirini shakllantiruvchi raqamli o‘quv platformasiga aylantirish imkonini beradi.

Buning uchun “ssenariy – qaror – harakat – raqamli qayd – baholash – qayta aloqa – takroriy mashq” yopiq o‘quv siklini joriy etish, adaptiv ssenariylar va raqamli analitikadan foydalanish, shuningdek, virtual muhitda egallangan ko‘nikmalarning real jihozlar bilan bajariladigan amaliy mashqlarga transferini baholash zarur.

Shunday qilib, immersiv texnologiyalarni pedagogik maqsad, standartlashtirilgan baholash, real jihozlar bilan amaliy mashqlar va mobil o‘qitish imkoniyatlari bilan integratsiyalash aholining yong‘in xavfsizligi bo‘yicha tayyorgarlik qamrovini kengaytirish, o‘quv jarayonining amaliy yo‘naltirilganligini oshirish hamda jamiyatda barqaror xavfsizlik madaniyatini shakllantirishga xizmat qiladi.

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YAKKABOG‘ TUMANINING TABIIY-GEOGRAFIK SHAROITI VA LANDSHAFT TUZILISHI

Annotatsiya. *Maqolada Qashqadaryo viloyati Yakkabog‘ tumanining relyefi, iqlimi, suv resurslari, tuproq va o‘simlik qoplami so‘nggi yillardagi ilmiy tadqiqotlar asosida tavsiflanadi. Balandlik mintaqalanishi asosida tumanda to‘rt landshaft guruhi ajratilib, ulardan xo‘jalikda foydalanish xususiyatlari va geoekologik muammolar ko‘rsatiladi.*

Kalit so‘zlar: *Yakkabog‘ tumani, Hisor tizmasi, Yakkabog‘daryo, adir, bo‘z tuproqlar, balandlik mintaqalanishi, landshaft.*

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NATURAL-GEOGRAPHICAL CONDITIONS AND LANDSCAPE STRUCTURE OF YAKKABOG DISTRICT

Abstract. *Based on recent scientific research, the article describes the relief, climate, water resources, and soil and vegetation cover of Yakkabog district, Kashkadarya region. Four landscape groups are identified in the district according to altitudinal zonation. The features of their economic use and the related geoecological problems are also described.*

Keywords: *Yakkabog district, Gissar Range, Yakkabogdarya River, adyrs (piedmont hills), sierozems, altitudinal zonation, landscape.*

Kirish. Har bir hududning tabiiy sharoiti va landshaft tuzilishini bilish yer va suvdan to‘g‘ri foydalanish, tuproq eroziyasining oldini olish hamda tabiatni muhofaza qilish uchun zarur [1; 12]. Tog‘, tog‘oldi va tekislikni birga qamrab olgan tumanlarda bu masala ayniqsa muhim, chunki kichik maydonda bir-biridan keskin farq qiladigan tabiiy komplekslar joylashadi.

Yakkabog‘ tumani Qashqadaryo viloyatining sharqida, Hisor tizmasi tarmoqlari bilan Qashqadaryo tekisligi tutashgan joyda joylashgan. So‘nggi yillarda bu hudud tabiati landshaftshunoslik [1; 2], tuproqshunoslik [4], botanika [5; 6] va ekoturizm [3] yo‘nalishlarida o‘rganilgan. Biroq bu tadqiqotlar asosan butun Janubi-g‘arbiy Hisor yoki Qashqadaryo havzasi miqyosida bajarilgan. Mazkur ishning maqsadi ushbu ma’lumotlarni umumlashtirib, Yakkabog‘ tumani misolida landshaft tuzilishini yoritishdan iborat.

Tadqiqotda adabiyot va xaritalarni tahlil qilish, qiyosiy-geografik va landshaft-tipologik usullardan foydalanildi.

Geografik o‘rni va relyefi. Tuman shimolda Chiroqchi va Shahrisabz, qolgan tomonlarda Qamashi tumanlari bilan chegaradosh [9]. Maydoni 1,1 ming km², aholisi 266 ming kishidan ortiq [10]. Aholi asosan tumanning g‘arbiy, sug‘oriladigan qismida zich joylashgan.

Tuman relyefining asosiy xususiyati uning sharqdan g‘arbga qarab pog‘onasimon pasayib borishidir. Sharqiy qismida Hisor tizmasining janubi-g‘arbiy tarmoqlari joylashgan. Ular g‘arbga tomon pasayib adirlarga, adirlar esa Qashqadaryo tekisligiga o‘tadi [1; 9]. Tog‘lar asosan qadimgi (paleozoy) jinslardan, adir va tekisliklar esa yumshoq lyoss va daryo yotqiziqlaridan tuzilgan [4; 14]. Tog‘larda eroziya, sel va surilma kabi jarayonlar faol kechadi [7].

Iqlimi. Tuman iqlimi keskin kontinental: yozi uzoq va issiq, qishi qisqa va nisbatan yumshoq. Tekislik va adirlarda yillik o‘rtacha harorat 15°C atrofida bo‘lib, balandlik ortgan sari pasayib boradi [2; 9]. Yog‘in esa, aksincha, tog‘larga tomon ko‘payadi. Relyefning g‘arbga qarab pasayishi nam havo massalarining tog‘ yonbag‘irlarida to‘xtab qolishiga sabab bo‘ladi. Shu tufayli adirlarda lalmikor (sug‘orilmaydigan) dehqonchilik qilish uchun yetarli yog‘in tushadi [9].

Iqlimning balandlik bo‘yicha o‘zgarishi xo‘jalikka ham ta’sir qiladi: tog‘oldida pillachilik va pistachilik, o‘rta tog‘larda bog‘dorchilik va asalarichilik uchun sharoit qulay, eng baland qismlar esa faqat yozgi yaylov sifatida foydalaniladi [2].

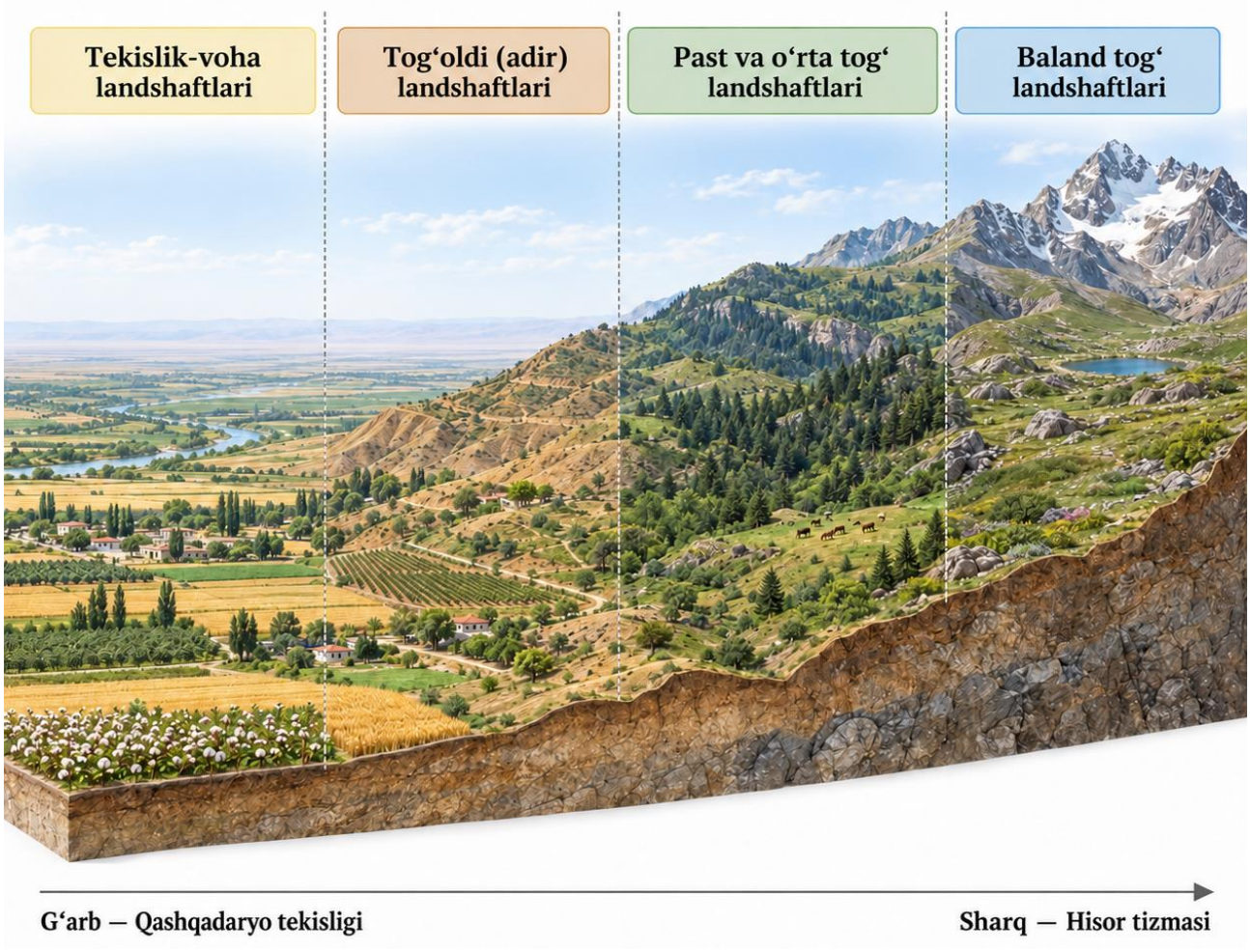
Suv resurslari. Tumanning asosiy suv manbai – Yakkabog‘daryo (Qizildaryo). Uning uzunligi 99 km bo‘lib, asosan qor va muzlik suvlaridan to‘yinadi [11; 16]. Shu sababli daryo bahor va yoz boshida sersuv bo‘ladi. Yakkabog‘daryo sersuvligi bo‘yicha Qashqadaryo havzasida ikkinchi o‘rinda turadi, ammo Qashqadaryoga to‘g‘ridan-to‘g‘ri quyilmaydi: tog‘dan chiqqach Qorabog‘ va Qizilsuv tarmoqlariga bo‘linadi, Qizilsuv esa Tanxozdaryo orqali Qashqadaryoga qo‘shiladi [2].

Daryo suvini sug‘orish mavsumida teng taqsimlash uchun Qorabog‘, No‘g‘ayli, Yangiqo‘rg‘on suv omborlari qurilgan. Darxon, Beshariq, Xo‘jailg‘or va Qurjab ariqlari asosiy sug‘orish tarmoqlari hisoblanadi [9].

Tuproq va o‘simlik qoplami. Tuproqlar ham balandlikka qarab almashinadi. Tekislik va past adirlarda och tusli va oddiy bo‘z tuproqlar, baland adirlarda to‘q tusli bo‘z tuproqlar, tog‘larda esa tog‘ jigarrang va tog‘-o‘tloq tuproqlari tarqalgan [4; 12]. Yakkabog‘ tumanida lalmi yerlarning ulushi katta, ammo qiya yonbag‘irlar va eroziya ulardan foydalanishni cheklaydi [2; 8].

O‘simlik qoplami K.Z. Zokirov ajratgan balandlik mintaqalariga mos keladi [13]. Past qismlarda tabiiy o‘simliklar deyarli saqlanmagan, ularning o‘rnini ekinzor va bog‘lar egallagan. Adirlarda efemer o‘tlar, tog‘larda archazor, butazor va yong‘oq-mevali o‘rmon qoldiqlari, eng baland qismlarda esa subalp va alp o‘tloqlari uchraydi. Tuman sharqidagi tog‘larda Hisor davlat qo‘riqxonasining Qizilsuv bo‘limi joylashgan. Bu bo‘lim hududdagi eng yaxshi archa o‘rmonlaridan birini muhofaza qiladi [15]. Qo‘riqxona hududida qor qoploni, qo‘ng‘ir ayiq, Turkiston silovsini kabi noyob hayvonlar yashaydi [14]. Tuman hududidagi Xontaxta tog‘ massivining daraxt-buta florasi alohida o‘rganilgan [6].

Landshaft tuzilishi. Tabiiy komponentlarning balandlik bo‘yicha qonuniy almashinuvi natijasida tumanda g‘arbdan sharqqa qarab to‘rt landshaft guruhi ajratiladi (1-rasm). R.X. Allayorov ko‘rsatganidek, landshaftlardan xo‘jalikda foydalanish darajasi tog‘lardan tekislikka qarab ortib boradi [1; 2].



1-rasm. Yakkabog‘ tumani landshaft guruhlarining g‘arbdan sharqqa sxematik profili (rasm mualliflar tomonidan [1; 2; 9] ma’lumotlari asosida tuzilgan)

Har bir landshaft guruhining asosiy belgilari 1-jadvalda qiyoslab berilgan.

1-jadval.

Yakkabog‘ tumani landshaft guruhlarining qiyosiy tavsifi

Landshaft guruhi	Joylashuvi	Tuproqlari	O‘simlik qoplami	Xo‘jalikda foydalanish
I. Tekislik-voha agrolandshaftlari	Tumanning g‘arbiy qismi, daryo yotqiziqlaridan tuzilgan tekislik	Sug‘oriladigan och tusli va oddiy bo‘z tuproqlar	Tabiiy o‘simlik deyarli yo‘q; ekinzor, bog‘, tutzor	Sug‘orma dehqonchilik, aholi punktlari
II. Tog‘oldi (adir) landshaftlari	Tog‘ etaklaridagi lyossli to‘lqinsimon qirlar	Oddiy va to‘q tusli bo‘z tuproqlar	Efemer va efemeroid o‘tlar	Lalmikor dehqonchilik, bahorgi yaylov
III. Past va o‘rta tog‘ landshaftlari	Hisor tarmoqlarining yonbag‘irlari va daryo vodiylari	Tog‘ jigarrang tuproqlar	Archazor, butazor, yong‘oq-mevali o‘rmon qoldiqlari	Yaylov chorvachiligi, o‘rmonchilik, rekreatsiya
IV. Baland tog‘ landshaftlari	Yakkabog‘daryo havzasining eng yuqori qismi	Tog‘-o‘tloq tuproqlari	Subalp va alp o‘tloqlari	Tabiatni muhofaza qilish (qo‘riqxona), yozgi yaylov, ekoturizm

Manba: muallif tomonidan [1; 2; 4; 9; 13] ma’lumotlari asosida tuzilgan.

1-jadvaldan ko‘rinadiki, tekislik va adir landshaftlari inson faoliyati ta’sirida kuchli o‘zgargan, tog‘ landshaftlari esa tabiiy holatini nisbatan saqlab qolgan. Yakkabog‘ adirlari Janubi-g‘arbiy Hisordagi eng ko‘p o‘zgartirilgan landshaftlar qatoriga kiradi [1].

Geoekologik muammolar. Tuman landshaftlaridagi asosiy muammolar quyidagilar: adirlarda qiya yerlarni haydash va ortiqcha mol boqish natijasida tuproq eroziyasi va jarlanishning kuchayishi [2; 8]; tog‘oldi yaylovlarida o‘simlik qoplamining siyraklashuvi; daryo oqimi sug‘orish mavsumiga to‘liq mos kelmagani sababli suv taqchilligi; qo‘riqxona atrofida o‘tin tayyorlash va dorivor o‘simliklarni nazoratsiz terish.

Xulosa. Yakkabog‘ tumanining tabiiy sharoiti Hisor tizmasi tarmoqlaridan g‘arbga qarab pasayuvchi relyef bilan belgilanadi. Relyefga bog‘liq holda iqlim, tuproq va o‘simlik qoplami almashinib, tumanda to‘rt landshaft guruhi shakllangan: tekislik-voha, adir, past va o‘rta tog‘ hamda baland tog‘ landshaftlari. Tumanning suv ta’minoti tog‘ landshaftlariga bog‘liq, shu sababli ularni muhofaza qilish butun tuman uchun muhim. Adirlarda eroziyaga qarshi tadbirlar (yonbag‘ir bo‘ylab haydash, ixotazorlar, pista kabi qurg‘oqchilikka chidamli ekinlar), sug‘oriladigan yerlarda suv tejovchi texnologiyalar, tog‘larda esa qo‘riqxona rejimiga mos ekoturizmni rivojlantirish tavsiya etiladi.

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CURRENT CONCEPTS OF SALMONELLOSIS PATHOGENESIS: THE ROLE OF VIRULENCE FACTORS AND IMMUNE RESPONSE

Abstract. *Salmonellosis is one of the most important foodborne bacterial infections and is characterized by a broad clinical spectrum ranging from self-limited acute gastroenteritis to severe invasive and systemic disease. Current concepts of salmonellosis pathogenesis emphasize the complex interaction between the virulence determinants of* Salmonella enterica*, the intestinal epithelial barrier, the gut microbiota, and the host immune system. A central role is played by Salmonella pathogenicity islands SPI-1 and SPI-2, which encode type III secretion systems responsible for delivering bacterial effector proteins directly into host cells. SPI-1 primarily promotes intestinal epithelial invasion and inflammatory responses, whereas SPI-2 facilitates intracellular bacterial survival and replication, particularly within macrophages.*

Keywords: *salmonellosis,* Salmonella enterica*, pathogenesis, virulence factors, pathogenicity islands, SPI-1, SPI-2, type III secretion system, immune response, inflammasome, macrophages, gut microbiota.*

Introduction. Salmonellosis remains a major bacterial infection of global public health importance. Human disease is predominantly caused by *Salmonella enterica*, a species that includes numerous serovars with different host ranges, virulence characteristics, and clinical manifestations. Non-typhoidal *Salmonella* most commonly causes acute gastroenteritis, whereas typhoidal serovars, particularly *S. Typhi* and *S. Paratyphi*, are associated with systemic enteric fever [1,2].

The pathogenesis of salmonellosis is considerably more complex than simple penetration of the intestinal mucosa by a pathogenic microorganism. Successful infection requires coordinated bacterial adaptation to the gastrointestinal environment, adhesion to host cells, epithelial invasion, intracellular survival, manipulation of host signaling pathways, and evasion or modification of immune responses. A particularly important feature of *Salmonella* is its ability to regulate virulence according to the anatomical location and stage of infection. Two major pathogenicity islands, SPI-1 and SPI-2, encode type III secretion systems (T3SS) that deliver bacterial effector proteins into host cells. These systems have complementary functions: SPI-1 is primarily associated with epithelial invasion, whereas SPI-2 supports intracellular survival and systemic dissemination [2,3].

The normal microbiota provides colonization resistance, while Salmonella-induced inflammation can alter the intestinal ecological environment and create conditions favorable for pathogen expansion [4].

Virulence factors of Salmonella. The first challenge encountered by *Salmonella* after ingestion is survival in the gastrointestinal tract. Gastric acidity, bile, antimicrobial peptides, oxidative stress and competition with commensal microorganisms constitute major barriers to infection. Salmonella possesses adaptive regulatory mechanisms that allow it to respond rapidly to these environmental stresses. Adhesion to intestinal epithelial cells is an essential stage preceding invasion. Fimbriae and other adhesins facilitate attachment to the epithelial surface, while flagella provide motility and contribute to interactions with host cells. One of the most important determinants of Salmonella virulence is SPI-1. The SPI-1-encoded T3SS functions as a molecular apparatus that injects bacterial effector proteins directly into epithelial cells. These proteins alter the actin cytoskeleton and induce membrane ruffling, facilitating bacterial internalization [3,5]. After internalization, Salmonella is enclosed within a specialized compartment known as the Salmonella-containing vacuole (SCV). At this stage, the SPI-2 system becomes particularly important. SPI-2-encoded T3SS effectors modify intracellular trafficking, vesicular transport and host-cell organelles, creating an intracellular environment that supports bacterial survival and replication [2,5].

Role of Salmonella effector proteins. The effector proteins delivered by Salmonella T3SS represent major molecular determinants of host-pathogen interaction. They interfere with cytoskeletal organization, intracellular trafficking, inflammatory signaling, apoptosis, autophagy and cellular metabolism. SPI-1 effectors facilitate epithelial invasion and stimulate signaling pathways involved in the recruitment of inflammatory cells. This contributes to the development of intestinal inflammation and the clinical manifestations of gastroenteritis [3,5].

In contrast, SPI-2 effectors are particularly important for intracellular persistence. They modify the SCV and interfere with normal antimicrobial mechanisms of epithelial cells and macrophages. As a result, bacteria can survive in cells that would normally participate in their elimination [5].

Interaction with the intestinal epithelium and microbiota. The intestinal epithelium is an essential component of host defense. Tight junctions, mucus, antimicrobial peptides, secretory IgA and the resident microbiota collectively limit the ability of invasive bacteria to colonize the intestinal tract.Salmonella infection disrupts this equilibrium and stimulates a pronounced inflammatory response. Epithelial cells and immune cells produce chemokines and cytokines that recruit neutrophils and other leukocytes to the site of infection. The interaction between inflammation and the microbiota is particularly important. Inflammation changes the chemical and metabolic environment of the intestine and can reduce the competitive advantage normally provided by commensal bacteria. Salmonella can exploit of these changes to expand within the intestinal lumen [4].

Innate immune response. The innate immune system represents the first major immunological barrier against Salmonella. Host cells recognize pathogen-associated molecular patterns through pattern-recognition receptors (PRRs), including Toll-like receptors, NOD-like receptors and other cytosolic sensors. Tumor necrosis factor-α, IL-1β, IL-6 and chemokines contribute to recruitment and activation of neutrophils, macrophages and other immune cells. Neutrophils eliminate bacteria through phagocytosis, reactive oxygen species, antimicrobial proteins and other mechanisms.

Macrophages play a particularly complex role. They engulf bacteria and produce antimicrobial mediators but may also become a cellular niche for Salmonella persistence. The ability of Salmonella to modify the SCV through SPI-2 effectors allows intracellular bacteria to resist several antimicrobial mechanisms [5].

Inflammasomes and pyroptosis The NAIP/NLRC4 inflammasome can recognize bacterial flagellin and components of the T3SS. Its activation results in caspase-1 activation, maturation of IL-1β and IL-18, and pyroptosis of infected cells [6]. The NLRP3 inflammasome can also participate in Salmonella recognition. Its activation is associated with cellular stress signals such as potassium efflux, mitochondrial reactive oxygen species and lysosomal damage. Recent research emphasizes that NLRC4 and NLRP3 may operate at different stages and in different cellular compartments during infection. Pyroptosis contributes to host defense by eliminating infected cells and releasing inflammatory mediators. Nevertheless, excessive inflammasome activation can contribute to tissue damage.

Conclusion. Current knowledge indicates that salmonellosis is a complex infectious process resulting from continuous interaction between *Salmonella enterica*, the intestinal epithelium, the microbiota and the host immune system.The pathogenicity of Salmonella is determined by a coordinated set of virulence factors. SPI-1 and SPI-2 are central to this process: SPI-1 promotes epithelial invasion and inflammatory signaling, while SPI-2 supports intracellular survival and replication. Effector proteins delivered through these secretion systems modify host-cell signaling, cytoskeletal organization, intracellular trafficking and immune responses.

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USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN MATHEMATICS LESSONS AS A MEANS OF STUDENTS' CREATIVE THINKING DEVELOPMENT

Abstract. *This article explores the role of information and communication technologies (ICT) in mathematics education to develop students' creative thinking. It highlights digital tools like interactive whiteboards, presentations, and simulators, demonstrating how they enhance visualization, individualize learning, and improve overall lesson efficiency through practical classroom examples.*

Key words: *mathematics, information and communication technologies, computer, mathematics lesson, interactive whiteboard, presentations, lesson plan, function, interest, creative thinking.*

Mathematics, like no other science, can make a significant contribution to the implementation of the tasks set for the school, since the activity of a mathematics teacher is aimed at developing the skills of spatial imagination, logical thinking - in a word, the development of intelligence. In mathematics lessons, various pedagogical technologies can be used: modular training, project activities, information and communication technologies. In this case, learning becomes active, the emphasis is on learning through practice, the productive work of students in small groups, the use of inter-subject relationships, and the development of independence.

Statement of a question. The competency-based approach to teaching mathematics forces the teacher to constantly review the arsenal of teaching and upbringing tools, choosing the most effective forms and developing them together with students, based on the knowledge and experience of students gained in mathematics lessons. Using a computer allows you to create an information environment that stimulates the interest and inquisitiveness of students.

The form and place of using computers in the lesson, of course, depends on the content of this lesson, the goal set by the teacher. What are the functions and features of the application of educational programs? The following functions can be distinguished: instrumental (making visual aids); demonstrating (showing ready-made demonstration programs, slides, presentations, etc.); training (simulators); controlling.

Various types of lessons are possible with the use of information technologies: lessons-conversations using a computer as a visual aid; lessons in setting up and conducting research; practical work lessons; lessons-tests; integrated lessons, etc.

In recent years, along with computer technology, schools have received interactive whiteboards, which are a touch screen connected to a computer, the

image from which is transmitted to the board by a projector. Special software for interactive whiteboards allows you to work with texts and objects, audio and video materials, Internet resources, make handwritten notes directly on top of open documents and save information.

A lesson in mathematics using ICT is visual, colorful, informative, interactive, saves the time of the teacher and the teacher, allows the teacher to work at his own pace, allows the teacher to work with students in a differentiated and individual way, and makes it possible to quickly monitor and evaluate learning outcomes.

The goals of ICT in the process of teaching mathematics are: the formation of skills to work with information, the development of communication skills; preparation of the personality of the "information society"; the opportunity to give the child as much educational material as he can learn; the formation of research skills, the ability to make optimal decisions.

The computer can be used at all stages of the learning process: when explaining new material, consolidating, repeating, controlling ZUN. At the same time, for the student, he performs various functions: a teacher, a working tool, an object of study, a collaborating team, a leisure (game) environment.

The main means of ICT in the study of mathematics are: a computer as a universal information processing device; A printer is a device that allows you to capture information on paper.

The use of ICT tools is a necessary condition for the modern educational process, when the main thing is not the transmission of fundamental knowledge, but the development of creative abilities, the creation of opportunities for realizing the potential of the individual. ICT is used not as a goal, but as another pedagogical tool that contributes to the achievement of the goal of the lesson.

Computer in the lessons in the following forms: the use of media resources as a source of information (disks); computer support for the teacher's activities at different stages of the lesson; using a computer to perform technological maps; portfolio creation.

Multimedia accompaniment of lessons increases the efficiency of obtaining knowledge by students. The term "multimedia" is a tracing paper from the English word multimedia, which can be translated as "many environments" (from multi - many and media - environment). Multimedia technology allows you to simultaneously use different ways of presenting information in the form of numbers, text, graphics, animation, video and sound.

Basically, when studying mathematics, various types of multimedia products are used: this is a computer presentation that is created using the Power Point program, it is a sequence of slides, with the help of this program a presentation is created to study new material.

The advantages of presenting information in the form of a presentation over information in the form of speech: a large amount of time is released, but the presentation must match the pace of assimilation, student recording; the computer allows you to show a complex experience safely, to explain its essence, but this

should complement, not replace. The presentation greatly facilitates the management of the lesson, the organization of the work of students, but requires the teacher to be confident in technology, knowledge of programs, and readiness to work as usual.

If necessary, in the learning process, the student can independently return to that part of the information that he did not learn without distracting the teacher, for example: the formula is erased from the board, and if the student did not have time to write it down, then the teacher will have to interrupt the story and return again to the formula. And vice versa, commenting on the material that is on the slides, the teacher can dwell on certain points in more detail. For example, when studying the topic “Prime and Composite Numbers”, you can introduce students to the construction of the sieve of Eratosthenes using a presentation. This will interest students, and they themselves will be able to try to build the sieve of Eratosthenes in their notebooks.

Presentations-surveys: questions, tasks that activate students for further work in the lesson, create a favorable climate. So, when repeating the topic “Ordinary fraction” at the beginning of the lesson, you can repeat the theoretical material using the presentation and immediately check the correctness of the implementation.

Presentations for organizing both frontal and group work. With the help of presentations, it is also possible to create routes for students, i.e. see the end result of their work. For example, compiling a travel map, or playing by stations.

Presentations for self-testing of knowledge, skills and abilities of students. At any stage, using the presentation, you can carry out independent work, and then students can check it. After completing the work, students can exchange notebooks and mutually check the work.

Advantages of using e-learning tools: digital educational resources: screen and sound manuals; technical teaching aids are

- the ability to repeatedly repeat, stop, which allows the teacher to focus the attention of students;
- refer to theoretical material, make historical references, work with definitions and laws;
- clarity of processes, clear images of installations and models, uncluttered;
- modeling of processes and phenomena;
- Obtaining and analysis of graphic dependence.

ICT outside school hours can be used in the form of: virtual excursions, creative homework: make a crossword puzzle, anagrams, rebuses, a question; work with tests; student conferences.

The use of computer technology in teaching makes it possible to differentiate educational activities in the classroom, activates the cognitive interest of students, develops their creative abilities, and stimulates mental activity.

The use of ICT contributes to the growth of the teacher's professional skills, increasing the efficiency of mastering the skills of independent search, processing

and presentation of knowledge, developing the personality of students and preparing for a comfortable life in the information society.

Therefore, the main directions for improving the quality of mathematical education are: increasing the professional competence of the teacher; use in the educational process the integration of the content and cognitive activity of students, i.e. active approach: a) to form skills; b) use computer technologies, modern pedagogical technologies, problem-based teaching methods, research and design technologies; It is advisable to carry out control using ICT in a differentiated manner at the basic level (reproductive), advanced and high

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TUB SONLAR XOSSALARIN O‘RGANISH METODIKASI

Annotatsiya: *Ushbu maqolada matematika fanini o‘qitish jarayonini takomillashtirish, xususan, natural sonlar qatorida tub sonlarning o‘rni, ularning nazariy va amaliy xossalarini o‘rganish metodikasi yoritilgan.*

Kalit so‘zlar: *tub sonlar, tarkibiy sonlar, sinov bo‘lishlar usuli, Eratosfen g‘alviri, egzak tub sonlar, natural qator, Dirixli teoremasi, bo‘luvchi.*

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METHODOLOGY OF STUDYING THE PROPERTIES OF PRIME NUMBERS

Abstract: *This article highlights the improvement of the mathematics teaching process, specifically focusing on the methodology of studying the properties of prime numbers and their role within the sequence of natural numbers..*

Keywords: *prime numbers, composite numbers, trial division method, Sieve of Eratosthenes, twin primes, natural sequence, Dirichlet's theorem, divisor.*

Ta’limning fan va ishlab chiqarish bilan integrasiyasi mexanizmlarini rivojlantirish, uni amaliyotga joriy etish, o‘qishni, mustaqil bilim olishni individuallashtirish hamda masofaviy ta’lim tizimi texnologiyasini, uning vositalarini ishlab chiqish, o‘zlashtirish, yangi pedagogik va axborot texnologiyalari asosida o‘quvchi va talabalarni o‘qitishni jadallashtirish ana shunday dolzarb vazifalar sirasiga kiradi.

Har bir n natural son uchun hech bo’lmaganda ikkita bo’luvchilarga ega: 1 va n. Shunday n natural sonlar mavjudki, ular 1 va n dan boshqa bo’luvchilarga ega emas.

1-ta’rif . p natural son tub deyiladi , agar $p > 1$ va u 1 va o’zidan boshqa natural bo’luvchilarga ega bo’lmasa.

Odatda tub sonlar p va q lar bilan belgilanadi, tub sonlarning dastlabki 20 tasi quyidagilardan iborat :

2, 3,5,7,11,13,17,19,23,29,31,37,41,43,47,53,59, 61,67,71.

2-*ta’rif* . n >1 natural son tarkibli deyiladi agar u 1 va n dan farqli hech bo’lmaganda bitta natural bo’luvchiga ega bo’lsa.

Bu ta’rifga ko’ra 2 dan boshqa barcha n=2k (k>1) juft sonlar tarkiblidir, chunki ular 2 ga bo’linadi va 1<2<n, bu ta’riflardan ko’ramizki 1 son tub ham emas tarkibli ham emas.

1-teorema. Har bir n>1 natural natural sonning 1 dan farqli eng kichik bo’luvchisi p tub sondir.

Isbot. Haqiqatan, aks holda p biror q (1<q<p) bo’luvchiga ega bo’lib, q/p va p/n. Bundan q/n va q<p kelib chiqadi. Bu esa p ning eng kichik ekanligiga ziddir.

2-teorema. Har qanday n natural son berilgan p tub songa yoki bo’linadi yoki u bilan o’zaro tubdir.

Isbot. Agar p tub son bo’lib , n ixtiyoriy natural son bo’lsa , u holda n va p sonlarning eng katta umumiy bo’luvchisi yoki p ga yoki 1 ga teng, chunki p boshqa bo’luvchilarga ega emas.

3-teorema. Agar ab ko’paytma biror p tub songa bo’linsa, u holda ko’paytuvchilardan kamida bittasi p ga bo’linadi.

Isboti. Agar (a,p)=1 ya’ni o’zaro tub sonlar bo’lsa ifodani ikkala tomoniga b ni ko’paytirib quyidagiga ega bo’lamiz: (ab,bp)=b. Teorema shartiga ko’ra ab/p va bp ko’paytma p ga bo’linadi bunan kelib chiqadiki b ham p ga bo’linadi. Yoki quyidagicha olsak (b,p)=1 deb tenglikning ikkala tomoniga a ni ko’paytiramiz , (ab,ap)=a desak ab/p va ap/p bundan kelib chiqadiki a/p bo’ladi. Xulosa ab ko’paytma p tub songa bo’linsa albatta ularning biriga bo’linadi.

Matematik induksiya usulidan foydalanib, bu teoremani ko’paytuvchilarning soni ikkitadan ortiq bo’lganda ham qo’llash mumkin.

Tub sonlar guruhlarga to’planishi mumkin, masalan,

$17\ va\ 19,\ 41\ va\ 43,\ 9\cdot 2^{211}\pm 1,\ 156\cdot 5^{202}\pm 1,\ 291\cdot 2^{1553}\pm 1.$

Bunday qo’shni tub sonlar juftlari egzaklar deb ataladi. ular cheksiz ko’p deb faraz qilinadi. 150000 ta ketma- ket sonlar orasida, birinchisi 10^8 bo’lganda 601 ta egzak bor. 3 tadan ketma-ket tub son bo’lgan guruhlar ham mavjud, masalan 3163, 3167, 3169, yoki 32713, 32717, 32719.

L.Eyler x^2-x+41 ko’phad x=0,1,2, … , 40 faqat tub qiymatlar ni qilinishini topgan. Lekin hozirda ham tub sonlarni hisoblashga imkon beruvchi formula topilmagan.

Berilgan n soni bo’yicha uni kichik ko’paytuvchilarga yoyish yoki tub son ekanligini qanday aniqlash mumkin? Bizga ma‘lumki, kvadrati N dan oshmaydigan barcha sonlarni sanab ko’rish lozim. Agar N ulardan hech biriga bo’linmasa N- tub son, aks holda N murakkab son. Bu usulni birinchi bo’lib 1202 yilda Lionard Pizanskiy takidlab o’tgan.

Sinab ko’rishdagi bo’luvchilar sonini ancha qisqartirish mumkin. Masalan, agar N 2 ga bo’linmasa, N ning bo’luvchilari sifatida juft sonlarni sinab ko’rish ma‘nosiz, agar N 3 ga bo’linmasa, 3 ga bo’linuvchi sonlarni ham sinash kerak emas. Natijada sinab ko’rinadigan bo’luvchilardan 6 ga bo’lganda 0,2,3,4, qoldiqlar beruvchi sonlarni chiqarib tashlaymiz, ya’ni faqat 6k+1 va 6k+5 ko’rinishdagi sonlar qoladi. Quyidagi sinov bo’linishlar usulini hosil qiladi.

1. N soni 2 ga yoki 3 ga bo’linishi tekshiriladi. Agar bo’linsa u holda N murakkab son.

2. Sinov bo’luvchilar jadvalini tuziladi. Unda birinchi satr 1, 5 ko’rinishga ega har bir keyingi satr oldingisiga 6 ni qo’shish bilan hosil qilinadi. Har bir yangi satr paydo bo’lganda unga kirgan sonlar N ni bo’lish yoki bo’lmasligini tekshiramiz. Natijada biz N ning bo’luvchisini topamiz, va bu holda N murakkab son yoki jadvalning shunday elementiga aytiladiki, uning kvadrati N dan oshib ketadi. Oxirgi holda ishni to’xtatish lozim va N son tub son deb tasdiqlash mumkin.

Sinov bo’lishlar usuli ya’ni katta murakkab sonlarning katta bo’lmagan bo’luvchilarini topishga imkon beradi.

Bu usul bilan N=1009 bo’lganda faqat jadvalning 5 dan 31 gacha sonlariga 10 ta sinov bo’lishni bajarish yetarli bo’ladi va dastlab 1009 ning 2 va 3 ga bo’linishini bo’linish alomatlari yordamida tekshirish lozim.

Dastlabki, bo’luvchilar 2 va 3 qatoriga 5 ni ham kiritish mumkin. U holda sinov bo’luvchilari jadvali 8 ta ustunga ega bo’ladi.

1	5
7	11
13	17
19	23
25	29
31	35

1	7	11	13	17	19	23	29
31	37	41	43	47	49	53	59

Uning birinchi satrida 30 bilan o’zaro tub 1 dan 30 gacha $30=2\cdot3\cdot5$ barcha sonlar turadi, keying satr oldingisidan uning elementlariga 30 ni qo’shish bilan hosil qilinadi. Bu jadval yana kamroq sinov bo’luvchilarini o’z ichiga oladi.

Bu usul zamonaviy kompyuterlarda ham qo’llaniladi. Dastlab bo’luvchilar sifatida 2,3,5,7,11,13 sonlari olinadi. Bunda jadval 5760 ta ustunga ega bo’ladi. uning har bir yangi satri oldingisidan

$$30030=2\cdot3\cdot5\cdot7\cdot11\cdot13$$

Sonni qo’shish bilan hosil qilinadi. 14 ta o’nli raqam bilan yozilgan sonlar tub tekshirib sanoqli sonlarda bajariladi.

Masalani biroz o’zgartiramiz. Faraz qilaylik 1 dan biror N natural songacha bo’lgan natural qator oralig’ida joylashgan barcha tub sonlarni topish talab qilinadi. Bu oraliqdan barcha murakkab sonlarni chiqarib tashlash usuli qadimgi grek matematigi Eratosfen (eramizgacha 276-194 yil) ga ma’lum bo’lgan va Eratosfen deb ataladi. Biz uni biroz takomillashgan ko’rinishda keltiramiz :

1. 3 dan N gacha bo’lgan toq sonlarni yozing.

2. 3^2 ni va keyin har bir uchinchi sonni o’chiring sonni o’chiring. Keyin 5^2 va har bir beshinchi sonni o’chiring .

3. Bu jarayonni birinchi o’chirilmagan sonni har bir marta tanlaganda, undan keyin keluvchi karralilar o’chirish mumkin bo’lguncha davom ettiriladi.

4. O’chirilmay qolgan sonlar 1 dan N gacha kesmadagi barcha tub sonlar to’plamini tashkel etadi.

1N=100 uchun quyidagi jadvalga ega bo’lamiz.

3	5	7	9	11	13	15	17	19	21
23	25	27	29	31	33	35	37	39	41
43	45	47	49	51	53	55	57	59	61
63	65	67	69	71	73	75	77	79	81
83	85	87	89	91	93	95	97	99	

Belgilanmay qolgan sonlar tub sonlar, unga 2 ni qo’shamiz.

2	3	5	7	11
13	17	19	23	29
31	37	41	43	47
53	59	61	67	71
73	79	83	89	97

1 dan 100 gacha natural sonlar qatori kesmasida jami 25 ta tub son bor. Natural qator bo’yicha yurib biz faqat murakkab sonlarni o’chiramiz. Birinchi marta 3 ga bo’linadiganlari, ikkinchi marta qolganlaridan 5 ga bo’linadiganlarini , keyin 7 ga bo’linadiganlarini va h.k. o’chiramiz. Faraz qilaylik, o’chirilmagan sonlar orasida a murakkab son qolgan bo’lsin. 1 dan farqli eng kiochik bo’luvchisini p deb belgilaymiz. p tub son bo’lsa, u holda u o’chirilmagan; bundan tashqari

$$p^2 \le pb = a \le N$$

Bu natural qator bo’yicha qandaydir o’tishda p^2 dan boshlab p ga bo’linuvchi, shu jumladan a soni ham o’chirilganini ham bildiradi. Lekin biz a o’chirilmagan deb faraz qilgan edik. Bu qarama-qarshilik a sonining tub son ekanligini bildiradi. Demak, o’chirilmay qolgan barcha sonlar tub sonlar.

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PEDAGOGICAL FACTORS FOR SHAPING AND DEVELOPING DIGITAL-STATISTICAL COMPETENCE IN GEOGRAPHY MASTER'S STUDENTS

Abstract. *The article provides a scientific and theoretical analysis of the pedagogical factors that ensure the formation and development of digital-statistical competence in geography master's students at higher education institutions. The concept of "pedagogical condition" is defined on the basis of philological, philosophical, psychological and pedagogical approaches. Using the discipline "Medical Geography" as an example, three main pedagogical conditions are substantiated: ensuring the binary and continuous nature of digital-statistical training, consistently integrating digital-statistical content into professional subjects, and ensuring variability in the methods of mastering digital-statistical activity.*

Key words: *digital-statistical competence, pedagogical condition, geography education, medical geography, interdisciplinary integration.*

Introduction. Under conditions of digitalisation, the ability of geography master's students to collect, process and statistically analyse large volumes of geographical, demographic and environmental data is becoming an integral part of their professional training. This need is especially evident in mastering the discipline "Medical Geography", since the analysis of public health and environmental factors relies directly on digital-statistical methods.

Identifying the pedagogical conditions that contribute to the effective implementation of a pedagogical model for developing students' digital-statistical competence is therefore an important scientific and pedagogical task. In particular, the effectiveness of the pedagogical model applied in teaching "Medical Geography" largely depends on how well it is supported by the pedagogical conditions required for its implementation. This approach to the content and significance of pedagogical conditions is reflected in the research of M.V.Alieva [1], V.I.Desyatov [6] and other scholars [1].

Modern scientific studies [1, 6] propose various systems of pedagogical conditions aimed at ensuring the effectiveness of the pedagogical process. However, the specific character of a pedagogical model aimed at developing digital-statistical competence in geography master's students, as well as the professionally oriented content of "Medical Geography", indicates the need to identify a distinct set of pedagogical conditions suited to this process [1]. Accordingly, factors were divided into two main groups: those ensuring the effectiveness of each component of the pedagogical model, and those enhancing students' readiness for professional activity. The purpose of the article is to scientifically substantiate the main pedagogical conditions that serve this process and to describe the mechanisms of their implementation.

Theoretical Analysis of the Concept of "Pedagogical Condition". In pedagogy, the term "condition" is interpreted as the main factor or requirement that ensures the correct, effective and purposeful organization of the educational process. Pedagogical conditions are usually divided into didactic, educational and psychological-pedagogical types. The term "environment" denotes the complex of surroundings, material-technical base, social environment, psychological climate and organizational factors necessary for the effective organization and development of the educational process [3]. In the educational process, the concept of "pedagogical condition" expresses an interconnected system of internal and external factors that serves the formation of students' professional competencies.

In the scientific literature, the concept of "pedagogical condition" has been defined in various ways by scholars such as A.P.Belyaeva [4], A.Y.Nain [7] and E.V.Yakovlev [12], who have substantiated different methodological approaches to identifying the pedagogical conditions that ensure the effectiveness of a particular activity.

Higher education institutions' complex of pedagogical conditions aimed at developing the digital-statistical competence of geography master's students serves to increase the effectiveness of the pedagogical model that has been developed. In particular, in teaching "Medical Geography", the unity of content-coordinating and subjective-content pedagogical conditions plays an important role in developing students' professional knowledge, practical skills and ability to analyse problematic situations [13].

Pedagogical conditions are usually considered as internal and external factors. External factors include geographical, natural, climatic, political and economic factors, which are usually related to an environment that cannot be changed. Internal factors, on the other hand, are directly related to the organisation of the educational process and include organisational-pedagogical, methodological and ergonomic factors. By improving these internal factors, higher education institutions can organise the process of developing students' digital-statistical competence more effectively (Figure 1).

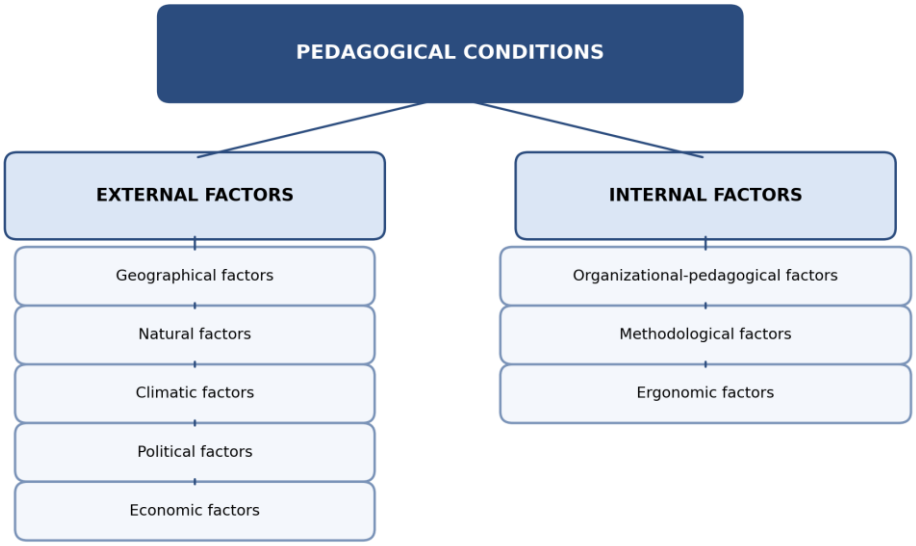


Figure 1. Types of pedagogical conditions

The concept of "condition" is a general scientific category applied across various fields of science, expressing the system of factors that determine the emergence, development and effectiveness of a given process. In the pedagogical interpretation, this concept is characterised by causes, situations, organisational factors, environmental characteristics and other influencing components that directly or indirectly affect a person's development, upbringing and education. The content interpretations of this category found in various scientific approaches are summarised in Table 1.

Table 1. Content characteristics of the concept of "condition"

Approach	**Scientific interpretation of the concept**
Philological	A set of circumstances that determine the emergence, realisation, and continuation of a particular phenomenon, process or activity [8].
Philosophical	A holistic complex of objects, processes, states and their interactions that ensure the existence, formation and development of an object or phenomenon [11].
Psychological	A system of internal and external factors that directly or indirectly influence a person's psychological development and the dynamics of activity [10].
Pedagogical	An interrelated complex of natural, social, organizational, external and internal factors that purposefully or indirectly influence the development and formation of the learner as a person [9].

A review of the scientific literature shows that there is no single, universally accepted conceptual approach to the concept of "pedagogical conditions" among researchers. This divergence is explained by the complex, multi-component nature of pedagogical conditions, which varies depending on the purpose and content of a particular pedagogical system. Nevertheless, a synthesis of the scientific views presented shows that although the content of pedagogical conditions is interpreted differently from various methodological positions, there is commonality in their conceptual essence: they appear as a system of interrelated organisational, content-related, methodological and technological factors that serve to improve the effectiveness of the educational process, achieve the set pedagogical goal and form the necessary competencies.

A synthesis of numerous scientific-pedagogical studies shows that several main types of conditions have been identified in pedagogical theory and practice. Organisational-pedagogical conditions have been covered in the works of V.A.Belikov, E.I.Kozireva, S.N.Pavlov and other researchers in connection with the purposeful organization and management of the pedagogical process; for geography master's students, this type of condition is important in determining the content sequence of the educational process, interdisciplinary integration and cooperation mechanisms among educational subjects. Psychological-pedagogical conditions have been studied by N.V.Zhuravskaya, A.V.Krugliy and other scholars in connection with a person's motivation, cognitive activity and reflection; in the context of digital-statistical competence, these conditions serve to foster students' stable interest in statistical and digital activity and to develop their intrinsic motivation. Didactic conditions have been explained by M.V.Rutkovskaya and other researchers in connection with selecting educational content, systematising learning material, and applying methods and tools appropriately; this group is of particular importance for determining the didactic mechanisms that ensure geography master's students master statistical methods and geographical data in an interconnected manner. Based on this theoretical position, the following three pedagogical conditions were identified as the main ones determining the effectiveness of developing digital-statistical competence within the scope of this research.

Main Pedagogical Conditions. *1. Ensuring the binary and continuous nature of digital-statistical training.*

In the study, special attention was paid to the continuity and gradual complexity of the educational process as one of the important pedagogical factors for developing digital-statistical competence in geography master's students. Continuity means organising digital-statistical training in a logical sequence across all stages of master's education, clearly defining the knowledge, skills and activities acquired at each stage, and gradually increasing the complexity of content, methods and tasks at subsequent stages. This process consists of the following stages:

- diagnosing the entry-level knowledge and practical skills of students at the admission stage;

● mastering the theoretical and practical foundations of digital-statistical activity through the elective course "Digital-Statistical Methods in Geography";

● gradually deepening theoretical and practical training, moving from descriptive statistics to correlational, dynamic and spatial-statistical analysis;

● gaining professional experience by solving real geographical tasks using digital-statistical methods during research practice and the master's thesis.

Continuity of this kind treats digital-statistical training as a consistent developmental trajectory that begins with the student's existing foundational knowledge and progresses toward complex digital-statistical analysis and independent research activity. Within this trajectory, the content, methods and diagnostic mechanisms used at each subsequent stage are made progressively more complex, ensuring that professional and research subjects are thematically and methodologically linked to one another rather than treated as isolated units.

The binary nature of the training is expressed in the mutual integration of two interrelated content systems: the geographical and the digital-statistical components. The geographical component determines the content of research objects and territorial processes, while the digital-statistical component provides the tools for their quantitative analysis, processing and scientific interpretation. This binary nature is also manifested in that, on the one hand, mastering digital-statistical methods is a result of the student's professional training, and on the other hand, these methods serve as a functional tool for geographical research, monitoring, forecasting and evidence-based decision-making. This pedagogical condition can be implemented through binary lectures, integrated seminars and joint consultations among instructors from geography, statistics and information technology fields, which requires content-coordinated professional cooperation among teachers.

2. Consistently integrating digital-statistical content into professional subjects.

Analysing the functional role of digital-statistical methods in the system of training a geography specialist makes it possible to identify the content components of this competence and link them to professional subjects. An analysis of the current qualification requirements, curricula and syllabi shows that statistical methods, digital databases and analytical tools serve as a basic integrative component linking the content of several professional subjects. Foundational knowledge is usually formed in the following areas: within mathematical-statistical disciplines, descriptive statistics, sampling, variance, correlation and other quantitative analysis methods; within computer science disciplines, spreadsheets, databases, creating graphs and diagrams, and sorting, filtering and processing data. Accordingly, it is methodologically sound to introduce the special course "Digital-Statistical Methods in Geography" from the very first stage of master's education.

The professional necessity of digital-statistical methods is even more evident in the content of natural and economic geography subjects, for example, in analysing meteorological series in climatology, water regime indicators in hydrology, and demographic dynamics in population geography. Likewise, in research projects, the master's thesis and independent scientific work, processing

large volumes of numerical data, comparing them across time and space, and developing scientific forecasts are key forms of digital-statistical activity.

The digital-statistical component should also be integrated into subjects related to geography teaching methodology; for instance, in studying topics such as "Graphic and Cartographic Visualisation of Geographical Data" and "Methods of Working with Digital Data", it is important to reveal the didactic potential of statistical methods. This, in turn, requires updating the content of lectures, seminars, practical classes, independent study and research practice. Such methodological support must correspond to the current level of development of statistics, digital technologies and geographical science, remain closely connected with professional and research activity, and ensure the balanced development of the cognitive, practical-activity and motivational components that together constitute a geography master's student's digital-statistical competence.

3. Ensuring variability in the methods of mastering digital-statistical activity

This pedagogical condition is characterised by giving the master's student a certain degree of choice and independent decision-making when completing digital-statistical tasks. In this regard, the student is allowed to independently choose, to a certain extent, the form and content of the educational or research task, the level of task complexity, the methods of data processing and digital tools used, and the pace and mode of individual activity. The main purpose of this approach is to reveal each student's individual intellectual and research potential as fully as possible, turning them into an active subject of digital-statistical activity. Such variability is reflected in designing the student's individual educational trajectory, whose structural components are as follows [5]:

- target component – determining individual educational and research goals based on the student's professional motives and interests;
- content component – systematising the content of digital-statistical training and identifying integrative links with professional subjects;
- diagnostic component – selecting diagnostic tools suited to determining the level of digital-statistical competence achieved;
- organisational-pedagogical component – identifying the forms, methods, tools and pedagogical conditions necessary to achieve the set educational and professional goals.

Here, the teacher does not act as the one who dictates ready-made solutions, but rather as a consultant who provides methodological support in choosing the optimal statistical method, data source and research strategy. The effectiveness of an individual educational trajectory depends not only on the student's freedom to choose tasks, but also on their ability to justify that choice professionally and scientifically; accordingly, the principle of variability must be implemented in harmony with pedagogical guidance rather than as unrestricted freedom. As a result, the student's independent learning activity, analytical thinking and research initiative are strengthened.

Conclusion. The analysis conducted shows that the process of developing digital-statistical competence in geography master's students is not limited to

mastering statistical knowledge and digital tools alone, but must rely on a specific complex of pedagogical conditions. Ensuring the binary and continuous nature of digital-statistical training, its consistent integration into professional subjects, and ensuring variability in the methods of mastering this activity – only when these conditions are implemented in an interrelated manner does the pedagogical environment necessary for the sustainable development of this competence arise. This, in turn, creates the methodological basis for preparing a digitally and statistically competent master's student capable of independently carrying out the cycle of searching, systematising, statistically analysing, visualising, and scientifically interpreting geographical information.

The integrated implementation of these conditions enables students to move from separately forming statistical knowledge and digital skills toward being able to mobilise them for solving real geographical problems. This indicates the need to design the content of digital-statistical education, its forms of organisation, and diagnostic tools as an integral methodological system. In future research, it would be advisable to develop diagnostic criteria and methods that allow for a quantitative and qualitative assessment of changes in students' level of digital-statistical competence resulting from the practical implementation of these pedagogical conditions.

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NOOTROPIC AGENTS IN PEDIATRIC NEUROLOGY: CURRENT EVIDENCE, CLINICAL USE, AND SAFETY CONSIDERATIONS

Abstract: *Nootropic drugs are widely used in some clinical settings as adjunctive agents in the management and rehabilitation of pediatric neurological disorders. This review examines the pharmacological characteristics, proposed mechanisms of action, clinical applications, efficacy, and safety considerations of selected nootropic agents in pediatric neurology. Particular attention is given to piracetam, citicoline, hopantenic acid, phenibut, and pyritinol. The available literature suggests that the clinical effects of these agents vary considerably depending on the drug, neurological condition, age of the patient, and treatment context. Although some nootropics demonstrate potential effects on neuronal metabolism, neurotransmission, membrane function, and neuroplasticity, the available clinical evidence remains heterogeneous. Recent studies also indicate that the efficacy of individual agents cannot be generalized across different pediatric neurological disorders. Therefore, nootropic drugs should not be considered universal treatments and should be used only when clinically justified, with careful consideration of age-specific safety and potential adverse effects.*

Keywords: *Nootropic drugs, pediatric neurology, piracetam, citicoline, hopantenic acid, phenibut, pyritinol, neuroplasticity, cognitive function, neuroprotection.*

Introduction

Pediatric neurology is a rapidly developing field of modern medicine that focuses on the diagnosis, treatment, and rehabilitation of neurological disorders occurring during childhood. Neurological conditions in children may result from a wide range of factors, including perinatal hypoxia and hypoxic-ischemic brain injury, birth-related complications, genetic disorders, central nervous system infections, traumatic brain injury, metabolic abnormalities, and neurodevelopmental disorders. These conditions may affect cognitive, motor, behavioral, speech, and learning functions and, in some cases, may lead to long-term functional impairment. Nootropic drugs represent a heterogeneous group of pharmacological agents that have been traditionally described as substances capable of influencing cognitive functions and neuronal metabolism. The term “nootropic” was introduced by Corneliu E. Giurgea in 1972 in connection with the development of piracetam. Since then, numerous compounds with different pharmacological mechanisms have been classified as nootropics in various countries. These include agents proposed to influence neuronal membrane function, cellular energy

metabolism, neurotransmission, neuroplasticity, or neuroprotective processes. However, the pharmacological properties and clinical indications of individual nootropic agents differ considerably, and the term “nootropic” does not represent a single pharmacological class with uniform mechanisms of action.

In pediatric neurology, some nootropic agents have been used as adjunctive therapies in children with cognitive or developmental difficulties, including selected cases of delayed psychomotor or speech development and during neurological rehabilitation. Proposed mechanisms include modulation of neuronal metabolism, effects on membrane phospholipid synthesis, changes in neurotransmitter activity, and potential support of neuronal plasticity. Nevertheless, evidence derived from experimental or pharmacological studies should not automatically be interpreted as evidence of clinical effectiveness in children. The clinical evidence concerning nootropic drugs in pediatric patients remains heterogeneous. Some individual agents have been investigated in specific neurological conditions, whereas for others, high-quality randomized controlled trials and long-term safety data are limited. Therefore, their potential benefits should be evaluated according to the specific drug, clinical indication, age of the patient, treatment duration, safety profile, and quality of available evidence. In particular, nootropic agents should not be considered universal treatments for neurological or neurodevelopmental disorders.

Relevance

Neurological and neurodevelopmental disorders in children represent an important medical and social problem because they may affect cognitive development, speech, motor functions, behavior, learning ability, and the quality of life of children and their families. Perinatal hypoxia, hypoxic-ischemic brain injury, birth-related complications, central nervous system infections, traumatic brain injury, genetic and metabolic disorders may contribute to neurological impairment during childhood. Therefore, improving approaches to comprehensive treatment and rehabilitation of children with neurological disorders remains an important area of pediatric medicine.

Aim

The aim of this study is to analyze the pharmacological characteristics, proposed mechanisms of action, clinical applications, efficacy, and safety of selected nootropic drugs used in pediatric neurology, with particular attention to their potential role as adjunctive therapy in children with neurological and neurodevelopmental disorders.

Main part

Nootropic drugs are pharmacological agents traditionally used to influence cognitive functions and neuronal metabolic processes. Their pharmacological effects vary depending on their chemical structure and mechanism of action. Some nootropic agents may influence neuronal energy metabolism, neurotransmission, membrane function, and neuroplasticity. Piracetam is considered a classical nootropic agent and has been investigated for its effects on neuronal membrane function and cerebral metabolic processes. Citicoline is involved in phospholipid synthesis and has been studied for its potential role in maintaining neuronal

membrane integrity. Hopantenic acid has pharmacological properties associated with the GABAergic system and has traditionally been used in some pediatric neurological conditions. The proposed mechanisms of nootropic drugs include modulation of neuronal metabolism, support of cellular energy processes, and possible effects on synaptic plasticity. Some experimental studies have also suggested potential neuroprotective and antihypoxic properties of individual agents. However, pharmacological mechanisms observed in experimental models cannot automatically be considered evidence of clinical effectiveness. Therefore, clinical outcomes should be evaluated using appropriate human studies and evidence-based clinical data. In pediatric patients, pharmacological responses may differ from those observed in adults because of age-dependent physiological and pharmacokinetic characteristics. Consequently, the selection of a nootropic agent should take into account the child's age, diagnosis, neurological status, concomitant treatment, and potential risks. Nootropic therapy should therefore be considered individually rather than as a uniform treatment approach.

Nootropic drugs have traditionally been used in some countries as adjunctive therapy for selected neurological and neurodevelopmental conditions in children. The article describes their use in conditions associated with delayed psychomotor and speech development, cognitive difficulties, consequences of perinatal neurological injury, and rehabilitation after traumatic brain injury. In children with developmental delay, pharmacological treatment may be considered together with speech therapy, psychological support, special education, and other rehabilitation interventions. Following perinatal hypoxia or hypoxic-ischemic brain injury, comprehensive rehabilitation remains the principal therapeutic approach. Physiotherapy, therapeutic exercise, speech therapy, and developmental interventions may be combined according to the child's functional needs. Nootropic drugs, when considered, should only represent an adjunctive component rather than a replacement for rehabilitation. In attention-deficit/hyperactivity disorder, nootropic drugs are not considered first-line treatment in international clinical practice. Behavioral interventions, psychological support, parent education, and approved pharmacological treatments are generally prioritized. Similarly, nootropic drugs are not established standard treatments for autism spectrum disorder. In children with cerebral palsy, treatment primarily focuses on motor rehabilitation, functional independence, communication, and management of associated problems.

The clinical efficacy of nootropic drugs remains heterogeneous and depends on the specific pharmacological agent and clinical condition. Some individual drugs have demonstrated potentially beneficial effects in selected studies, whereas evidence for other agents remains limited or inconsistent. Citicoline has been investigated for its potential neuroprotective and metabolic effects, including in pediatric neurological conditions. However, available clinical evidence does not support generalized conclusions regarding its effectiveness across all pediatric disorders. Piracetam has also been studied in relation to cognitive and neurological functions, but its clinical benefits should be interpreted according to the specific indication and quality of available evidence. Hopantenic acid is used in some

countries, particularly within regional pediatric neurological practice, although internationally recognized high-quality evidence remains limited for several proposed indications. Phenibut requires particular attention because, in addition to its anxiolytic and GABA-related pharmacological effects, clinical literature has reported adverse effects associated with excessive use, dependence, withdrawal, and intoxication. Therefore, phenibut should not be presented as a routinely established pediatric nootropic therapy. Pyritinol has also been used historically as a nootropic agent, but its clinical application varies between countries and available evidence is not sufficient to support broad therapeutic claims. Safety assessment is especially important in children because adverse effects and drug interactions may have significant consequences.

The management of pediatric neurological disorders requires a comprehensive and multidisciplinary approach aimed at improving functional development and quality of life. Pharmacological treatment is only one component of this approach. Depending on the underlying disorder, children may require physiotherapy, occupational therapy, speech and language therapy, psychological support, special education, and long-term developmental monitoring. Nootropic drugs have traditionally been incorporated into complex treatment programs in some clinical settings. Their proposed role is to support neuronal metabolism, cognitive functioning, or recovery processes. In children with developmental delay, any pharmacological intervention should be combined with appropriate developmental and educational rehabilitation. Following hypoxic-ischemic brain injury, rehabilitation should be individualized according to motor, cognitive, behavioral, and communication impairments. Similarly, after traumatic brain injury, treatment should focus on functional recovery and monitoring of cognitive symptoms. In children with epilepsy, additional caution is required because the effect of individual drugs on seizure control must be considered. Nootropic therapy should never replace established antiepileptic treatment or other evidence-based interventions. The potential value of a nootropic agent should therefore be evaluated as part of the overall treatment plan. This approach allows clinicians to avoid unnecessary pharmacological exposure while ensuring that potentially useful adjunctive interventions are considered when clinically appropriate.

From the perspective of evidence-based medicine, the therapeutic value of nootropic drugs should be determined by the quality and consistency of clinical evidence rather than by proposed pharmacological mechanisms alone. The available literature demonstrates substantial differences between individual nootropic agents, indications, study populations, and clinical outcomes. Some studies report potentially positive effects, while others show limited or inconclusive benefits. Therefore, the results obtained for one drug or one neurological condition should not automatically be extrapolated to other pediatric populations. Randomized controlled trials, systematic reviews, and long-term safety studies are particularly important for establishing the effectiveness of pharmacological interventions in children. Pediatric studies should also consider age-specific pharmacokinetics, adverse effects, drug interactions, and long-term developmental outcomes. The

current evidence does not support the use of nootropic drugs as universal treatments for pediatric neurological disorders. Instead, their use should be restricted to clinically justified situations in which the expected benefits outweigh potential risks. Treatment should be individualized according to the diagnosis, clinical severity, age of the child, and available evidence. Further well-designed clinical trials are required to clarify the efficacy and safety of individual nootropic agents. Such research may contribute to more accurate clinical recommendations and safer pharmacological decision-making in pediatric neurology.

Results

The analysis demonstrated that nootropic drugs represent a heterogeneous group of pharmacological agents with different mechanisms of action and clinical applications. The reviewed literature indicates that individual nootropic agents may influence neuronal metabolism, neurotransmission, membrane function, and neuroplasticity. However, the strength of clinical evidence varies considerably between individual drugs and neurological conditions. Piracetam and citicoline have been among the most frequently investigated agents, while hopantenic acid and pyritinol have been used predominantly in specific regional clinical practices. The available evidence suggests that the potential clinical effects of these agents depend strongly on the underlying neurological condition and characteristics of the pediatric population. Some studies have reported improvements in selected cognitive, neurological, or functional outcomes, whereas other investigations have failed to demonstrate statistically significant benefits. Recent clinical evidence concerning citicoline also indicates that its effects cannot be generalized to all pediatric neurodevelopmental disorders. In particular, clinical studies in children with autism spectrum disorder have not provided sufficient evidence to establish a consistent therapeutic benefit. The analysis also identified important safety considerations associated with certain agents. Phenibut, in particular, has been associated with adverse effects, tolerance, dependence, withdrawal symptoms, and intoxication in the clinical literature. Therefore, its use in children requires particular caution. Overall, the results indicate that nootropic drugs may have a potential role as adjunctive agents in selected clinical situations, but current evidence does not support their universal use in pediatric neurology. The findings emphasize the importance of individualized treatment decisions, appropriate clinical indications, and continuous assessment of therapeutic benefits and potential risks.

Discussion

The findings of this review demonstrate that the clinical role of nootropic drugs in pediatric neurology remains controversial and requires careful interpretation of available evidence. Although several nootropic agents have demonstrated pharmacological effects on neuronal metabolism, membrane function, neurotransmission, and neuroplasticity, these mechanisms alone cannot be considered sufficient evidence of clinical effectiveness. The heterogeneity of published studies makes it difficult to establish uniform recommendations for the use of nootropic drugs in children. Differences in age, diagnosis, disease severity, treatment duration, outcome measures, and study methodology may contribute to

the inconsistent findings reported in the literature. Citicoline provides an important example of this uncertainty, as its potential neuroprotective mechanisms have been investigated in different neurological conditions, while clinical benefits have not been consistently demonstrated in pediatric neurodevelopmental disorders. The safety profile of individual agents should also be considered when evaluating their potential clinical usefulness. Phenibut is particularly concerning because reports of dependence, withdrawal, intoxication, and other serious adverse effects limit its suitability as a routine pediatric therapy. These findings indicate that the risk-benefit ratio should be carefully assessed before prescribing any nootropic agent. In addition, nootropic treatment should not replace established rehabilitation strategies or evidence-based management of specific neurological disorders. For children with developmental difficulties, cerebral palsy, autism spectrum disorder, or consequences of perinatal brain injury, multidisciplinary rehabilitation remains essential. Pharmacological interventions, when indicated, should complement rather than substitute these approaches. Therefore, the current evidence supports a selective and individualized approach to nootropic therapy rather than their routine or universal administration. Further large-scale randomized controlled trials with standardized clinical outcomes and long-term follow-up are required to determine the efficacy, safety, and appropriate indications of individual nootropic drugs in pediatric neurology.

Conclusion

The analysis of the available scientific literature indicates that nootropic drugs may have potential value as adjunctive pharmacological agents in selected areas of pediatric neurology. Their proposed effects include modulation of neuronal metabolism, neurotransmission, membrane function, and neuroplasticity. However, the clinical evidence supporting these effects remains heterogeneous and varies substantially between individual drugs and neurological conditions. Therefore, the pharmacological mechanism of a nootropic agent should not be considered sufficient evidence of its clinical efficacy. In pediatric patients, particular attention should be given to age-specific safety, potential adverse effects, drug interactions, and the limited availability of high-quality long-term clinical studies. The evidence currently available does not support the routine or universal use of nootropic drugs for pediatric neurological and neurodevelopmental disorders. Their administration should be individualized and considered only when there is a clear clinical indication and an appropriate assessment of the potential benefits and risks. Nootropic therapy should also not replace established rehabilitation, behavioral, educational, or disease-specific treatment strategies. Further well-designed randomized controlled trials involving adequately characterized pediatric populations are needed to determine the efficacy, safety, optimal indications, and long-term outcomes of individual nootropic agents. Such evidence will help establish a more scientifically justified and clinically appropriate role for nootropic drugs in modern pediatric neurology.

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O'ZBEKISTONNING TURLI HUDUDLARIDAGI CHORVACHILIK XO'JALIKLARIDA VETERINARIYA RADIOMONITORING NATIJALARI

Annotatsiya. *Maqolada Toshkent viloyati Bekobod tumani Ulug'bek hududidagi "Istiqlol naslchilik" fermer xo'jaligi, Samarqand viloyati Nurobod tumanidagi "Nurobod go'sht sut" MChJ va Qoraqalpog'iston Respublikasi Amudaryo tumanidagi "Soatov Otabek" agroferma xo'jaliklarida o'tkazilgan veterinariya radiomonitoringi natijalari umumlashtirilgan.*

Kalit so'zlar: *veterinariya radiomonitoringi, dozimetriya, gamma-nurlanish, seziy-137, radionuklid, radiokimyoviy tahlil, mufel pechi, radioekologiya, chorvachilik, yem-xashak.*

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RESULTS OF VETERINARY RADIOMONITORING IN LIVESTOCK FARMS OF VARIOUS REGIONS OF UZBEKISTAN

Abstract. *The article summarizes the results of veterinary radiomonitoring conducted at the "Istiqlol Naslchilik" farm in Bekabad district of Tashkent region,*

“Nurobod Go‘sht Sut” LLC in Nurobod district of Samarkand region, and “Soatov Otabek” agro-farm in Amudarya district of the Republic of Karakalpakstan.

Keywords: *veterinary radiomonitoring, dosimetry, gamma radiation, cesium-137, radionuclide, radiochemical analysis, muffle furnace, radioecology, cattle, feed.*

Kirish yer yuzasidagi barcha tirik organizmlar doimiy ravishda ionlashtiruvchi nurlanish ta’sirida bo‘ladi. Ionlashtiruvchi nurlanish manbalari kelib chiqishiga ko‘ra uch guruhga bo‘linadi:

Kosmik nurlanishlar;

Tabiiy radioaktiv elementlar — U-238, Th-232, K-40 va ularning parchalanish mahsulotlari;

Sun’iy radionuklidlar — yadroviy qurol sinovlari va atom elektr stansiyalaridagi avariyalar natijasida hosil bo‘lgan radionuklidlar.

Birinchi va ikkinchi guruh manbalar tabiiy fon nurlanishini tashkil etadi. Uchinchi guruh esa texnogen radioaktiv ifloslanishni keltirib chiqaradi. Chorvachilik mahsulotlarining radiatsiyaviy xavfsizligini ta’minlash veterinariya nazoratining muhim yo‘nalishlaridan biri hisoblanadi. Ayniqsa, sobiq yadroviy sinov poligonlariga yaqin hududlarda va atom elektr stansiyalari ta’sir doirasidagi xo‘jaliklarda muntazam radiomonitoring o‘tkazish zarurati tug‘iladi.

Mazkur tadqiqotning maqsadi uchta turli hududda joylashgan chorvachilik xo‘jaliklarida veterinariya radiomonitoringini o‘tkazish, tashqi gamma-nurlanish darajasini baholash va radiokimyoviy tahlil natijalari asosida radioekologik xulosalar ishlab chiqishdan iborat.

Tadqiqot materiallari va metodlari

Tadqiqotlar quyidagi xo‘jaliklarda olib borildi:

Xo‘jalik	Hudud	Sana	Hayvonlar soni	O‘lchov sharoiti
“Istiqlol naslchilik” fermer xo‘jaligi	Toshkent viloyati, Bekobod tumani, Ulug‘bek	2026-yil 10-iyun	41 bosh qora-ola zotli qoramol	37 °C, bulutsiz, 1 m, 4–7 sm
“Nurobod go‘sht sut” MChJ	Samarqand viloyati, Nurobod tumani	2026-yil 10–11-fevral	4715 bosh boyat zotli mayda shoxli mol	16 °C, bulutli, 1 m, 5–9 sm
“Soatov Otabek” agroferma	Qoraqalpog‘iston, Amudaryo tumani	2026-yil mart	202 bosh sut tovar fermasi	37–38 °C, shamolsiz, bulutsiz, 1 m, 6–9 sm

Dozimetrik o‘lchovlar “konvert” usulida 100×100 m nazorat maydonlarida amalga oshirildi. Toshkent viloyatidagi xo‘jalikda 7 nuqtada (burchaklar, tomonlar o‘rtasi va markaz), Samarqand viloyatida beda maydonida 10 nuqtada, nazorat

uchastkasida 6 joyda, o‘tloqli maydonda 7 nuqtada, Qoraqalpog‘istonda beda maydonida 10 nuqtada va o‘tloqli maydonda 5 nuqtada o‘lchovlar o‘tkazildi. Har bir nuqtada kamida 3 marta takroriy o‘lchov olinib, o‘rtacha qiymat hisoblandi.

Radiokimyoviy tahlil uchun tuproq, beda, pichan va suv namunalari olindi. Namunalar dastlab quritish shkafida 90–120 °C haroratda doimiy vaznga quritildi, so‘ngra 100–200 °C haroratda ko‘mir holatiga keltirildi. Keyin mufel pechida 400–500 °C haroratda kullash amalga oshirildi. Kullash koeffitsiyenti quyidagi formula bo‘yicha hisoblandi:

$$Koz = \frac{M}{m}$$

bu yerda: M*M* — xom namunaning og‘irligi, g; m*m* — hosil bo‘lgan kulning og‘irligi, g.

Kulda seziy-137 miqdori B.P. Kruglikov (1967) usuli yordamida radiokimyoviy tahlil qilindi. Bunda seziy geksaxlortellurit (Cs_2TeCl_6) ko‘rinishidagi xlorid kislota eritmasidan foydalanildi. So‘ngra gamma-spektrometr yordamida radionuklid miqdori Bq/kg (quruq massa) birligida aniqlandi.

Tadqiqot natijalari
Toshkent viloyati, “Istiqlol naslchilik” fermer xo‘jaligi

O‘lchov nuqtasi	Ekvivalent doza quvvati, mkr/soat
Dezinfeksiya maydoni oldi	10,2 ± 0,3
Tug‘ruqxona	13,2 ± 0,4
Boqish bo‘limi	12,4 ± 0,3
Suv havzasi	9,3 ± 0,2
Yem saqlash ombori	11,4 ± 0,3
Nazorat punkti atrofi	14,2 ± 0,5
O‘rtacha qiymat	12,8 ± 0,4

“Konvert” usulida 100×100 m nazorat maydonida o‘tkazilgan o‘lchovlar natijalari: 1-burchak (shimoli-sharq) — 10,2 ± 0,3; 2-burchak (janubi-sharq) — 13,2 ± 0,4; 3-burchak (janubi-g‘arb) — 12,4 ± 0,3; 4-burchak (shimoli-g‘arb) —9,3 ± 0,2; shimoliy tomon o‘rtasi — 11,4 ± 0,3; janubiy tomon o‘rtasi — 14,2 ± 0,5; markaz — 12,8 ± 0,4. Umumiy o‘rtacha qiymat — 11,9±0,34 mkr/soat.

Samarqand viloyati, “Nurobod go‘sht sut” MChJ

O‘lchov nuqtasi	Ekvivalent doza quvvati, mkr/soat
Beda maydoni (“konvert”, 10 nuqta)	15,3
Darvoza va dezinfeksiya to‘sig‘i orqasi	16
Hayvonlar binosiga kirish yo‘li	15,7
Boqish bo‘limi	15,8
Hovuz suvi	12,3
Yem ombori	14,2
Nazorat uchastkasi (100×100 m, 6 joy)	17,8
O‘tloqli maydon (100×100 m, 7 nuqta)	10,3–13,0

Qoraqalpog‘iston, “Soatov Otabek” agroferma

O‘lchov nuqtasi	Ekvivalent doza quvvati, mkr/soat
Beda maydoni (“konvert”, 10 nuqta)	15,6
Darvoza va dezinfeksiya to‘sig‘i orqasi	14,7
Dezobarer oldi	13,7
Tug‘ruqxona	12,7
Boqish bo‘limi	11,4
Yem saqlash ombori	14,3
Kollektor	14,9
Hovuz (suv)	11,1
Xodimlar dam olish maskani	10,1
Sut qutilari	9,3
Bino ichida	10,4
Chorva mollar shiyponi (soyada)	8,3
O‘tloqli maydon (100×100 m, 5 nuqta)	8,1–15,6

Barcha o‘lchov natijalari O‘zbekiston Respublikasi SanPiN 0134-03 bo‘yicha ruxsat etilgan me’yordan (30 mkr/soat) sezilarli darajada past bo‘ldi.

Toshkent viloyati va Qoraqalpog‘iston xo‘jaliklarida olingan barcha namunalarda seziy-137 miqdori aniqlash chegarasidan past bo‘lib, “aniqlanmadi” deb baholandi. Samarqand viloyati Nurobod tumanidagi tadqiqotda namunalar olingan bo‘lsada, radiokimyoviy tahlil natijalari maqolada to‘liq keltirilmagan.

Statistik tahlil “Istiqlol naslchilik” fermer xo‘jaligida o‘tkazilgan 21 ta o‘lchov natijalari bo‘yicha statistik tahlil quyidagicha:

Istiqlol naslchilik” fermer xo‘jaligida o‘tkazilgan 21 ta o‘lchov natijalari bo‘yicha statistik tahlil

Ko‘rsatkich	Qiymat
O‘lchovlar soni (n)	21
O‘rtacha qiymat	12,1 mkr/soat
Standart og‘ish (σ)	1,42 mkr/soat
Variatsiya koeffitsiyenti (CV)	11,70%
Minimal qiymat	9,3 mkr/soat
Maksimal qiymat	14,2 mkr/soat
Median	12,4 mkr/soat

Variatsiya koeffitsiyenti 11,7% ni tashkil etib, bu o‘lchovlarning nisbatan barqaror ekanligini ko‘rsatadi (CV < 20%).

Muhokama olingan natijalar shuni ko‘rsatadiki, uchta hududda ham tashqi gamma-nurlanishning ekvivalent doza quvvati 8,1–17,8 mkr/soat oralig‘ida bo‘lgan. Bu ko‘rsatkichlar O‘zbekiston Respublikasi SanPiN 0134-03 bo‘yicha ruxsat etilgan me’yordan (30 mkr/soat) pastdir. Toshkent viloyati uchun tabiiy fon nurlanishining o‘rtacha qiymati 10–15 mkr/soat oralig‘ida bo‘lishi ilmiy adabiyotlarda qayd etilgan. Demak, olingan natijalar asosan tabiiy fon chegarasida bo‘lib, hududlarda texnogen radioaktiv ifloslanish belgilari aniqlanmadi.

Funksional zonalar bo‘yicha eng past ko‘rsatkichlar suv havzalari, soyadagi shiyponlar va sut idishlari atrofida qayd etildi. Eng yuqori ko‘rsatkichlar esa ayrim hollarda darvoza va dezinfeksiya to‘siqlari, nazorat punktlari va beda maydonlarida kuzatildi. Bu farqlar statistik jihatdan ishonchli emas ($p > 0,05$) va tabiiy tebranishlar, tuproq tarkibi, relyef hamda o‘lchov sharoitlari bilan izohlanadi.

Radiokimyoviy tahlil natijalari bo‘yicha tuproq, beda, pichan va suv namunalarida seziy-137 aniqlanmadi. Bu esa xo‘jalik hududlarining radioekologik jihatdan toza ekanligini tasdiqlaydi. Ma’lumki, seziy-137 uzoq yashovchi radioaktiv izotop bo‘lib, yarim yemirilish davri 30,17 yilni tashkil etadi. U oziq-ovqat zanjiri orqali inson organizmiga kirib, jigar, taloq va mushak to‘qimalarida to‘planishi mumkin. Shuning uchun chorvachilik mahsulotlarida uning muntazam nazorat qilinishi muhim ahamiyatga ega.

Olingan natijalar boshqa tadqiqotchilar tomonidan o‘tkazilgan shunga o‘xshash tadqiqotlar natijalari bilan mos keladi. Xususan, Mirzayev va Qurbonov (2023) Buxoro viloyati Olot tumani va Surxondaryo viloyati Boysun tumanidagi xo‘jaliklarda, Mirzayev (2024) Andijon viloyati Izboskan tumani va Namangan viloyati Yangiqo‘rg‘on tumanidagi xo‘jaliklarda ham seziy-137 aniqlanmaganligini qayd etgan.

Xulosa O‘zbekistonning uchta hududida joylashgan chorvachilik xo‘jaliklarida tashqi gamma-nurlanishning ekvivalent doza quvvati 8,1–17,8 mkr/soat oralig‘ida bo‘lib, o‘rtacha qiymatlar 12,1–14,3 mkr/soat atrofida ekanligi aniqlandi. Bu ko‘rsatkichlar SanPiN 0134-03 bo‘yicha ruxsat etilgan me’yordan (30 mkr/soat) sezilarli darajada past.

Toshkent viloyati “Istiqlol naslchilik” fermer xo‘jaligida 21 ta o‘lchov natijalari bo‘yicha o‘rtacha qiymat 11,9±0,34 mkr/soat, standart og‘ish 1,42 mkr/soat, variatsiya koeffitsiyenti 11,7% ni tashkil etdi. Bu o‘lchovlarning barqarorligini ko‘rsatadi.

Funksional zonalar bo‘yicha eng past ko‘rsatkichlar suv havzalari, soyadagi shiyponlar va sut qutilari atrofida, eng yuqori ko‘rsatkichlar esa ayrim nazorat punktlari, darvoza va dezinfeksiya to‘siqlari hamda beda maydonlarida qayd etildi.

Radiokimyoviy tahlil o‘tkazilgan tuproq, beda, pichan va suv namunalarida seziy-137 aniqlanmadi. Bu ko‘rsatkich xo‘jalik hududlarining radioekologik jihatdan toza ekanligini tasdiqlaydi.

O‘rganilgan xo‘jaliklar hududi radioekologik jihatdan xavfsiz hisoblanadi va bu yerda yetishtirilayotgan chorvachilik mahsulotlari radiatsiyaviy xavfsizlik talablariga javob beradi.

Veterinariya radiomonitoringi ishlarini muntazam ravishda davom ettirish va kengaytirish zarur. Kelgusida tadqiqotlarni yilning turli fasllarida o‘tkazish, shuningdek, boshqa radionuklidlar (Sr-90, K-40) bo‘yicha ham tahlillar o‘tkazish tavsiya etiladi.

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ISPAN TILI TA’LIMIDA TALABALARNING MADANIYATLARARO KOGNITIV DUNYOQARASHINI RAQAMLI TEXNOLOGIYALAR VOSITASIDA SHAKLLANTIRISH MODELI VA PEDAGOGIK SHART-SHAROITLARI

Annotatsiya. *Maqolada ispan tilini o‘rganayotgan talabalarning madaniyatlararo kognitiv dunyoqarashini raqamli ta’lim muhitida shakllantirishning pedagogik modeli taqdim etilgan. Model maqsadli, mazmuniy, jarayonli, texnologik va natijaviy bloklardan iborat bo‘lib, uning markazida izlash, tahlil, qiyoslash, talqin va refleksiv baholash bosqichlaridan tashkil topgan kognitiv faoliyat sikli turadi. Virtual almashinuv, til korpuslari, raqamli hikoyalash va sun’iy intellekt vositalarining didaktik funksiyalari aniqlangan, modelning pedagogik shart-sharoitlari va diagnostik mezonlari asoslangan.*

Kalit so‘zlar: *pedagogik model, raqamli ta’lim muhiti, ispan tili, virtual almashinuv, telekollaboratsiya, sun’iy intellekt, madaniyatlararo kognitiv dunyoqarash, pedagogik shart-sharoitlar, diagnostika.*

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A MODEL AND PEDAGOGICAL CONDITIONS FOR DEVELOPING STUDENTS’ INTERCULTURAL COGNITIVE WORLDVIEW THROUGH DIGITAL TECHNOLOGIES IN SPANISH LANGUAGE EDUCATION

Abstract. *The article presents a pedagogical model for developing the intercultural cognitive worldview of university students of Spanish in a digital learning environment. The model comprises target, content, process, technological and outcome blocks; its core is a cognitive activity cycle of search, analysis, comparison, interpretation and reflective evaluation. The didactic functions of virtual exchange, language corpora, digital storytelling and artificial intelligence tools are identified, and the model’s pedagogical conditions and diagnostic criteria are substantiated.*

Keywords: *pedagogical model, digital learning environment, Spanish language, virtual exchange, telecollaboration, artificial intelligence, intercultural cognitive worldview, pedagogical conditions, diagnostics.*

Kirish

Raqamli ta’lim muhiti xorijiy til o‘rganuvchiga autentik madaniy materiallar, ona tilida so‘zlashuvchilar bilan jonli muloqot va xalqaro hamkorlikdagi loyihalar uchun keng imkoniyatlar ochmoqda. O‘zbekiston Respublikasida xorijiy tillarni o‘rganishni ommalashtirishga[15] va “Raqamli O‘zbekiston – 2030” strategiyasini amalga oshirishga[16] qaratilgan hujjatlarda xorijiy til ta’limi sifatini oshirish va ta’lim jarayoniga raqamli texnologiyalarni joriy etish vazifalari belgilangan. Biroq xorijiy tadqiqotlar raqamli muhitning o‘zi madaniyatlararo kompetensiyani avtomatik ravishda shakllantirmasligini, uning samarasi maqsadli loyihalangan topshiriqlar, refleksiya va o‘qituvchi ko‘magiga bog‘liqligini ko‘rsatmoqda.

Madaniyatlararo kognitiv dunyoqarash deganda talabaning ona tili va o‘rganilayotgan til orqali ifodalangan dunyo manzaralarini qiyoslash asosida shakllanadigan, madaniy hodisalarni idrok etish, talqin qilish va baholashning barqaror tizimi tushuniladi. Maqolaning maqsadi – ispan tili ta’limida uni raqamli texnologiyalar vositasida shakllantirish modelini ishlab chiqish, uning pedagogik shart-sharoitlari va diagnostik vositalarini asoslashdan iborat.

Mavzuga oid adabiyotlar tahlili

R.O’Dowd virtual almashinuvning asosiy modellari va uni oliy ta’limga keng joriy etish muammolarini tahlil qilgan[17]. R.Godwin-Jones telekollaboratsiya madaniyatlararo kommunikativ kompetensiyani rivojlantirishning samarali yondashuvi bo‘la olishini, biroq buning uchun ishtirokchilar muloqotini tanqidiy refleksiya va o‘qituvchi ko‘magi bilan uyg‘unlashtirish zarurligini ko‘rsatgan[18].

Ispan tili ta’limida olib borilgan tadqiqotlar ham shunga o‘xshash xulosalarga olib kelgan. G.Villegas-Paredes, S.Canto Gutiérrez va I.Rodríguez Moranta Utrecht universitetining ispan tilini o‘rganuvchi talabalari hamda Universidad Internacional de La Rioja (UNIR) magistraturasidagi bo‘lajak ispan tili o‘qituvchilari o‘rtasida beshta hamkorlikdagi topshiriq asosida tashkil etilgan telekollaborativ loyihaning madaniyatlararo kommunikativ kompetensiyani rivojlantirishdagi imkoniyatlarini o‘rgangan[19]. M.Giralt va hammualliflari ispan tili ta’limidagi virtual almashinuvni madaniyatlararo va raqamli kompetensiyalarni birgalikda rivojlantirish vositasi sifatida ko‘rib chiqqan[20]. A.Sevilla Pavón va J.Haba Osca maqolasining

[15] O‘zbekiston Respublikasi Prezidentining 2021-yil 19-maydagi PQ-5117-son “O‘zbekiston Respublikasida xorijiy tillarni o‘rganishni ommalashtirish faoliyatini sifat jihatidan yangi bosqichga olib chiqish chora-tadbirlari to‘g‘risida”gi qarori. – URL: https://lex.uz/docs/5426736

[16] O‘zbekiston Respublikasi Prezidentining 2020-yil 5-oktabrdagi PF-6079-son “«Raqamli O‘zbekiston – 2030» strategiyasini tasdiqlash va uni samarali amalga oshirish chora-tadbirlari to‘g‘risida”gi Farmoni. – URL: https://lex.uz/docs/5030957

[17] O’Dowd R. From telecollaboration to virtual exchange: state-of-the-art and the role of UNICollaboration in moving forward // Journal of Virtual Exchange. – 2018. – Vol. 1. – P. 1-23.

[18] Godwin-Jones R. Telecollaboration as an approach to developing intercultural communication competence // Language Learning & Technology. – 2019. – Vol. 23, No. 3. – P. 8-28.

[19] Villegas-Paredes G., Canto Gutiérrez S., Rodríguez Moranta I. Telecolaboración y competencia comunicativa intercultural en la enseñanza-aprendizaje de ELE: un proyecto en educación superior // Porta Linguarum. – 2022. – Monográfico IV. – P. 97-118.

[20] Giralt M., Villegas-Paredes G., Beaumont Aparicio G. Developing intercultural and digital competence through virtual exchanges in Spanish language learning and teaching // Journal of Spanish Language Teaching. – 2026. – Vol. 13, No. 1. – P. 80-99.

sarlavhasiga chiqarilgan ishtirokchi e'tirofi – dunyo bir vaqtning o'zida "shunchalik turli va o'xshash" bo'lishi mumkinligini anglash – telekollaboratsiyaning aynan dunyoqarash darajasidagi ta'sirini yaqqol ifodalaydi[21]. E'tiborli jihati, bu tadqiqotlarning barchasida virtual almashinuv oldindan loyihalangan topshiriqlar va pedagogik rahbarlik asosida tashkil etilgan.

YuNESKO generativ sun'iy intellektdan (SI) ta'limda inson markazlashgan, axloqiy va tanqidiy yondashuv asosida foydalanishni tavsiya etadi[22]. E.Kasneci va hammualliflari katta til modellari individual qayta aloqa va muloqot mashqlari uchun imkoniyat yaratishi bilan birga, noaniq ma'lumot va tarafkashlik xavfini ham tug'dirishini qayd etgan[23]. Biroq ko'rib chiqilgan ishlarda raqamli vositalar ko'pincha alohida-alohida o'rganilgan; ularni madaniyatlararo bilish faoliyati bosqichlari va dunyoqarash komponentlari bilan tizimli bog'lovchi yaxlit model, xususan, o'zbek talabalari uchun ispan va o'zbek madaniyatlarini qiyoslash kontekstida ishlab chiqilmagan.

Tadqiqot metodologiyasi

Tadqiqotda pedagogik modellashtirish, tizimli-tuzilmaviy tahlil, pedagogik loyihalash va ilg'or xorijiy tajribani qiyosiy tahlil qilish metodlaridan foydalanildi. Modelning texnologik blokini loyihalashda muallifning ispan tili mashg'ulotlarida raqamli texnologiyalarni qo'llash bo'yicha avvalgi kuzatishlari[24] umumlashtirildi.

Natijalar va muhokama

Ishlab chiqilgan model besh o'zaro bog'liq blokdan iborat:

– **maqsadli blok** – ijtimoiy buyurtma va Servantes instituti "Plan curricular"i[25] talablari asosida madaniyatlararo kognitiv dunyoqarashni shakllantirish maqsadi va vazifalarini, metodologik asos sifatida madaniyatlararo, kompetensiyaviy, kognitiv, aksiologik va raqamli-pedagogik yondashuvlarni belgilaydi;

– **mazmuniy blok** – "Ispan tilida so'zlashuvchi dunyo: tarix va zamonaviylik", "Madaniy konseptlar va qadriyatlar" (familia, amistad, honor, fiesta, tiempo), "Kommunikativ xulq-atvor me'yorlari" (murojaat shakllari, xushmuomalalik strategiyalari, noverbal muloqot) hamda "Madaniyatlararo mediatsiya va onlayn muloqot" modullarini qamrab oladi;

– **jarayonli blok** – besh bosqichli madaniyatlararo kognitiv faoliyat siklini amalga oshiradi (1-jadval);

– **texnologik blok** – raqamli vositalar, shakl va metodlar majmuini, jumladan, virtual almashinuv, keys-stadi, loyiha metodi va madaniy tushunmovchilik

[21] Sevilla Pavón A., Haba Osca J. «Te das cuenta de que el mundo puede ser tan distinto y similar al mismo tiempo»: telecolaboración y desarrollo de la competencia intercultural en la educación superior // Didáctica. Lengua y Literatura. – 2016. – Vol. 28. – P. 263-284.

[22] UNESCO. Guidance for generative AI in education and research. – Paris: UNESCO, 2023.

[23] Kasneci E., Sessler K., Küchemann S. et al. ChatGPT for good? On opportunities and challenges of large language models for education // Learning and Individual Differences. – 2023. – Vol. 103. – Art. 102274.

[24] Xalillayev A.K. Ta'lim jarayonida raqamli texnologiyalarning samarali qo'llanilishi: metodik yondashuvlar // Ispan tilining O'zbekistonda rivojlanishi: tarixiy kontekst, yangi imkoniyatlar va zamonaviy tendensiyalar: xalqaro ilmiy-amaliy anjuman materiallari. – Toshkent, 2025. – B. 298-301.

[25] Instituto Cervantes. Plan curricular del Instituto Cervantes. Niveles de referencia para el español. – Madrid: Biblioteca Nueva, 2006.

vaziyatlarini tahlil qilishga asoslangan “madaniy assimilyator” metodini[26] o‘z ichiga oladi;

– **natijaviy blok** – mezon, ko‘rsatkich va darajalar hamda diagnostika vositalarini belgilaydi (2-jadval).

1-jadval

Raqamli ta’lim muhitida madaniyatlararo kognitiv faoliyat sikli (“familia” – “oila” konseptlari misolida)

Bosqich va kognitiv amal	Raqamli vositalar	Topshiriq namunasi
1. **Izlash**: axborotni topish, saralash va baholash	Centro Virtual Cervantes, RTVE Play, Google Arts & Culture	“La familia en España y en América Latina” mavzusida uchta autentik manba topish va ishonchliligini baholash
2. **Tahlil**: konseptning lisoniy va madaniy belgilarini aniqlash	CORPES XXI korpusi, DLE lug‘ati	“familia” so‘zining korpusdagi birikmalarini (*familia numerosa*, *familia política* va b.) tahlil qilish
3. **Qiyoslash**: o‘xshashlik va farqlarni aniqlash	Raqamli aqliy xarita, Venn diagrammasi	“familia” va “oila” konseptlarining qadriyatli belgilarini (katta oila, mehr-oqibat, *compadrazgo* va mahalla) qiyoslash
4. **Talqin**: o‘zga nuqtai nazarni tushunish, vositachilik	Videokonferensiya, eTandem, SI suhbat-simulyatsiyasi	Ispan tilida so‘zlashuvchi tengdosh bilan oilaviy an’analar haqida suhbat, tushunmovchiliklarni izohlash
5. **Refleksiv baholash**: o‘z stereotiplari va pozitsiyasini baholash	E-portfolio, refleksiv kundalik, raqamli hikoya	“Ispan oilasi haqidagi qaysi tasavvurim o‘zgardi?” mavzusida 2-3 daqiqalik raqamli hikoya

Siklda har bir raqamli vosita muayyan kognitiv amalga xizmat qiladi: CORPES XXI korpusi[27] konseptning zamonaviy ispan tilidagi real qo‘llanishini ko‘rsatsa, virtual almashinuv madaniy farqlarni jonli muloqotda “sinab ko‘rish” imkonini beradi. Sun’iy intellekt vositalari suhbatdosh-simulyator sifatida qo‘llanilib, ular bergan madaniy ma’lumotlar autentik manbalar bilan albatta solishtiriladi.

Modelning samarali ishlashi quyidagi pedagogik shart-sharoitlarga bog‘liq: autentik lingvomadaniy kontentni raqamli ta’lim resurslari bilan integratsiyalash; madaniyatlararo dialogik ta’limni tashkil etish, bunda talaba virtual almashinuvda o‘zbek madaniyatini ispan tilida taqdim etuvchi “madaniyat vakili” sifatida ishtirok etadi; individual va hamkorlikdagi raqamli faoliyatni uyg‘unlashtirish; har bir siklni refleksiv mahsulot bilan yakunlash orqali refleksiv-kognitiv faollikni rag‘batlantirish; o‘qituvchining texnologik, pedagogik va mazmuniy bilimlari

[26] Fiedler F.E., Mitchell T., Triandis H.C. The culture assimilator: An approach to cross-cultural training // Journal of Applied Psychology. – 1971. – Vol. 55, No. 2. – P. 95-102.
[27] Real Academia Española. Banco de datos (CORPES XXI) [en línea]. Corpus del Español del Siglo XXI (CORPES). – URL: https://www.rae.es/banco-de-datos/corpes-xxi

integratsiyasiga (TPACK)[28] tayangan raqamli-madaniyatlararo fasilitatorlik faoliyati.

Talabalarning madaniyatlararo kognitiv dunyoqarashini baholash uchun 2-jadvalda keltirilgan diagnostik tizim ishlab chiqildi.

2-jadval

Madaniyatlararo kognitiv dunyoqarashni baholash mezonlari, ko‘rsatkichlari va vositalari

Mezon	Ko‘rsatkichlar	Diagnostika vositalari
Kognitiv-madaniy bilimlarning mazmuniyligi	Ispan tilida so‘zlashuvchi xalqlar tarixi, qadriyatlari, me’yorlari haqidagi bilimlar; konsept mazmunini ochib bera olish	Lingvomadaniy test, konsept tahlili topshirig‘i
Madaniyatlararo tafakkurning qiyosiyligi	O‘xshashlik va farqlarni asoslash; stereotiplarni aniqlash va tahlil qilish	Qiyosiy esse rubrikasi, “madaniy assimilyator” keyslari
Aksiologik munosabatning barqarorligi	Ochiqlik, hurmat va bag‘rikenglik; milliy o‘zlikni anglash	Madaniyatlararo sezgirlik shkalasi, so‘rovnoma
Kommunikativ faoliyatning samaradorligi	Kontekstga mos strategiyalar; onlayn muloqot va mediatsiya	Virtual almashinuvni kuzatish, CEFR deskriptorlari asosidagi rubrika
Refleksivlik darajasi	O‘z qarashlaridagi o‘zgarishlarni anglash va asoslash	Refleksiv kundalik, e-portfolio kontent-tahlili

Aksiologik mezonni baholashda G.-M.Chen va W.J.Starosta ishlab chiqqan madaniyatlararo sezgirlik shkalasidan[29], kommunikativ mezonni baholashda CEFR qo‘shimcha jildidagi onlayn muloqot va mediatsiya deskriptorlaridan[30] foydalaniladi. Natijalar uch daraja orqali talqin qilinadi: *fragmentar* (past) daraja – madaniy bilimlar tarqoq, baholash etnosentrik; *qiyosiy* (o‘rta) daraja – talaba madaniyatlarni qiyoslaydi, biroq farqlarni asosan tashqi belgilar bilan izohlaydi; *integrativ* (yuqori) daraja – talaba madaniy hodisalarni ularning ichki mantiqidan kelib chiqib talqin qiladi, etnorelativ pozitsiyada turadi va madaniyatlar o‘rtasida vositachilik qila oladi.

Taklif etilgan model mavjud tajribadan uch jihati bilan farqlanadi: birinchidan, raqamli vositalar alohida emas, balki kognitiv sikl bosqichlariga biriktirilgan holda qo‘llaniladi; ikkinchidan, qiyoslash ona madaniyatiga tayangan

[28] Mishra P., Koehler M.J. Technological Pedagogical Content Knowledge: A framework for teacher knowledge // Teachers College Record. – 2006. – Vol. 108, No. 6. – P. 1017-1054.
[29] Chen G.-M., Starosta W.J. The development and validation of the Intercultural Sensitivity Scale // Human Communication. – 2000. – Vol. 3. – P. 1-15.
[30] Council of Europe. Common European Framework of Reference for Languages: Learning, Teaching, Assessment. Companion Volume. – Strasbourg: Council of Europe Publishing, 2020. – P. 84-87, 90-122.

holda, ispan va o‘zbek madaniyatlari kesimida olib boriladi; uchinchidan, sun’iy intellekt vositalari mustaqil bilim manbai emas, balki autentik manbalar bilan tekshiriladigan suhbatdosh-simulyator vazifasini bajaradi. Modelning samaradorligini pedagogik tajriba-sinov asosida tekshirish tadqiqotning navbatdagi bosqichini tashkil etadi.

Xulosa

Ispan tili ta’limida talabalarning madaniyatlararo kognitiv dunyoqarashini shakllantirish raqamli vositalarni tizimsiz qo‘llash orqali emas, balki ularni maqsadli, mazmuniy, jarayonli, texnologik va natijaviy bloklardan iborat yaxlit model doirasida izlash, tahlil, qiyoslash, talqin va refleksiv baholash bosqichlariga biriktirish orqali samarali amalga oshiriladi. Modelning natijadorligi autentik kontent, dialogik ta’lim, individual va hamkorlikdagi faoliyat uyg‘unligi, refleksiya hamda o‘qituvchining raqamli-madaniyatlararo fasilitatorligidan iborat shart-sharoitlarga bog‘liq. Ishlab chiqilgan diagnostik tizim talabalar dunyoqarashidagi o‘zgarishlar dinamikasini kuzatish va ta’lim jarayoniga o‘z vaqtida tuzatishlar kiritish imkonini beradi. Model materiallaridan amaliy ispan tili, mamlakatshunoslik va lingvokulturologiya fanlari mashg‘ulotlarida foydalanish tavsiya etiladi.

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TOPONIMIKA: TIL, TARIX VA GEOGRAFIK TADQIQOTLAR UYG'UNLIGI

Annotatsiya. *Ushbu tezisda toponimika fanining tilshunoslik, tarix va geografiya fanlari bilan uzviy bog'liqligi hamda uning tutash sohalardagi tadqiqot predmeti tahlil qilingan. Toponimikaning fan sifatidagi predmeti, vazifalari, toponimlarning asosiy turlari (oykonim, gidronim, oronim va boshqalar) hamda O'zbekiston, jumladan Qashqadaryo vohasi toponimiyasidagi tarixiy-lisoniy qatlamlar yoritilgan. Toponimlarning nafaqat geografik obyektlarni nomlash vositasi, balki xalq tarixi, tili va madaniyati haqidagi muhim manba ekanligi asoslangan.*

Kalit so'zlar*: toponimika, onomastika, toponim, oykonim, gidronim, oronim, mikrotoponim, geografik nom, til qatlami, joy nomlari.*

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TOPONYMY: THE INTERPLAY OF LANGUAGE, HISTORY, AND GEOGRAPHICAL RESEARCH

Annotation. *This thesis analyzes the close interrelation of toponymy with linguistics, history and geography, as well as the subject of research of this science at the junction of these disciplines. It highlights the subject and tasks of toponymy as a science, the main types of toponyms (oikonyms, hydronyms, oronyms, etc.), and the historical-linguistic layers of the toponymy of Uzbekistan, including the Qashqadaryo oasis. It is substantiated that toponyms are not only a means of naming geographical objects but also an important source of information about the history, language and culture of a people.*

Keywords*: toponymy, onomastics, toponym, oikonym, hydronym, oronym, microtoponym, geographical name, language layer, place names.*

Kirish. Har qanday geografik obyekt — tog', daryo, aholi punkti, ko'cha yoki dala — o'ziga xos nomga ega bo'lib, bu nomlar tasodifiy vujudga kelmaydi, balki ma'lum til qonuniyatlari, tarixiy jarayonlar va geografik xususiyatlar asosida shakllanadi. Mana shu nomlarni — toponimlarni — o'rganuvchi fan toponimika deb ataladi. Toponimika tilshunoslik, tarix va geografiya fanlarining manfaatlari tutashgan bo'g'inida joylashgan bo'lib, u geografik nomlarning kelib chiqishi, ma'nosi, tuzilishi va tarqalish qonuniyatlarini tadqiq etadi. Ushbu tezisning maqsadi toponimikaning fanlararo mohiyatini ochib berish, uning tilshunoslik, tarix va

geografiya bilan aloqadorlik nuqtalarini ko‘rsatish hamda O‘zbekiston toponimiyasining o‘ziga xos xususiyatlarini tahlil qilishdan iborat.

Toponimika — onomastikaning bir bo‘limi bo‘lib, geografik nomlarni, ya’ni toponimlarni har tomonlama o‘rganadi. Fanning predmetini toponimlarning etimologiyasi (kelib chiqishi), semantikasi (ma’no xususiyatlari), struktura-so‘z yasalish qonuniyatlari, geografik tarqalishi hamda tarixiy taraqqiyoti tashkil etadi. Toponimikaning asosiy vazifalari qatoriga quyidagilar kiradi: toponimlarning etimologik tahlilini amalga oshirish; ularni tuzilishi va ma’nosiga ko‘ra tasniflash; geografik nomlar xaritasini (toponimik xaritalarni) yaratish; nomlarning me’yoriy-imloviy jihatdan to‘g‘ri qo‘llanilishini ta’minlash (nomlarni standartlashtirish); shuningdek, tarixiy nomlarni qayta tiklash va muhofaza qilish. Fan sifatida toponimika XX asrning ikkinchi yarmidan boshlab mustaqil tadqiqot sohasi sifatida shakllandi, biroq geografik nomlarga qiziqish qadimdan mavjud bo‘lgan [1, 7-b.].

Toponimlar, avvalambor, lisoniy hodisa bo‘lib, ular ma’lum bir tilning leksik-grammatik qonuniyatlari asosida shakllanadi. Shu sababli toponimika tilshunoslikning uzviy tarkibiy qismi hisoblanadi. Geografik nomlarni tahlil qilish orqali tilning tarixiy taraqqiyoti, fonetik o‘zgarishlari, so‘z yasalish usullari va leksik qatlamlari haqida qimmatli ma’lumotlarga ega bo‘lish mumkin. Ko‘pgina toponimlarda hozirgi adabiy tilda iste’moldan chiqqan arxaik so‘zlar, dialektal shakllar yoki substrat tillarga oid izlar saqlanib qolgan bo‘ladi, bu esa tilshunoslarga qadimgi til qatlamlarini tiklashda muhim manba bo‘lib xizmat qiladi [5, 14-b.]. Masalan, ko‘plab gidronim va oronimlarning tarkibida sug‘diy, baqtriy yoki boshqa qadimgi Sharq tillariga xos elementlar uchraydi, ular hozirgi turkiy va forsiy nomlar bilan qorishib ketgan.

Toponimlar — o‘ziga xos “tarixiy hujjat” bo‘lib, ular orqali o‘tmishdagi xalqlar, elatlar, urug‘-qabilalar, ko‘chish jarayonlari, xo‘jalik faoliyati va diniy e’tiqodlar haqida ma’lumot olish mumkin. Ko‘pgina joy nomlari qadimgi qabila va urug‘ nomlaridan (etnotoponimlar), hukmdorlar yoki mashhur shaxslar nomidan, shuningdek muayyan tarixiy voqealar bilan bog‘liq holda kelib chiqqan. Ma’muriy-siyosiy o‘zgarishlar ham toponimiyada o‘z izini qoldiradi: sovet davrida ko‘plab tarixiy nomlar mafkuraviy nomlar bilan almashtirilgan bo‘lsa, mustaqillik yillarida esa xalqning tarixiy xotirasini tiklash maqsadida asl nomlar qayta tiklanmoqda [3, 26-b.]. Shu bois toponimikani tarix fani uchun muhim yordamchi manbalardan biri deb hisoblash mumkin, chunki yozma manbalarda saqlanmagan ko‘plab ma’lumotlar aynan joy nomlarida “muzlab qolgan” holda saqlanadi.

Toponimlarning katta qismi bevosita geografik obyektlarning tabiiy xususiyatlarini — relyefi, gidrologik sharoiti, o‘simlik qoplami, iqlimi yoki joylashuvini aks ettiradi. Shu jihatdan toponimika geografiya fani, xususan, kartografiya bilan chambarchas bog‘liq: har qanday xarita geografik nomlarsiz to‘liq bo‘la olmaydi, nomlarning to‘g‘ri va izchil qo‘llanilishi esa xaritalarning ilmiy-amaliy qiymatini belgilaydi. Toponimlar orqali hududning geografik xususiyatlarini — masalan, botqoqlik, tepalik, o‘rmonlik yoki cho‘l ekanligini — bilib olish mumkin, bu esa geografik tadqiqotlar, hududiy rejalashtirish va turizm sohasida amaliy ahamiyat kasb etadi [6, 33-b.]. Shuningdek, toponimlarning

hududiy tarqalish qonuniyatlarini o‘rganish orqali tabiiy-geografik zonalashtirish va aholi joylashuvi tarixini aniqlashtirish mumkin.

Ifodalanadigan obyekt turiga ko‘ra toponimlar bir necha guruhlarga bo‘linadi: oykonimlar — aholi punktlari nomlari (Toshkent, Qarshi, Buxoro); gidronimlar — suv obyektlari nomlari (Amudaryo, Zarafshon, Qashqadaryo); oronimlar — relyef shakllari nomlari (Chotqol, Hisor, Ustyurt); dromonimlar — yo‘l va marshrutlar nomlari; drimonimlar — o‘rmon va daraxtzorlar nomlari; agroonimlar — dala va ekin maydonlari nomlari. Bundan tashqari, hudud ko‘lamiga ko‘ra makrotoponimlar (yirik hududlar, davlat va viloyat nomlari) va mikrotoponimlar (mahalliy ahamiyatga ega kichik obyektlar — buloq, tepalik, ko‘cha nomlari) farqlanadi [2, 41-b.].

O‘zbekiston, jumladan Qashqadaryo vohasi toponimiyasi bir necha tarixiy-lisoniy qatlamdan tashkil topgan. Eng qadimgi qatlamni sug‘diy-baqtriy va boshqa Sharqiy Eron tillariga oid substrat nomlar tashkil etadi, ular asosan yirik daryo va tog‘ nomlarida saqlanib qolgan. Undan keyingi davrda turkiy qatlam shakllangan bo‘lib, u hozirgi kunda toponimiyaning asosiy qismini tashkil etadi va aholi punktlari, tog‘lar, suv manbalari nomlarida yaqqol namoyon bo‘ladi. Forscha-tojikcha qatlam savdo-madaniy aloqalar va qo‘shni xalqlar bilan yaqin aloqalar natijasida shakllangan bo‘lsa, arabcha qatlam islom dini bilan bog‘liq nomlarda o‘z aksini topgan. Rus-sovet davri qatlami esa asosan mafkuraviy va ma’muriy xarakterdagi nomlardan iborat bo‘lib, mustaqillik yillarida ularning katta qismi tarixiy-milliy nomlar bilan almashtirildi [4, 52-b.]. Bu qatlamlarning har biri xalqning etnik tarixi, ko‘chish jarayonlari va madaniy aloqalarini o‘rganishda qimmatli manba bo‘lib xizmat qiladi.

Toponimika tilshunoslik, tarix va geografiya fanlarining manfaatlari tutashgan bo‘g‘inda joylashgan bo‘lib, geografik nomlarni har tomonlama — lisoniy, tarixiy va geografik nuqtai nazardan — o‘rganish orqali xalqning o‘tmishi, tili va tabiiy muhiti haqida boy ma’lumot beradi. O‘zbekiston toponimiyasining ko‘p qatlamli tarkibi mamlakat tarixining murakkab va boy ekanligidan dalolat beradi. Shu sababli toponimlarni ilmiy asosda tadqiq etish, ularning imlosi va qo‘llanilishini standartlashtirish, shuningdek tarixiy nomlarni asrab-avaylash — nafaqat tilshunoslar va geograflar, balki tarixchilar uchun ham dolzarb vazifa bo‘lib qolmoqda.

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ONA O‘LIMIDA QOG‘ANOQ SUVLAR ELEMENTLARI BILAN EMBOLIYANING GISTOLOGIK JIHATLARI

Annotatsiya: *Qog‘anoq suvlari bilan emboliya – tug‘ruqdagi ayol qon tomir tizimiga amniotik suyuqlikni tushishi natijasidagi patologik holat bo‘lib, shok, nafas yetishmovchiligi, gipoksiya, koagulopatiya rivojlanishi bilan xarakterlanadi.*

Kalit so‘zlar: *qog‘anoq suvlari, homiladorlarni anafilaktoid sindromi, DVS sindrom.*

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HISTOPATHOLOGICAL FEATURES OF AMNIOTIC FLUID DEBRIS EMBOLISM IN MATERNAL MORTALITY

Abstract: *Amniotic fluid embolism is a pathological condition resulting from the entry of amniotic fluid into the maternal vasculature during labor. It is characterized by the development of shock, respiratory failure, hypoxia, and coagulopathy.Tashkent, Uzbekistan.*

Keywords: *amniotic fluid, anaphylactoid syndrome of pregnancy, disseminated intravascular coagulation (DIC).*

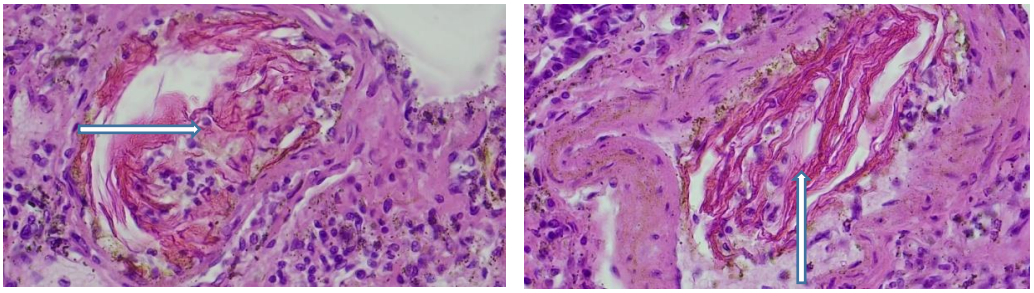
Mavzuning dolzarbligi: Bugungi kunda qog‘anoq suvlari bilan emboliya onalar o‘limi strukturasida 10% ni tashkil qiladi, bu patologiyada o‘lim ko‘rsatkichi yuqori bo‘lib, 80-90% ga yetadi, 50% dan ortiq homilalar esa asfiksiya yoki distresss sindrom rivojlanishi oqibatida vafot etadi. Qog‘anoq suvlari bilan emboliya – homiladorlik va tug‘ruqning xavfli oqibatlarga olib keluvchi oldindan

aytib bo‘lmaydigan asoratidir. U kam sezilarli simptomlardan to ona o‘limiga olib keladigan yurakning to‘satdan to‘xtashigacha bo‘lgan turli ko‘rinishda namoyon bo‘lishi mumkin. Tashxis ko’pincha istisno usuli bilan qo’yiladi.

Qog‘anoq suvlari - tarkibida tuzlar, gormonlar, enzimlar, vitaminlar, biologik aktiv moddalar (serotonin, gistamin, prostoglandin), tromboplastin va homila hayot faoliyati mahsulotlarini saqlovchi murakkkab kimyoviy tarkibga ega bo‘lgan kolloid eritma bo‘lib, uning tarkibi homiladorlik muddati, ona va homila organizmlari holatiga bog‘liq holda o‘zgarib boradi. Qon tomir tizimiga qog‘anoq suvlarni o‘tishi bachadon yoki bachadon bo‘yni yirtilishi, kesar kesish operatsiyasi, pardalar rivojlanishi anomaliyalari, amnion va ona qon tomirlari orasida patologik bog‘liklik bo‘lganda ro‘y beradi. Mazkur patologiyani rivojlanish omillariga yo‘ldoshning zich birikishi, me’yoriy joylashgan yo‘ldoshni erta ko‘chishi, hamda ko‘psuvlilik, ko‘phomilalik, tez tug‘ruq faoliyati, homila pufagini kech ochilishi va bachadon atoniyasida rivojlanuvchi bachadon ichi gidrostatik bosimi ortishi kiradi [1;29]. Qog‘anoq suvlari bilan emboliyada shikastlangan qon tomirlardan homila oldi suvlari qon tomir tizimiga o‘tadi va pastki kovak vena orqali yurak o‘ng bo‘lmachasiga, u yerdan o‘pka arteriyasiga boradi hamda o‘pkaning yirik va mayda qon tomirlarida mexanik obstruksiyaga olib keladi, bu esa o‘z navbatida o‘pka perfuziyasini buzilishi, vazokonstriksiya, o‘pka arteriyasida bosim ortishi, o‘ng qorincha yetishmovchiligiga sabab bo‘ladi. Homila oldi suvlari tarkibida tromboplastinsimon, antifibrinolitik faollikka ega bo‘lgan moddalar prokoagulyant tizimni faollashtirib DVS sindrom rivojlanishiga olib keladi, bu asorat ko‘pincha tug‘ruq jarayoning oxirida kuzatiladi. Onaning qon tomir tizimiga qog‘anoq suvining tushishi qon plazmasida bronxokonstriktor, hamda o‘pka va koronar vazokonstriktor bo‘lgan endotelin konsentratsiyasini oshiradi, bu esa respirator va yurak qon tomir kollapsini chaqirishi mumkin [2;10]. Shuningdek so‘nggi paytlarda qog‘anoq suvlari bilan emboliya amniotik suyuqlik tarkibidagi biologik faol moddalarga anafilaksiya, shuningdek “homiladorlarni anafilaktoid sindromi ” sifatida ko‘rib chiqilmoqda. Homila oldi suvlari bilan emboliya jarayoni ikki bosqichda kechadi. Ona qon tizimiga vazoaktiv substansiyalarni tushishi birinchi bosqichni turtki mexanizmi hisoblanadi, bu o‘pka arteriyalarni spazmi, gipoksiya, og‘ir darajali o‘pka gipertenziyasi va o‘ng qorincha yetishmovchiligiga olib keladi, boshlang‘ich bosqichda onalar o‘limi 50% atrofini tashkil qiladi. Ikkinchi bosqich o‘pka arteriyasi, o‘pka kapillyarilari, markaziy venoz bosimni ortirishi va o‘pka shishi bilan xarakterlanuvchi chap qorincha yetishmovchiligi va gemodinamik o‘zgarishlar bilan boshlanadi. Endogen mediatorlarni (prostoglandin, leykotrien, gistamin, bradikinin, sitokin, tromboksan, trombotsitlarni faollashtiriruvchi omillar) chiqishiga ona organizmini reaksiyasi – gemodinamik buzilishlar, koagulopatiya va DVS sindrom rivojlanishi, keyinchalik o‘pka qon tomirlarini amniotik suyuqlik bilan embolizatsiyasi, prokoagulyant tizimni faollashuvi bilan xarakterlanadi, bu esa sirkulyator kollapsga olib keladi. Sud-tibbiy ekspertlar qog‘anoq suvlari bilan emboliyani isbotlash va qog‘anoq suvlari bilan emboliyani yuzaga kelish mexanizmini aniqlash zaruriyatiga duch kelishadi. Homila oldi suvlari bilan emboliyani sud tibbiy tashxislashda kasallik tarixi, autopsiya protokoli va gistologik

tekshiruv ma’lumotlarini tahlili muhim ahamiyat kasb qiladi [3;49]. Makroskopiyada o‘pka vazni ortishi bilan tasdiqlanuvchi o‘pka shishi xos bo‘lib, o‘pkalar xamirsimon konsistensiyada, yuzasi to‘q olcha rangda, ba’zi joylarda pushti rangli sohalar bilan, kesib ko‘rilganda ko‘piklanuvchi pushti rangli suyuqlik aralash suyuq qon oqishi kuzatiladi. Mikroskopik tekshiruvda o‘pka mikrosirkulyator o‘zanining to‘laqonligi, interstitsial va alveolyar shishning morfologik ekvivalenti - ko‘plab alveolalar bo‘shlig‘i va interstitsiyda pushti rangi suyuqli to‘planishi, nafas faoliyatini o‘tkir buzilishini tasdiqlovchi – ko‘plab distelektaz o‘choqlari, kompensator emfizema va bronxiolospazm, shuningdek mayda va o‘rta kalibrdagi o‘pka arteriyalari, alveolalararo to‘siqlar kapillyarlarida amniotik suyuqlik elementlari – muguzlanuvchi epiteliy hujayralari, tukchalar, mekoniy va amorf massalar topiladi, o‘pkadagi patomorfologik o‘zgarishlar o‘limga sabab bo‘luvchi massiv interstitsial va interalveolyar shish chaqirgan o‘pka arteriyalarining homila oldi suvlari bilan emboliyasi natijasidagi homiladorlik anafilaktoid sindromi rivojlanishining morfologik komponenti hisoblanadi. O‘tkir yurak yetishmovchiligi miokardning o‘tkir shikastlanishi va kengayishiga olib keladi, bu gistologik tekshiruvda kardiomiotsitlarning to‘lqinsimon kechishi, fragmentatsiyasi va o‘choqli ishemik nekrozlari bilan namoyon bo‘ladi. Bachadon to‘qimasini mikroskopik tekshiruvida aksariyat qon tomirlarini bo‘shligi, ayrimlarida esa homila oldi suvlari elementlari ko‘riladi. DVS-sindrom bosh miya va parenximatoz a’zolar mikrosirkulyator o‘zan qon tomirlarida staz, sladj, mikroangiopatiya, mikropolitromboz, in’eksiya joylardagi teri qoplamlari, ichki a’zolar parenxima va stromasi, shilliq va seroz qavatlarga ko‘plab nuqtali va o‘zaro qo‘shiluvchi qon quyilishlar bilan namoyon bo‘ladi, oshqozon, ingichka va yo‘g‘on ichaklar shilliq qavatlarida o‘tkir eroziyalar paydo bo‘ladi, bosh miyada perivaskulyar shish va miya moddasini bo‘kishi, ensefalomalyatsiya o‘choqlari, yurak bo‘shligi, yirik qon tomirlar bo‘shlig‘ida suyuq qon qoldiqlari, gemoperikard, gemoperitoneum aniqlanadi. Ba’zi holatlarda subtotal nekronefroz, pankreonekroz, gepatotsitlarning sentrolobulyar nekrozlari, buyrak usti bezi po‘stloq qavati hujayralarining degranulyatsiyasi va mag‘iz qavatida gemorragik nekroz o‘choqlari ko‘riladi. Bizning amaliyotmizda uchragan qog‘anoq suvlar elementlari bilan emboliya holatini misol tariqasida keltiramiz: 34 yoshli ayol, akusherlik kompleksida vafot etgan. Dastlabki sud – tibbiy tashxis: Asosiy: Jigar gepatozi – fibrozli sirrozga o‘tishi. Ikki tomonlama bronxopnevmoniya, o‘ng tomonlama yopishqoq plevrit. Bachadon bo‘yniga qon quyilishi, yo‘ldosh chetining ko‘chishi. Qorin devori, ikkala bilak va oyoq sohalari teri ostiga petixial qon quyilishi. Asosiy kasallik asorati: Ichki a’zolar kamqonligi, bosh miya va o‘pka shishi, o‘tkir yurak qon tomir yetishmasligi. DVS? Qog‘anoq suvidan emboliya? Hamrox: Homiladorlik–2, tug‘ruq-1, 39-hafta, tug‘ruqdan keyingi qon ketish, epiziotomiyadan keyingi choklangan yara. Gepatosplenomegaliya. Yurak ishemik kasalligi. Ingichka va yog‘on ichaklar yallig‘lanishi. Tibbiy hujjatlari bo‘yicha “psixonevrologik kasalliklar” bilan ro‘yxatda turgan. Sud – gistologik tekshiruvda quyidagilar aniqlandi: O‘pkalarda qog‘anoq suvlari elementlari bilan emboliya – o‘pka arteriyalarida homila oldi suvlari elementlari, ayrim bronxiolalarning spazmi,

yirik o‘choqlarda o‘tkir emfizema, Sudan – III bilan bo‘yalgan o‘pka to‘qimasi mayda qon tomir kapillyarlarida yog‘ emboliyasining kuchsiz darajasini gistologik belgilari; yurakda kardiomiotsitlarning gipoksik distrofiyasi, tarqalgan o‘tkir fragmentatsiyasi; bosh miya, miyacha yumshoq pardasi va moddasida shish, neyronlarning distrofik o‘zgarishlari; a’zolarda gemodinamikaning o‘tkir buzilishi, o‘tkir distrofik o‘zgarishlar; №№1,2 raqamlangan “O‘ng o‘pka ildiz sohasidan namunalar”da o‘choqlarda o‘tkir emfizema, o‘choqli oraliq pnevmoniya; №№3,4 raqamlangan “Qizilo‘ngach shilliq qavati boshlang‘ich sohasidan namunalar”da qizinlo‘ngachda qon quyilish belgilari aniqlanmadi; №1 raqamlangan “Yo‘ldoshning qon quyilgan sohasidan namuna”da xorial plastinka sohasida o‘choqli, mayda o‘choqli qon quyilishlar; №1A raqamlangan “Bachadon”miometriysida kamqonlik, oraliq to‘qimada shish; №2,№2A raqamlangan “Bachadon bo‘yni qon quyilgan sohasidan namunalar”da ko‘lamdor, tarqalgan qon quyilishlar leykotsitlar aralashmasi, eritrotsitlarning gemolizi bilan; hamrox: yurak ishemik kasalligining gistologik belgilari; o‘pkalarda oraliq, mayda o‘choqli leykotsitli pnevmoniya; jigarda disseminilashgan yog‘li gepatoz.



1,2-rasm. O‘pka to‘qimasi qon tomirlarida qog‘anoq suvlari elementlari (oq ko‘rsatkich bilan ko‘rsatilgan). Bo‘yash gematoksilin – eozin bilan, X400

Xulosa: Sud tibbiyot amaliyotida qog‘anoq suvlari bilan emboliya tekshirish uchun murakkab hisoblangan onalar o‘limining sabablaridan biridir. Qog‘anoq suvlari bilan emboliyada gistologik tekshiruv muhim ahamiyat kasb qiladi, shu bilan birga gistologik tekshiruv natijalari klinik va tanatogenetik ma’lumotlari bilan o‘zaro bog‘liq ravishda interpretatsiya qilinishi kerak.

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THE EFFECTIVENESS OF ARTIFICIAL INTELLIGENCE PROGRAMS IN ORGANIZING FOREIGN LANGUAGE LESSONS

Abstract. *The rapid development of artificial intelligence (AI) has created new opportunities for improving the organization and effectiveness of foreign language education. AI-based programs can support teachers in lesson planning, language assessment, vocabulary development, pronunciation practice, writing correction, individualized learning, and the creation of interactive educational materials. This article examines the effectiveness of artificial intelligence programs in organizing foreign language lessons and analyzes their potential to improve students' linguistic competence and learning motivation. The study is based on an analysis of contemporary pedagogical approaches and research findings concerning the integration of AI into language education.*

Keywords: *artificial intelligence, foreign language education, AI programs, language learning, digital education, personalized learning, adaptive learning, language competence, educational technology, artificial intelligence tools.*

Introduction. The development of digital technologies has significantly transformed the educational process. In particular, the emergence of artificial intelligence has introduced new approaches to teaching and learning foreign languages. Traditional foreign language lessons are increasingly complemented by digital platforms, intelligent tutoring systems, automated assessment tools, speech-recognition applications, and conversational AI systems. These technologies provide learners with opportunities to practice language skills beyond the traditional classroom environment.

Foreign language learning requires continuous practice in several areas, including listening, speaking, reading, writing, vocabulary acquisition, grammar development, and pronunciation. However, teachers often face difficulties in providing individualized feedback to every learner within a limited lesson period. Artificial intelligence can partially address this problem by providing immediate feedback, adapting tasks to learners' abilities, generating additional exercises, and facilitating personalized learning trajectories.

Literature Review. The application of artificial intelligence in education has attracted considerable attention from researchers and educational institutions. Contemporary studies emphasize that AI can contribute to personalized learning, automated assessment, intelligent tutoring, and the development of digital learning environments.

One of the major advantages of AI-supported education is its ability to personalize the learning process. Intelligent systems can analyze learners' responses and adjust instructional materials according to individual performance.

The effectiveness of AI-supported foreign language instruction is considered in relation to three main criteria: **pedagogical effectiveness, learner engagement, and individualization of instruction**.

Artificial intelligence programs can support almost every stage of a foreign language lesson. Their effectiveness depends largely on how appropriately teachers integrate them into the pedagogical process. One of the most practical applications of AI is the generation of lesson plans and teaching materials. AI systems can help teachers develop lesson objectives, classroom activities, discussion questions, vocabulary exercises, reading texts, writing tasks, and assessment questions.

For example, a teacher can provide an AI system with information about students' language level, lesson duration, topic, and learning objectives. The system can then suggest a sequence of activities appropriate for the target group.

Thus, AI contributes to differentiated instruction and supports the creation of individualized learning pathways. Vocabulary acquisition is one of the most important components of foreign language learning. AI applications can generate personalized vocabulary lists, example sentences, quizzes, flashcards, and contextual exercises.

AI can also identify words that a learner frequently misunderstands or forgets and recommend additional practice. Context-based vocabulary learning is especially effective because students encounter new words in meaningful sentences rather than memorizing isolated lexical units.

For example, instead of simply presenting the word *environment*, an AI system can generate different contexts:

- environmental protection;
- environmental problems;
- environmental policy;
- environmental awareness.

This approach enables learners to understand not only the meaning of a word but also its collocations and communicative functions.

AI tools can provide explanations of grammatical structures and generate exercises at different difficulty levels. When a learner makes a grammatical mistake, an AI system can identify the error and explain the relevant rule.

For instance, if a student writes *"She go to university every day,"* an AI system can identify the subject-verb agreement problem and provide the corrected form: *"She goes to university every day."*

The main advantage is immediate feedback. Students do not necessarily have to wait until the teacher checks their work.

An effective pedagogical approach is not to allow AI to write the entire assignment for the learner but to use AI-generated feedback as a basis for revision. In this model, students remain responsible for producing the original text while AI functions as a feedback mechanism.

For example, an AI system can indicate that a paragraph lacks coherence and suggest the use of linking expressions. The learner can then revise the paragraph independently.

This approach encourages metacognitive awareness and develops students' ability to evaluate their own writing.

The effectiveness of AI in organizing foreign language lessons

The effectiveness of AI-supported foreign language instruction can be analyzed through several pedagogical indicators.

Area	**Traditional approach**	**AI-supported approach**
Lesson planning	Mainly teacher-centered	Teacher + AI-assisted planning
Feedback	Often delayed	Frequently immediate
Individualization	Limited by class size	Highly adaptable
Speaking practice	Limited classroom time	Additional simulated practice
Vocabulary	General word lists	Personalized vocabulary
Writing	Teacher correction	Automated + teacher feedback
Assessment	Periodic	Continuous monitoring possible
Independent learning	Relatively limited	Expanded through AI tools

The comparison demonstrates that AI can significantly expand the possibilities of foreign language instruction. Nevertheless, technological effectiveness should not be confused with pedagogical effectiveness. The presence of AI itself does not guarantee improved learning outcomes. The quality of implementation, task design, teacher guidance, and learner engagement remain essential.

Discussion. The integration of artificial intelligence changes the traditional structure of foreign language lessons. Instead of spending a considerable amount of classroom time on routine explanations and mechanical exercises, teachers can use AI to provide supplementary practice and devote more time to communicative activities, critical thinking, collaborative tasks, and individual support.

One of the most significant advantages of AI is **immediate feedback**. Learners can identify and correct mistakes while the learning process is still active. This can contribute to more effective learning and reduce the accumulation of persistent errors.

Conclusion. Artificial intelligence represents one of the most promising technological developments in contemporary foreign language education. AI-based programs can significantly improve the organization of lessons by supporting lesson planning, personalized instruction, language practice, automated feedback, assessment, and independent learning.

The greatest pedagogical value of AI lies in its ability to provide learners with additional opportunities for individualized and continuous practice. In particular, conversational AI and speech-recognition technologies can help overcome the limitations of classroom time and provide students with more opportunities to communicate in the target language.

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INGLIZ TILINI O‘RGANISHDA ENG KO‘P QO‘LLANILADIGAN USULLAR VA ULARNING SAMARADORLIGI

Annotatsiya: *Ushbu maqolada ingliz tilini o‘rganishda keng qo‘llaniladigan zamonaviy va an’anaviy metodologik yondashuvlar hamda ularning samaradorligi tahlil qilingan. Tadqiqotda kommunikativ yondashuv (CLT), til muhitiga to‘liq sho‘ng‘ish (Immersion), interval takrorlash (SRS), grammatik-tarjima hamda leksik yondashuv kabi asosiy metodlarning o‘ziga xos xususiyatlari, afzalliklari va amaliyotda qo‘llanilishi yoritib berilgan. Maqola yakunida til o‘rganuvchilarning individual imkoniyatlaridan kelib chiqqan holda metodlarni kompleks ravishda uyg‘unlashtirish bo‘yicha amaliy tavsiyalar berilgan.*

Kalit so‘zlar: *ingliz tili, metodologiya, kommunikativ yondashuv, immersion metodi, interval takrorlash, leksik yondashuv, til to‘sig‘i, og‘zaki nutq, samaradorlik.*

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THE MOST COMMONLY USED METHODS OF LEARNING ENGLISH AND THEIR EFFECTIVENESS

Annotation (abstract): *This article analyzes modern and traditional methodological approaches commonly used in learning the English language, alongside their effectiveness. The study highlights the features, advantages, and practical applications of key methods such as the Communicative Language Teaching (CLT) approach, total immersion, Spaced Repetition System (SRS), grammar-translation, and the lexical approach. In conclusion, practical recommendations are provided for combining these methods comprehensively based on the individual needs and abilities of language learners.*

Keywords: *English language, methodology, communicative approach, immersion method, spaced repetition, lexical approach, language barrier, speaking skills, efficiency.*

Hozirgi kunda axborot texnologiyalari va ilm-fan jadal rivojlanib borayotgan, xalqaro integratsiya jarayonlari kengaygan davrda xorijiy tillarni, xususan, ingliz tilini o‘zlashtirish zarurati har qachongidan ham dolzarb ahamiyat kasb etmoqda. Ingliz tili global miqyosda muloqot, ilm-fan, biznes, zamonaviy texnologiyalar va diplomatiya tiliga aylangani sababli, uni mukammal egallashga bo‘lgan ehtiyoj yildan-yilga ortib bormoqda. Shu bois, ta’lim oluvchilar oldida

turgan asosiy vazifalardan biri — tilni eng qisqa muddatda va yuqori samaradorlik bilan o‘rganish imkonini beruvchi optimal metodologiyani tanlashdir.

Biroq amaliyot shuni ko‘rsatmoqdaki, til o‘rganish jarayoni har doim ham bir maromda kechmaydi. Ko‘plab o‘rganuvchilar uzoq vaqt davomida grammatik qoidalarni yod olishlariga qaramay, real muloqot jarayonida "til to‘sig‘i" (language barrier) va fikrni erkin bayon eta olmaslik kabi muammolarga duch kelishadilar. Bu holat an’anaviy o‘qitish usullari bilan bir qatorda zamonaviy, interaktiv va kognitiv yondashuvlarni chuqur o‘rganish hamda ularni amaliyotga tatbiq etish zaruriyatini yuzaga keltiradi. Zamonaviy lingvodidaktika va metodika fanida tilni o‘qitishning turli yo‘nalishlari ishlab chiqilgan bo‘lib, ularning har biri o‘ziga xos afzallik va cheklovlarga ega.

Mazkur tadqiqot ishining **asosiy maqsadi** — ingliz tilini o‘rganishda amaliyotda eng ko‘p qo‘llaniladigan zamonaviy va an’anaviy metodologik yondashuvlarni qiyosiy tahlil qilish, ularning o‘ziga xos xususiyatlari, samaradorlik darajasi hamda qo‘llanish doirasini yoritib berishdan iboratdir.

Ushbu maqsadga erishish uchun quyidagi **vazifalar** belgilandi:

- Til o‘qitish metodikasida keng qo‘llaniladigan asosiy yondashuvlarni tasniflash va ularning nazariy asoslarini ochib berish;
- Kommunikativ yondashuv (CLT), immersion (til muhitiga to‘liq sho‘ng‘ish) metodi va interval takrorlash tizimlarining (SRS) o‘ziga xos afzalliklarini tahlil qilish;
- O‘rganuvchilarning individual psixologik va kognitiv xususiyatlaridan kelib chiqqan holda eng maqbul usullarni tanlash bo‘yicha ilmiy-metodik tavsiyalar ishlab chiqish.

Tadqiqotning **ilmiy ahamiyati** shundan iboratki, unda keltirilgan tahlillar va tavsiyalar mustaqil ravishda ingliz tilini o‘rganayotgan shaxslar, shuningdek, pedagoglar uchun o‘quv jarayonini yanada samarali tashkil etishda amaliy ko‘mak beradi.

Bugungi globallashuv davrida xorijiy tillarni, xususan, ingliz tilini mukammal egallash zamonaviy mutassislar va izlanuvchilar uchun birlamchi ehtiyojga aylandi. Til o‘rganish jarayonini tezlashtirish va uning natijadorligini oshirish maqsadida turli metodologik yondashuvlar qo‘llaniladi. Quyida amaliyotda eng ko‘p uchraydigan va yuqori samaradorlik ko‘rsatgan metodlar tahlil qilinadi.

1. Kommunikativ yondashuv (Communicative Language Teaching - CLT)

Ushbu metodologiyaning asosiy maqsadi — nazariy qoidalarni yodlashdan ko‘ra, tilni bevosita muloqot vositasi sifatida ishlatishdir.

- **Mohiyati:** Boshlang‘ich bosqichidanoq tinglovchi e’tibori erkin so‘zlashish, interaktiv mashqlar va real vaziyatlarni simulyatsiya qilishga qaratiladi.
- **Afzalligi:** Til to‘sig‘ini (language barrier) tezda yengishga va og‘zaki nutq kompetensiyasini shakllantirishga yordam beradi.

2. Immersion metodi (Til muhitiga to‘liq sho‘ng‘ish)

O‘rganuvchining kunlik hayotida makon va media-makonni ingliz tili bilan qamrab olishga asoslanadi.

• **Mohiyati:** Gadjetlar interfeysini ingliz tiliga o‘tkazish, filmlarni original tilda tomosha qilish, podkastlar eshitish va kundalik qaydlarni inglizcha yuritishni o‘z ichiga oladi.

• **Afzalligi:** Tilni tabiiy ravishda, xuddi ona tilini o‘zlashtirgandek, intuitiv darajada idrok etish imkonini beradi.

3. Interval takrorlash va Mnemonika usuli

Leksik bazani (so‘z boyligini) kengaytirish uchun mo‘ljallangan ilmiy-amaliy usul.

• **Mohiyati:** Yangi so‘zlarni **Spaced Repetition System (SRS)** algoritmlari (masalan, Anki, Quizlet dasturlari) hamda assotsiativ xotira (mnemonika) orqali ma’lum vaqt intervallarida takrorlab borish.

• **Afzalligi:** Ma’lumotlarni qisqa muddatli xotiradan uzoq muddatli xotiraga samarali o‘tkazadi.

4. Grammatik-tarjima metodi (Grammar-Translation Method)

An’anaviy usullardan biri bo‘lib, asosan akademik muhitda matnlarni tahlil qilish va qoidalarni chuqur o‘rganishda ishlatiladi.

• **Mohiyati:** Matnlarni so‘zma-so‘z tarjima qilish, grammatik strukturani mantiqiy tahlil qilish va yozma mashqlarni bajarish.

• **Afzalligi:** Yozma savodxonlikni hamda murakkab matnlarni tushunish ko‘nikmasini rivojlantiradi (lekin og‘zaki nutqni rivojlantirishda sustroq).

5. Lexical Approach (Leksik yondashuv)

Tilni alohida so‘zlar yig‘indisi emas, balki tayyor iboralar va turg‘un birikmalar (chunks, collocations) majmui sifatida o‘rganish.

• **Mohiyati:** Grammatik qoidalarga ortiqcha urg‘u bermay, tilda eng ko‘p ishlatiladigan tayyor iboralar va kassetalarni o‘zlashtirish.

• **Afzalligi:** Nutqning ravonligi va tabiiyligini sezilarli darajada oshiradi.

Xulosa: Til o‘rganish jarayonida yagona universal metod mavjud emas. Eng yuqori natijaga erishish uchun individual xususiyatlarni hisobga olgan holda **kommunikativ yondashuv** va **immersion metodini** o‘zaro uyg‘unlashtirib qo‘llash tavsiya etiladi.

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QUVURLARDAGI IKKI FAZALI MUHITDA VAQTINCHALIK HARAKAT

Annotatsiya: *Ushbu maqola filtrlash uchun suv yo‘qotilishini hisobga olgan holda turbulent beqaror harakatni (ikki o‘lchovli holat) tavsiflovchi differentsial tenglamalar tizimini yechish yo‘llari yoritiladi. Variatsion-farq usuli qo‘llaniladi va sonli natijalar keltiriladi.*

Kalit so‘zlar: *kvazy bir o‘lchovli vaqtinchalik harakat, quvurlardagi ikki fazali muhit, gidravlik qarshilik, quvurlar kesishgan maydoni, Laplas transformatsiyasi, qutblar.*

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TRANSIENT FLOW OF A TWO-PHASE MEDIUM IN PIPELINES

Annotation: *This article solves systems of differential equations that describe turbulent unsteady motion (two-dimensional case), taking into account water losses due to filtration. The variational-difference method is applied and numerical results are presented.*

Keywords: *quasi-one-dimensional transient motion, two-phase media in pipes, hydraulic resistance, pipe cross-sectional area, Laplace transform, poles.*

Kirish.

Ushbu maqolada, ikki fazali muhitning kvaziyali bir o‘lchovli beqaror harakatining tenglamalari gidravlik qarshilik (1) hisobga olingan holda kvazistatsion gipotezani qo‘llash asosida olingan.

ADABIYOTLAR TAHLILI VA METODOLOGIYA

Silindrsimon trubadagi ikki fazali suyuqlikning harakat tenglamalari (2) shaklga ega ekanligi ma'lum.

$$\rho_1 \frac{\partial u_1}{\partial t} = f_1 \mu_1 \left(\frac{\partial^2 u_1}{\partial r^2} + \frac{1}{r} \frac{\partial u_1}{\partial r} \right) + k(u_2 - u_1) - f_1 \frac{\partial p}{\partial z}, \quad (1)$$

$$\rho_2 \frac{\partial u_2}{\partial t} = f_2 \mu_2 \left(\frac{\partial^2 u_2}{\partial r^2} + \frac{1}{r} \frac{\partial u_2}{\partial r} \right) + k(u_1 - u_2) - f_2 \frac{\partial p}{\partial z}, \quad (2)$$

Bu yerda $\mu_1, \mu_2, \rho_1, \rho_2$ – birinchi va ikkinchi fazalarning yopishqoqligi va zichligi;

f_1, f_2 – g‘ovakliligi; k -o‘zaro ta'sir koeffitsienti.

MUHOKAMA VA NATIJALAR

(1) va (2) tengliklarni ko‘paytirib $2\pi f_1 f_2 rdr$ va 0 dan R gacha integrallab, (2) dan foydalanib, oddiy o‘zgarishlardan keyin biz quyidagi natijani olamiz

$$-f_1^2 f_2 \frac{\partial p}{\partial z} = f_2\rho_1 \frac{\partial W_1}{\partial t} - f_1 f_2 \mu_1 A_1 W_1 - k(f_1 W_2 - f_2 W_1). \quad (3)$$

$$-f_2^2 f_1 \frac{\partial p}{\partial z} = f_1\rho_2 \frac{\partial W_2}{\partial t} - f_1 f_2 \mu_2 A_2 W_2 - k(f_2 W_1 - f_1 W_2). \quad (4)$$

Bu yerda,

$$A_1 = \frac{\alpha_1^0 \frac{mI_1(mR)}{I_0(mR)} - \frac{kR}{2 f_1 f_2 \mu_1 \mu_2}}{\alpha_1^0 \frac{I_1(mR)}{mI_0(mR)} + \left(\frac{kR^2}{8 f_1 f_2 \mu_1 \mu_2} - \alpha_1^0\right)}; \; A_2 = \frac{\alpha_2^0 \frac{mI_1(mR)}{I_0(mR)} - \frac{kR}{2 f_1 f_2 \mu_1 \mu_2}}{\alpha_2^0 \frac{I_1(mR)}{mI_0(mR)} + \left(\frac{kR^2}{8 f_1 f_2 \mu_1 \mu_2} - \alpha_2^0\right)};$$

$$\alpha_1^0 = \frac{1}{f_1\mu_1 + f_2\mu_2} - \frac{1}{\mu_1}; \; \alpha_2^0 = \frac{1}{f_1\mu_1 + f_2\mu_2} - \frac{1}{\mu_2};$$

W_1, W_2 – birinchi va ikkinchi fazalarning o‘rtacha tezligi.

Ikki fazali muhit uchun doimiylik tenglamasi quyidagi shaklga ega

$$\frac{\partial p_i}{\partial t} + \frac{\partial(\rho_i u_i)}{\partial r} + \frac{\partial(\rho_i u_i)}{\partial z} + \frac{\rho_i u_i}{r} = 0, \; (i = 1,2). \quad (5)$$

(5) ni $2\pi f_i rdr$ ga ko‘paytirib va 0 dan R gacha integrallab, har bir tarkibiy qism uchun alohida, quyidagilarni yozamiz

$$f_1 s \frac{\partial \rho_1}{\partial t} + \frac{\partial M_1}{\partial z} = 0. \quad (6), \; f_2 s \frac{\partial \rho_2}{\partial t} + \frac{\partial M_2}{\partial z} = 0. \quad (7)$$

Bu yerda $M_i = 2\pi f_i \int_0^R \rho_i u_i rdr$ – massa xarajatlari, s- truba kesimining yuzi.

Aytaylik, aralashmaning o‘rtacha zichligi va trubaning maydoni uchun Гук qonuni amal qiladi $\rho_{cm} = \rho_0\left(1 + \frac{p - p_0}{K_{ж}}\right)$, $s = s_0\left(1 + \alpha \frac{p - p_0}{E}\right)$,

Bu yerda ρ_0 - p_0 bosim zichligi s_0 - $p = p_0$. bo‘lgandagi yuza. $K_{ж}$ - suyuqlikni siqish moduli, E-elastiklik moduli, α - o‘lchovsiz koeffitsient. (1) tenglamaga ko‘ra $\alpha \frac{(p - p_0)^2}{K_{ж} E}$, bundan, $\rho_{cm} s = s_0\rho_0\left[1 + \left(\frac{1}{K_{ж}} + \frac{a}{E}\right)(p - p_0)\right]$. (8)

(6) va (7) ni qo‘shib, (8) ni hisobga olgan holda va ba'zi o‘zgarishlardan keyin quyidagini yozamiz

$$-\frac{1}{c^2}\frac{\partial p}{\partial t}=\frac{\partial(\rho_1 W_1)}{\partial z}+\frac{\partial(\rho_2 W_2)}{\partial z}.(9),\ \text{bu yerda}\ \ c^2=\frac{k}{\rho_0},\ k=\frac{K_{ж}}{1+a\dfrac{K_{ж}}{E}}$$

(3), (4) va (9) tenglamalar - bu ikki fazali muhitning o‘rtacha tezligi, zichligi va bosimi kesishishlariga taalluqli kvazyozometrik harakat.

Olingan tenglamalar, gaz quvurining boshida va oxirida bosim yoki suyuqlik oqimining o‘zgarishini o‘rganish, shuningdek, ikki fazali muhit $(k,\mu,\rho$ va boshqalar) parametrlarini aniqlash uchun teskari muammolarni yechishda qiziqish uyg‘otadi.

Quvurlardagi ikki fazali muhitning beqaror harakati masalasini yechishni ko‘rib chiqamiz, buning uchun (3), (4) va (9) tenglamalarni quyidagicha yozamiz:

$$-\frac{\partial p}{\partial t}=\frac{\rho_1}{f_1^2}\left(\frac{\partial W_1}{\partial t}+a_1W_1+b_1W_2\right),\ -\frac{\partial p}{\partial t}=\frac{\rho_2}{f_2^2}\left(\frac{\partial W_2}{\partial t}+b_2W_1+a_2W_2\right),(10)$$

$$-\frac{\partial p}{\partial t}=c_2\left(\rho_1\frac{\partial W_1}{\partial z}+\rho_2\frac{\partial W_2}{\partial z}\right),\ \text{где}\quad a_1=\frac{k-f_1\mu_1A_1}{\rho_1},\ a_2=\frac{k-f_2\mu_2A_2}{\rho_2},$$

$$b_1=-\frac{kf_1}{\rho_1(1-f_1)},\ b_2=-\frac{kf_2}{\rho_2(1-f_2)}.$$

Biz boshlang‘ich va chegara sharoitida (10) sistema uchun yechimni qidirmoqdamiz:

$$W_1(z,0)=W_2(z,0)=0,\ p(z,0)=0,\ p(0,t)=\varphi(t),\ W_1(l,t)=f(t),\ (11)$$

Bu yerda $\varphi(t)$, $f(t)$-ma'lum farqlanadigan funktsiyalar Laplas transformatsiyasi hisoblanadi.

t, c o‘zgaruvchilari bo‘yicha Laplas qoidasini (10) tenglamaga qo‘llab (II) hisobga olib, biz quyidagini yozamiz

$$\left.\begin{aligned}
&-\frac{\partial p}{\partial z}=\frac{\rho_1}{f_1^2}(s+a_1)W_1(z,s)+\frac{\rho_1 b_1}{f_1^2}W_2(z,s)\\
&-\frac{\partial p}{\partial z}=\frac{p_2 b_2}{f_2^2}W_1(z,s)+\frac{p_2}{f_2^2}(s+a_2)W_2(z,s)\qquad (12),\\
&-sp=c^2\left(\rho_1\frac{\partial W_1}{\partial z}+\rho_2\frac{\partial W_2}{\partial z}\right)
\end{aligned}\right\}$$

$$p(0,c)=\Phi(s);\quad W_1(\ell,s)=F(s).\ (13)$$

(12) sistemaning birinchi ikki tenglamasidan topamiz

$$W_1=-\frac{\partial p}{\partial z}\cdot\frac{\Delta_1}{\Delta};\ W_2=-\frac{\partial p}{\partial z}\cdot\frac{\Delta_2}{\Delta};(14)$$

bu yerda

$$\Delta(s)=\alpha_1 s^2+\alpha_2 s+\alpha_3;\ \Delta_1(s)=\beta_1 s+\beta_2;\ \Delta_2(s)=c_1 s+c_2,\ \alpha_1=\frac{\rho_1\rho_2}{f_1^2 f_2^2};\ \alpha_2=\alpha_1(a_1+a_2);$$

$$\alpha_3=(a_1a_2-b_1b_2),\ \ \beta_1=\frac{\rho_2}{f_2^2};\ \beta_2=\frac{\rho_2 a_2}{f_2^2}-\frac{\rho_1 b_1}{f_1^2};\ \ c_1=\frac{\rho_1}{f_1^2};\ c_2=\frac{\rho_1 a_1}{f_1^2}-\frac{\rho_2 b_2}{f_2^2}.$$

(14) sistemadan $W_2=\frac{\Delta_2}{\Delta_1}W_1=\frac{c_1 s+c_2}{\beta_1 s+\beta_2}W_1$ или $W_2=\frac{c_1}{\beta_1}W_1+\frac{c_2\beta_1-c_1\beta_2}{\beta_1^2}\cdot\frac{1}{s+\frac{\beta_2}{\beta_1}}.W_1.$

undan kelib chiqadiki, $W_1(z,t)$ va $W_2(z,t)$ asl nusxalar funktsional munosabatlar bilan bog‘langan

$$W_2(z,t)=\frac{c_1}{\beta_1}W_1(z,t)+\frac{c_2\beta_1-c_1\beta_2}{\beta_1^2}\int_0^1 e^{-\frac{\beta_2}{\beta_1}(t-\tau)}W_1(z,\tau)d\tau. \qquad (15)$$

(12) sistemaning uchinchi tenglamasini (14) ga qo‘yamiz $\frac{\partial^2 p}{\partial z^2}-\lambda^2 p=0.$ u holda $P(z,s)=Ae^{\lambda z}+Be^{-\lambda z}$, , $W_1(z,s)=\frac{\lambda\Delta_1}{\Delta}\left(-Ae^{\lambda z}+Be^{-\lambda z}\right)$.

Bu yerda $\lambda(s)=\frac{1}{c}\sqrt{\frac{\alpha_1 s^3+\alpha_2 s^2+\alpha_3 s}{\gamma_1 s+\gamma_2}}$, (16)

$\gamma_1=\rho_1\beta_1+\rho_2 c_1;\ \gamma_2=\rho_1\beta_2+\rho_2 c_2.$ (13) shart bizga Ava B o‘zgarmaslarni topishga yordam beradi:

$$A+B=\Phi(s);\ \frac{\lambda\Delta_1}{\Delta}\left(-Ae^{\lambda\ell}+Be^{-\lambda\ell}\right)=F(s),$$

$$A=\Phi(s)-\Phi(s)\frac{e^{\lambda\ell}}{2ch\lambda\ell}-\frac{\Delta}{\lambda\Delta_1}\cdot\frac{1}{2ch\lambda\ell}F(s).\ B=\Phi(s)\frac{e^{\lambda\ell}}{2ch\lambda\ell}+\frac{\Delta}{\lambda\Delta_1}\cdot\frac{1}{2ch\lambda\ell}F(s).$$

Topshiriqlarning yechimi quyidagi ko‘rinishga ega:

$$P(z,s)=s\Phi(s)\frac{ch\lambda(\ell-z)}{sch\lambda\ell}-sF(s)\frac{\Delta}{\lambda\Delta_1}\frac{sh\lambda z}{sch\lambda\ell},$$

$$W_1(z,s)=s\Phi(s)\frac{\lambda\Delta_1}{\Delta}\frac{sh\lambda(\ell-z)}{sch\lambda\ell}+sF(s)\frac{sh\lambda z}{sch\lambda\ell},(17)$$

Tasvirlar uchun asl nusxalar $S\Phi(s)$ va $SF(s)$ vazifalari mavjud $\varphi'(t)$ va $f'(t)$, va tasvirlar mahsuloti asl nusxalarning yaxlit yig‘ilishiga mos keladi.

(17) da turgan $S\Phi(s)$ va $SF(s)$ omillarni tahlil qilish kerak.

$\frac{ch\lambda(\ell-z)}{sch\lambda\ell}$, $\frac{sh\lambda z}{sch\lambda\ell}$ funksiyalar tenglamaning ildizlariga mos keladigan oddiy S_η qutblarga ega, $ch[\lambda(s)\ell]=0$ (18)

$S_0 = 0$, qutb va funktsiyalar $\frac{\Delta}{\lambda\Delta_1}\frac{sh\lambda z}{sch\lambda\ell}, \frac{\lambda\Delta_1}{\Delta}\frac{sh\lambda(\ell - z)}{sch\lambda\ell}$, (19)

qutblardan tashqari mos ravishda $S = -\frac{\beta_2}{\beta_1}$ va $S = -\frac{\gamma_2}{\gamma_1}$

Darhaqiqat, $\frac{\lambda\Delta_1}{\Delta s}\frac{sh\lambda(\ell - z)}{ch\lambda\ell} = \frac{\lambda^2\Delta_1}{\Delta s}\frac{sh\lambda(\ell - z)}{\lambda ch\lambda\ell} = \frac{\beta_1 s + \beta_2}{\gamma_1 s + \gamma_2}\cdot\frac{sh\lambda(\ell - z)}{\lambda ch\lambda\ell}\cdot s \neq 0$, qiymat buning uchun $\lambda(s) = 0$ funktsiyasi uchun (19) qutb emas, chunki $\lim_{\lambda\to 0}\frac{sh\lambda z}{\lambda} = z$.(18) dan esa $\cos i\lambda\ell = 0$. bundan $\lambda^2 + \left(\frac{\pi}{2\ell}\right)^2 (2n-1)^2 = 0$; n=1,2,… (20)

Qutblar S_η (20) tenglama yechimlari bo‘lib, bunda u (16) tenglik bilan aniqlanadi.

Ushbu funktsiyalarning qoldiqlarini hisoblab, konvolyutsiya teoremasini qo‘llasak, masalaning yechimini asl nusxada topamiz.

$$p(z,t) = \varphi(t) - \frac{\alpha_3 z}{\beta_2} f(t) + \frac{\Delta\left(-\frac{\beta_2}{\beta_1}\right) sh\left[\lambda\left(-\frac{\beta_2}{\beta_1}\right) z\right]}{\beta_2\lambda\left(-\frac{\beta_2}{\beta_1}\right) ch\left[\lambda\left(-\frac{\beta_2}{\beta_1}\right)\ell\right]}\cdot\int_0^t f'(\tau) e^{-\frac{\beta_2}{\beta_1}(t-\tau)} d\tau +$$

$$-\frac{2}{\pi}\sum_{k=1}^{\infty}\frac{(-1)^{k-1} i}{2k-1}\cdot\frac{\Delta(S_k)}{S_k\Delta_1(S_k)}\cdot\frac{\sin\left[\frac{\pi z}{2\ell}(2k-1)\right]}{\frac{d\lambda(S_k)}{ds}}\cdot\int_0^t f'(\tau) e^{S_k(t-\tau)} d\tau;$$

$$W_1(z,t) = f(t) + \frac{(\gamma_1\beta_2 - \gamma_2\beta_2) sh\left[\lambda\left(-\frac{\gamma_2}{\gamma_1}\right)(\ell - z)\right]}{c^2\gamma_1^2\lambda\left(-\frac{\gamma_2}{\gamma_1}\right) ch\left[\lambda\left(-\frac{\gamma_2}{\gamma_1}\right)\ell\right]}\cdot\int_0^t \varphi'(\tau) e^{-\frac{\gamma_2}{\gamma_1}(t-\tau)} d\tau +$$

$$+\sum_{k=1}^{\infty}\frac{(-1)^{k-1} i\cos\left[\frac{\pi z}{2\ell}(2k-1)\right]}{\ell\cdot S_k\frac{\alpha\lambda(S_k)}{ds}}\int_0^t f'(\tau) e^{S_k(t-\tau)} dt +$$

$$+\frac{2}{\pi c^2}\sum_{k=1}^{\infty}\frac{(-1)^{k-1}}{2k-1}\cdot\frac{\beta_1 S_k + \beta_2}{\gamma_1 S_k + \gamma_2}\sin\left[\frac{\pi}{2}\left(1 - \frac{z}{\ell}\right)(2k-1)\right]\int_0^t \varphi'(\tau) e^{S_k(t-\tau)} d\tau;$$

Ikkinchi fazaning tezligi (15) tenglikdan aniqlanadi.

XULOSA

Muammoning aniq yechimidan bir qator amaliy masalalarni ko‘rib chiqishda foydalanish mumkin, masalan, suv bosimi, quvurlardagi bosim o‘zgarishi.

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ВЛИЯНИЕ ГЛАВНОГО ЮЖНО-КАРАКАЛПАКСКОГО КОЛЛЕКТОРА НА МЕЛИОРАТИВНОЕ СОСТОЯНИЕ ОРОШАЕМЫХ ЗЕМЕЛЬ БЕРУНИЙСКОГО РАЙОНА

Аннотация: *В статье рассматривается роль Главного Южно-Каракалпакского коллектора (ГЮКК) в регулировании водно-солевого режима орошаемых земель Берунийского района Республики Каракалпакстан. Особое внимание уделено изменению условий отвода коллекторно-дренажных вод, уровней грунтовых вод и мелиоративного состояния сельскохозяйственных земель. Строительство ГЮКК было направлено на изменение схемы отвода грунтово-сбросных и коллекторно-дренажных вод с территории южных районов Каракалпакстана.*

Ключевые слова: *ГЮКК, коллекторно-дренажные воды, грунтовые воды, орошаемые земли, мелиоративное состояние, засоление почв, водно-солевой режим.*

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IMPACT OF THE MAIN SOUTH KARAKALPAKSTAN COLLECTOR ON THE RECLAMATION STATUS OF IRRIGATED LANDS IN THE BERUNIY DISTRICT

Abstract: *This article examines the role of the Main South Karakalpakstan Collector (MSKC) in regulating the water-salt regime of irrigated lands in the Beruniy District of the Republic of Karakalpakstan. Particular attention is paid to changes in the conditions for the discharge of collector-drainage waters, groundwater levels, and the reclamation status of agricultural lands. The construction of the MSKC was aimed at altering the drainage scheme for groundwater runoff and collector-drainage waters from the southern districts of Karakalpakstan.*

Key words: *MSKC, collector-drainage waters, groundwater, irrigated lands, reclamation status, soil salinization, water-salt regime.*

Введение

Рациональное управление водными ресурсами в аридных условиях Каракалпакстана особенно важно для орошаемых земель нижнего течения Амударьи, где интенсивное земледелие способствует подъёму грунтовых вод и вторичному засолению почв. Берунийский район является важной сельскохозяйственной территорией правобережья Амударьи, а его мелиоративное состояние определяется эффективностью оросительной и коллекторно-дренажной систем. Особое значение имеет Главный Южно-Каракалпакский коллектор (ГЮКК), предназначенный для отвода коллекторно-дренажных вод Турткульского, Элликкалинского и Берунийского районов. В 2007 г. его трасса была сформирована на основе русла Акчадарьи, что позволило изменить направление стока и сократить поступление грунтово-сбросных вод в Амударью через Берунийский коллектор.

Цель исследования — оценить влияние функционирования ГЮКК на мелиоративное состояние орошаемых земель Берунийского района,

Материалы и методы

Материалами исследования послужили данные о работе коллекторно-дренажной системы южных районов Каракалпакстана, объёмах коллекторно-дренажного стока и расходах воды, а также сведения о мелиоративном состоянии орошаемых земель Берунийского района.

Основное внимание уделено периоду строительства и начального функционирования Главного Южно-Каракалпакского коллектора (ГЮКК), когда произошло изменение направления отвода коллекторно-дренажного стока. В 2006–2007 гг. за пределы орошаемой территории было отведено соответственно 666,5 и 642,6 млн м³ стока, что составляло 44 и 51 % объёма водозабора. Среднемесячные расходы коллекторно-дренажных вод варьировали от 6,0 м³/с в сентябре 2008 г. до 34,5 м³/с в марте 2006 г.

Оценка мелиоративного эффекта ГЮКК проведена с использованием системного подхода, учитывающего взаимосвязь водозабора, орошения, фильтрации, формирования грунтовых вод, коллекторно-дренажного стока и его отвода за пределы орошаемой территории.

Основными показателями оценки являлись глубина залегания и минерализация грунтовых вод, признаки вторичного засоления, эффективность коллекторно-дренажной сети, объём отводимого стока и сезонная динамика расходов воды в коллекторах. Исходные данные позволяют оценить основные направления гидромелиоративных изменений. Вместе с тем для количественной оценки степени улучшения мелиоративного состояния земель необходимы многолетние данные о динамике уровня и минерализации грунтовых вод, а также засолённости почв Берунийского района.

Результаты и обсуждение

До строительства ГЮКК значительная часть грунтово-сбросных и коллекторно-дренажных вод через Берунийский коллектор поступала в

Амударью. Изменение направления стока повысило эффективность дренажа и регулирования уровня грунтовых вод. Важным показателем работы системы является объём коллекторно-дренажного стока, отводимого за пределы орошаемой территории (Таблиц 1).

Таблица 1.

Объёмы коллекторно-дренажного стока из проектной зоны

Год	Объём коллекторно-дренажного стока, млн м³	Доля от водозабора, %
2023	666,5	44
2024	642,6	51

Из таблицы видно, что ежегодно за пределы орошаемой территории отводились значительные объёмы коллекторно-дренажного стока. В 2023 г. его абсолютный объём снизился по сравнению с 2024 г., однако доля в общем водозаборе увеличилась с 44 до 51 %, что подтверждает важную роль дренажной системы в регулировании водного баланса и предотвращении подъёма грунтовых вод. Среднемесячные расходы стока в исследуемый период варьировали от 6,0 до 34,5 м³/с, отражая сезонные и гидрологические особенности (Таблица 2).

Таблица 2.

Характеристика среднемесячных расходов коллекторно-дренажных вод

Показатель	Значение
Минимальный среднемесячный расход	6,0 м³/с
Максимальный среднемесячный расход	34,5 м³/с
Амплитуда изменения	28,5 м³/с
Соотношение максимального и минимального расхода	около 5,8 раза

Значительная сезонная изменчивость дренажного стока обусловлена режимом орошения, фильтрационными и гидрологическими условиями. Максимальный расход отмечен в марте 2023 г., минимальный — в сентябре 2018 г.; снижение стока в 2018 г. связано с маловодностью и дноуглубительными работами. Важным результатом функционирования ГЮКК стало улучшение отвода избыточных вод и увеличение глубины залегания грунтовых вод, что снижает риск капиллярного подъёма солей, вторичного засоления и переувлажнения почв.

ГЮКК выполняет не только функцию отвода дренажных вод, но и регулирует водно-солевой режим орошаемых земель. Эффективное снижение уровня грунтовых вод создаёт предпосылки для улучшения мелиоративного состояния земель Берунийского района. При этом объективная оценка требует учёта минерализации грунтовых вод, электропроводности почвенного раствора, содержания хлоридов и сульфатов и динамики солевого баланса.

В целом функционирование ГЮКК оказывает положительное влияние на коллекторно-дренажную систему, способствуя отводу избыточного стока, поддержанию глубокого залегания грунтовых вод и снижению риска вторичного засоления. Повышение эффективности системы требует

регулярной очистки и дноуглубления коллекторов, контроля пропускной способности и автоматизированного мониторинга стока.

Заключение

Проведённый анализ показал, что строительство Главного Южно-Каракалпакского коллектора (ГЮКК) стало важным этапом совершенствования региональной системы отвода коллекторно-дренажных вод. ГЮКК изменил существующую схему отвода грунтово-сбросных вод и обеспечил направление значительной части стока за пределы орошаемой территории. В 2006–2007 гг. объём отведённого коллекторно-дренажного стока составил соответственно 666,5 и 642,6 млн м³, или 44 и 51 % от объёма водозабора. При этом среднемесячные расходы характеризовались значительной сезонной изменчивостью — от 6,0 до 34,5 м³/с.

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АНАЛИЗ КАРТОГРАФИЧЕСКИХ МЕТОДОВ, ПРИМЕНЯЕМЫХ В ГЕОГРАФИЧЕСКОМ ОБРАЗОВАНИИ ЗАРУБЕЖНЫХ СТРАН

Аннотация. *В статье проведен сравнительный анализ картографических методов, применяемых в географическом образовании Германии, Великобритании, Франции, США, Японии, Южной Кореи и ряда стран СНГ. Цель исследования состоит в выявлении методических подходов, которые обеспечивают развитие картографической грамотности, пространственного мышления и географических компетенций обучающихся. Использованы сравнительно-педагогический анализ, контент-анализ научно-методической литературы и нормативно-образовательных материалов, а также систематизация практик работы с картами и цифровыми геоданными. Показано, что современная картографическая подготовка постепенно переходит от чтения готовой карты к работе с интерактивными картами, ГИС, дистанционными данными и исследовательскими проектами, ориентированными на объяснение пространственных связей и решение практических задач. Сформулированы направления адаптации международного опыта для географического образования Узбекистана с учетом национального содержания, технических возможностей школ и необходимости повышения квалификации педагогов.*

Ключевые слова: *географическое образование, картографический метод, картографическая грамотность, пространственное мышление, интерактивные карты, ГИС, цифровая картография.*

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ANALYSIS OF CARTOGRAPHIC METHODS USED IN GEOGRAPHY EDUCATION IN FOREIGN COUNTRIES

Abstract. *The article presents a comparative analysis of cartographic methods used in geography education in Germany, the United Kingdom, France, the United States, Japan, South Korea, and selected CIS countries. The study aims to identify methodological approaches that support the development of cartographic literacy, spatial thinking, and geographic competencies. The research applies comparative pedagogical analysis, content analysis of scientific, methodological and educational materials, and systematization of practices related to maps and digital geodata. The results show a transition from reading ready-made maps to using interactive maps, GIS, remote sensing data, and inquiry-based projects for explaining spatial relationships and solving practical problems. The article proposes directions for adapting international experience to geography education in Uzbekistan while considering national curriculum content, school technology capacity, and teacher professional development.*

Keywords: *geography education, cartographic method, cartographic literacy, spatial thinking, interactive maps, GIS, digital cartography.*

ВВЕДЕНИЕ

Современное географическое образование развивается в условиях быстрого обновления цифровых картографических средств, геоинформационных технологий и открытых пространственных данных. Поэтому вопросы использования карт в учебном процессе уже не ограничиваются демонстрацией местоположения объектов. Карта становится средством постановки учебной проблемы, анализа территориальных различий, выявления причинно-следственных связей и аргументации выводов. Особенно значимым это становится в системе повышения квалификации учителей, где необходимо не только осваивать новые цифровые инструменты, но и понимать их педагогическое назначение.

В Узбекистане подготовка специалистов в области географии и картографии, развитие цифрового образования и повышение информационно-технологических компетенций педагогов входят в число приоритетных направлений модернизации образования. В стратегии «Цифровой Узбекистан – 2030» обозначена необходимость широкого внедрения современных информационно-коммуникационных технологий в систему образования, формирования цифровой образовательной среды и повышения цифровых компетенций педагогических кадров [1]. В связи с этим международный опыт применения картографических методов представляет не только теоретический, но и практический интерес для обновления методики преподавания географии.

Цель исследования - на основе сравнительного анализа выявить основные модели применения картографических методов в географическом образовании зарубежных стран и определить направления их методически

обоснованной адаптации к условиям Узбекистана. Для достижения цели решались задачи: раскрыть современное понимание картографического метода; сопоставить практики работы с картами и цифровыми геоданными в разных национальных системах; обобщить опыт стран СНГ; выделить методические элементы, способствующие развитию картографической грамотности и пространственного мышления.

МАТЕРИАЛЫ И МЕТОДЫ

Исследование носит обзорно-аналитический характер. Материалами послужили научно-педагогические работы по географическому и пространственному образованию, национальные образовательные стандарты и программы, а также официальные образовательные и картографические ресурсы Германии, Великобритании, Франции, США, Японии, Южной Кореи, Казахстана, Кыргызстана, Узбекистана, Таджикистана и Туркменистана [2–15]. Применялись сравнительно-педагогический метод, качественный контент-анализ, систематизация и интерпретация методических практик.

Для визуального обобщения зарубежных кейсов дополнительно использовано простое качественное кодирование пяти типов деятельности, прямо зафиксированных в рассматриваемых описаниях: 1) анализ и сопоставление карт; 2) применение ГИС и веб-карт; 3) использование материалов дистанционного зондирования; 4) проектная или исследовательская работа; 5) решение прикладных территориальных либо риск-ориентированных задач. Наличие признака кодировалось значением 1, отсутствие явного упоминания - 0. Полученный показатель используется только для визуализации широты описанных практик и не является рейтингом качества национальных систем образования.

РЕЗУЛЬТАТЫ И ОБСУЖДЕНИЕ

1. Картографический метод как средство пространственного познания

В зарубежной научно-педагогической литературе картографический метод трактуется не как пассивное средство иллюстрации, а как активный способ познания и исследования. Содержание географии непосредственно связано с пространством, местоположением, территориальными различиями, взаимосвязями и динамикой процессов, поэтому карта выступает одним из основных инструментов формирования географического мышления. Картографические методы позволяют обобщать и систематизировать сведения об объектах и явлениях, переводить разрозненные факты в пространственную модель и тем самым развивать способность обучающегося видеть структуру территории.

Немецкая школа географической дидактики рассматривает работу с картой как один из ключевых механизмов формирования географического мышления: обучающийся учится выявлять причинно-следственные связи между территориальными объектами, понимать пространственные структуры и интерпретировать их [2]. В британской традиции картографическая деятельность тесно связана с компетентностным подходом, поскольку работа с картами развивает не только предметные знания, но и критическое

мышление, переработку информации и принятие решений в проблемных ситуациях [3]. Американские исследования связывают картографическую подготовку с развитием пространственного мышления, которое повышает осмысленность и устойчивость географических знаний [4; 5].

В этом контексте картографическая грамотность может быть определена как способность читать, анализировать, сопоставлять и оценивать карты, извлекать из них пространственную информацию и создавать простые картографические продукты. В современном образовании данный набор умений дополняется работой со слоями ГИС, веб-картами, цифровыми моделями и открытыми геоданными. Таким образом, карта становится одновременно источником данных, моделью территории и инструментом учебного исследования.

В школах Германии широко применяются чтение топографических и тематических карт, сопоставление карт для территориального анализа, построение картограмм на основе статистических данных, небольшие ГИС-проекты и ментальные карты. Например, при изучении размещения промышленности в Европе учащиеся могут сопоставлять карты Германии, Франции и Польши и определять влияние сырьевого, транспортного и рыночного факторов. Такая работа формирует последовательность «извлечение информации - сравнение - объяснение - вывод» [2].

В Великобритании картографические методы встроены в компетентностную модель географического образования. В учебной практике используются интерактивные карты, Google Maps, ArcGIS Online, снимки дистанционного зондирования и проектное обучение. При изучении повышения уровня моря учащиеся могут анализировать спутниковые изображения и цифровые карты прибрежных территорий, выделять потенциально уязвимые зоны и обсуждать территориальные последствия. Значение подобной работы состоит в объединении картографического чтения, анализа данных и аргументированного объяснения пространственного риска.

Во Франции карты используются для изучения территориального развития, демографических изменений, размещения экономической деятельности и пространственного проявления социальных процессов [6]. В этом подходе особенно заметна роль карты как средства синтеза: обучающийся сопоставляет несколько характеристик территории и формулирует связное географическое объяснение.

В США картографические методы последовательно соединяются с цифровыми данными. Учащиеся анализируют по цифровым картам температуру, осадки, атмосферное давление и направления ветра, связывают эти показатели с глобальными климатическими изменениями и региональными экологическими проблемами. При изучении географии землетрясений учащиеся наносят очаги сейсмичности на ГИС-карты, сопоставляют их с границами литосферных плит и анализируют зоны повышенного риска, включая разлом Сан-Андреас и Тихоокеанское огненное

кольцо [5; 7]. Такой формат развивает наблюдение, объяснение закономерностей и навыки работы с природными рисками.

В Японии картографическая подготовка характеризуется вниманием к точности пространственных данных и практическому анализу природных опасностей. Высокоточные топографические карты используются для изучения рельефа, геологического строения и территориальных различий. Особое место занимают карты землетрясений, вулканической активности и цунами: учащиеся определяют опасные зоны, оценивают возможные последствия и обсуждают действия в чрезвычайных ситуациях [8].

В Южной Корее картографические методы развиваются в цифровой образовательной среде. Электронные учебники, интерактивные карты и мультимедийные средства позволяют учащимся анализировать транспортные системы, плотность населения, промышленные центры и экологические проблемы с использованием компьютеров и планшетов. Сочетание цифровых карт и самостоятельных учебных исследований повышает прикладной характер географических знаний и способствует формированию исследовательской компетентности [9].

ТАБЛИЦА 1

СРАВНИТЕЛЬНАЯ ХАРАКТЕРИСТИКА КАРТОГРАФИЧЕСКИХ ПРАКТИК В ЗАРУБЕЖНЫХ СИСТЕМАХ ГЕОГРАФИЧЕСКОГО ОБРАЗОВАНИЯ

Страна	Основные инструменты и методы	Тип учебной деятельности	Формируемый результат
Германия	Топографические и тематические карты; картограммы; ментальные карты; мини-проекты в ГИС	Территориальное сравнение и выявление причинно-следственных связей	Картографическая грамотность, пространственный анализ
Великобритания	Интерактивные карты; Google Maps; ArcGIS Online; спутниковые изображения; проектное обучение	Анализ проблемной территории и зон риска	Критическое мышление, работа с цифровыми данными, решение задач
Франция	Карты территориального развития, демографии, экономики и социальных процессов	Сопоставление территориальных характеристик	Территориальный синтез и интерпретация
США	Цифровые метеокарты; ГИС-карты сейсмичности; сопоставление с тектоникой	Анализ природных процессов и опасностей	Пространственное и экологическое мышление, прогнозирование риска
Япония	Высокоточные топографические карты;	Анализ рельефа и природных опасностей	Риск-грамотность, пространственная

	карты землетрясений, вулканов и цунами		точность, безопасность
Южная Корея	Электронные учебники; интерактивные карты; мультимедиа; цифровой мониторинг	Исследование населения, транспорта, промышленности и экологии	Цифровая географическая и исследовательская компетентность

Источник: составлено авторами по материалам [2–9].

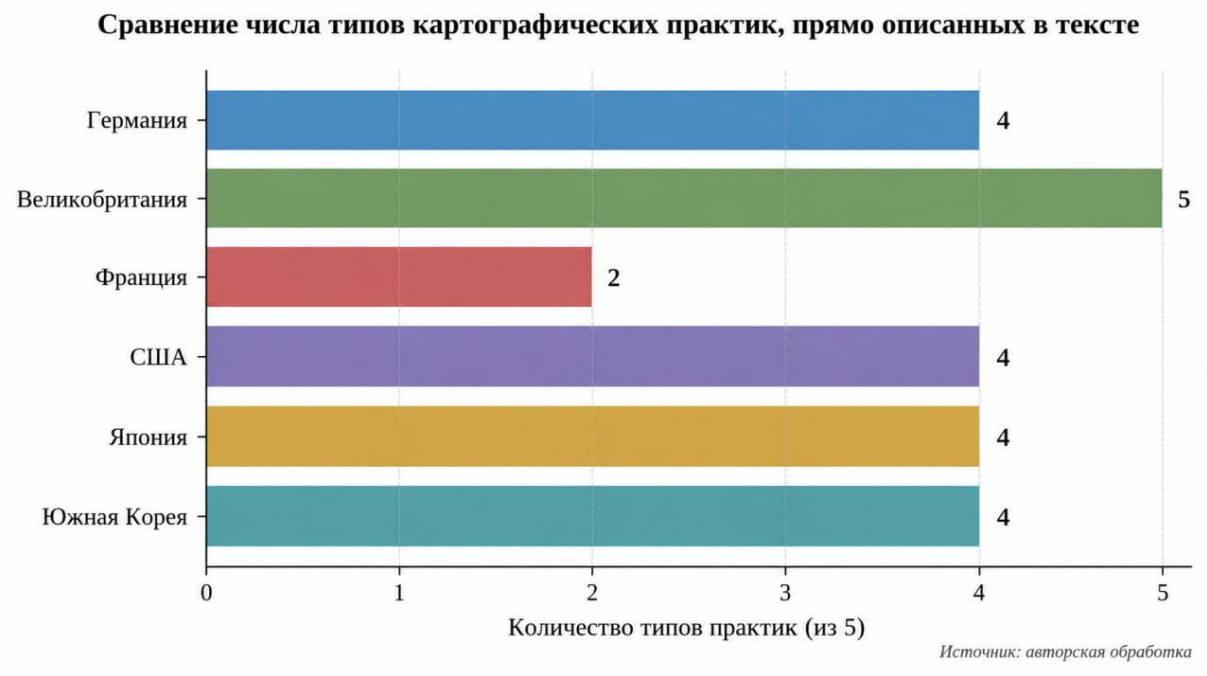


Рисунок 1 ШИРОТА КАРТОГРАФИЧЕСКИХ ПРАКТИК, ПРЯМО ПРЕДСТАВЛЕННЫХ В ОПИСАНИЯХ ШЕСТИ ЗАРУБЕЖНЫХ КЕЙСОВ

Примечание: показатель отражает только число явно описанных типов деятельности из пяти кодируемых категорий и не является рейтингом систем образования. Источник: авторское обобщение по [2–9].

В странах СНГ школьная география исторически развивалась на близкой дидактической основе, однако в настоящее время различается по структуре учебных программ, возрасту начала самостоятельного курса географии, роли интегрированных естественно-научных дисциплин и уровню цифровизации. Можно выделить две общие модели: в первой география относительно рано выделяется в самостоятельный предмет; во второй в младших классах пространственные представления формируются через интегрированные естественно-научные курсы, а самостоятельная география начинается позднее. Для второй модели особенно важно не допустить задержки формирования базовых картографических умений - ориентирования, понимания масштаба, координат, направления и территориального сравнения.

В Казахстане географическое образование строится на принципе спиральности: понятия и умения повторяются на разных ступенях, но каждое

последующее обращение предполагает более сложную деятельность. Учебная траектория развивается от нахождения объекта на карте к сопоставлению тематических карт, объяснению территориальных закономерностей и созданию собственного картографического результата. Типовые программы утверждены приказом Министерства просвещения Республики Казахстан №399 от 16 сентября 2022 года [10].

В Кыргызстане переход к 12-летнему общему образованию потребовал обновления содержания и распределения географии по классам. Предметный стандарт 2025 года определяет географию для 7–12 классов и связывает ее с изучением взаимодействия природы, населения, хозяйства и окружающей среды [11]. Специфика горного рельефа, водных ресурсов, пастбищ, природных опасностей и концентрации населения в долинах создает благоприятную основу для практико-ориентированных картографических заданий и межпредметных исследований.

В Узбекистане начальные элементы географических знаний формируются через природоведение и интегрированные естественно-научные дисциплины, а затем развиваются в самостоятельных курсах географии. Материалы итоговой государственной аттестации 2026 года опираются на содержание программ 7–10 классов [12]. Национальное содержание курса тесно связано с природными условиями Центральной Азии, размещением населения и хозяйства, водными ресурсами, кризисом Аральского моря, опустыниванием, орошаемым земледелием и экологической безопасностью. Это дает возможность строить картографические задания на проблемах, непосредственно связанных со средой проживания учащихся. Одновременно остается актуальной задача регулярного обновления учебных карт, атласов и статистики, а также расширения работы с открытыми геоданными и локальными исследованиями.

В Таджикистане география представлена последовательными курсами общей физической географии, материков и океанов, географии страны и экономической и социальной географии мира. Электронная библиотека Министерства образования и науки содержит школьные учебные материалы, в том числе географические, на разных языках, что имеет значение для многоязычной образовательной среды [13].

В Туркменистане школьное образование организовано на основе централизованных государственных программ и национальных учебников. В географическом содержании заметное место занимают Каракумы, водные ресурсы, орошаемое земледелие, минеральное сырье, расселение и отрасли хозяйства. Национальная тематика позволяет связывать географические знания с реальными ресурсными и экологическими задачами страны [14]. Вместе с тем открытая доступность подробных программных документов по компетенциям, часам и критериям оценивания ограничена, что затрудняет сопоставление отдельных методических элементов.

ТАБЛИЦА 2

ОСОБЕННОСТИ ГЕОГРАФИЧЕСКОГО И КАРТОГРАФИЧЕСКОГО ОБРАЗОВАНИЯ В ОТДЕЛЬНЫХ СТРАНАХ СНГ И ЦЕНТРАЛЬНОЙ АЗИИ

Страна	Организация содержания	Акцент картографической работы	Методически значимый элемент
Казахстан	Спиральное построение содержания; география как самостоятельный предмет на последующих ступенях	Переход от поиска объектов к сопоставлению тематических карт и созданию картографического результата	Спиральное усложнение практических заданий
Кыргызстан	Обновление содержания в условиях 12-летнего образования; география в 7–12 классах	Горные территории, водные ресурсы, природные опасности, устойчивое развитие	Проектные задания по местным природным рискам и ресурсам
Узбекистан	Интегрированные естественные науки на ранних этапах и последующее углубление географии	Национальные и региональные проблемы: вода, Арал, опустынивание, орошение, экология	Открытые геоданные, локальные исследования, обновление карт и атласов
Таджикистан	Последовательные курсы физической, страноведческой и социально-экономической географии	Электронные учебные ресурсы, в том числе на разных языках	Использование цифровой библиотеки в многоязычной среде
Туркменистан	Централизованные программы и национальные учебники	Пустынные территории, вода, орошение, ресурсы, расселение	Связь картографических заданий с ресурсными и экологическими проблемами

Источник: составлено авторами по материалам [10–14].

Сравнение показывает, что перенос зарубежной модели в готовом виде методически неоправдан. Системы образования различаются по учебным часам, структуре ступеней, языковой среде, техническому оснащению школ и содержанию национального курса. Более продуктивным является выбор отдельных педагогических решений, которые можно встроить в действующую программу без утраты национальной и региональной специфики.

Первое направление - переход от репродуктивного чтения карты к постановке аналитических вопросов. Ученик должен не только найти объект, но и сопоставить несколько тематических карт, определить

пространственную закономерность и объяснить причинную связь, например между рельефом и климатом, климатом и растительностью, плотностью населения и транспортом, ресурсами и промышленностью. Такое задание превращает карту из иллюстрации в инструмент аргументации.

Второе направление - поэтапное включение простых ГИС-операций: включение и сравнение слоев, измерение расстояний, классификация объектов, построение несложной тематической карты. Исследования пространственного образования показывают, что ГИС может поддерживать развитие пространственного мышления, если цифровая операция встроена в четко сформулированную учебную задачу, а не используется только как технологическая демонстрация [4; 15].

Третье направление - расширение практической базы за счет открытых метеорологических данных, веб-карт, статистических порталов и спутниковых изображений. Для Узбекистана особенно перспективны задания по водным ресурсам, опустыниванию, орошаемому земледелию, динамике городских территорий, пыльным бурям, природным опасностям и экологическим проблемам. Четвертое направление - обновление оценивания: наряду с фактическими вопросами целесообразно использовать задания, требующие прочитать карту, интерпретировать таблицу или диаграмму и сформулировать причинно обоснованный вывод.

Пятое направление связано с повышением квалификации учителей. Цифровой инструмент дает образовательный эффект только при наличии понятной дидактической цели, поэтому обучение педагогов должно соединять техническое освоение картографических сервисов с конструированием заданий, оцениванием и организацией исследовательской работы учащихся.

ТАБЛИЦА 3

ПРЕДЛАГАЕМАЯ МОДЕЛЬ ВНЕДРЕНИЯ КАРТОГРАФИЧЕСКИХ МЕТОДОВ В ГЕОГРАФИЧЕСКОЕ ОБРАЗОВАНИЕ УЗБЕКИСТАНА

Уровень	Тип учебной деятельности	Инструменты	Ожидаемый результат
Базовый уровень	Чтение условных знаков, масштаба, координат; поиск и описание объектов	Печатные и цифровые карты	Картографическая грамотность
Аналитический уровень	Сопоставление двух и более тематических карт; объяснение пространственных связей	Атласы, статистические карты, веб-карты	Пространственное мышление и причинный анализ
Цифровой уровень	Сравнение слоев, измерения, классификация, создание простой тематической карты	ArcGIS Online, QGIS или доступные веб-ГИС	Цифровая географическая компетентность

Исследовательский уровень	Работа с открытыми данными и спутниковыми изображениями; локальный проект	Открытые геоданные, ДЗЗ, метео- и статистические порталы	Исследовательская и информационная компетентность
Прикладной уровень	Оценка риска или территориальной проблемы; разработка аргументированного решения	Комплекс карт, таблиц, диаграмм и ГИС-слоев	Принятие решений и географическая аргументация

Источник: авторское обобщение по результатам сравнительного анализа.

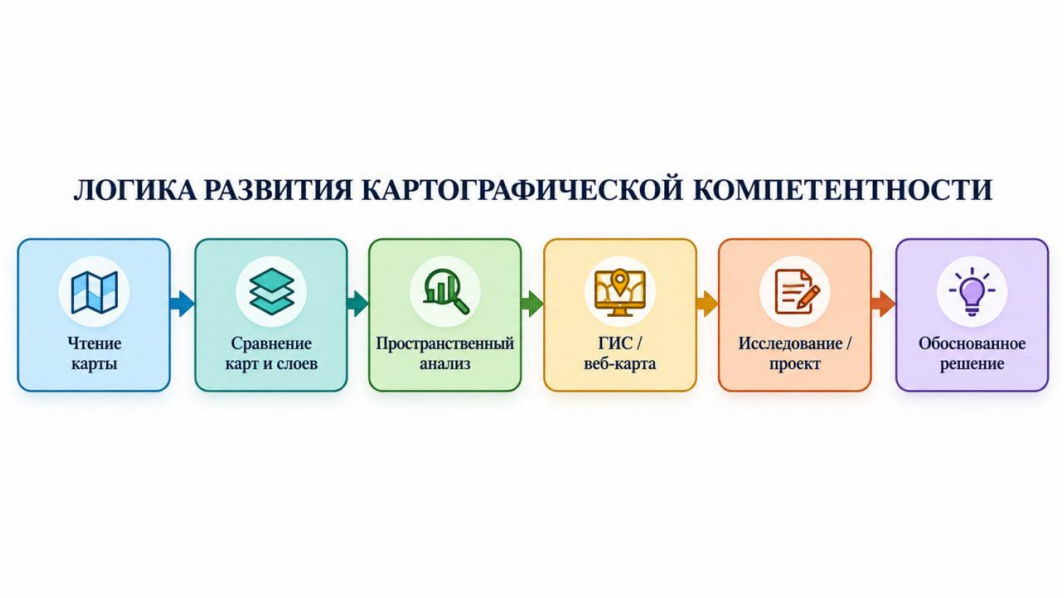


РИСУНОК 2 - ЛОГИКА РАЗВИТИЯ КАРТОГРАФИЧЕСКОЙ КОМПЕТЕНТНОСТИ ОБУЧАЮЩИХСЯ

Источник: авторская схема по результатам исследования.

ЗАКЛЮЧЕНИЕ

Проведенный анализ показывает, что в современном географическом образовании картографический метод последовательно меняет свою функцию: от средства иллюстрации и запоминания географических объектов он переходит к роли инструмента пространственного анализа, исследования и решения практических задач. Для Германии характерно сочетание традиционной картографической подготовки с ГИС-проектами и ментальными картами; в Великобритании заметно соединение веб-карт, дистанционного зондирования и проектного подхода; во Франции карта выполняет выраженную функцию территориального синтеза; в США и Японии цифровая картография активно используется для изучения природных процессов и рисков; в Южной Корее картографические средства интегрированы в цифровую образовательную среду.

Опыт Казахстана, Кыргызстана, Узбекистана, Таджикистана и Туркменистана демонстрирует сохранение общей значимости карты при различиях в структуре учебных программ и темпах цифровизации. Наиболее устойчивой тенденцией является переход от задания «найти объект на карте»

к деятельности, в которой учащийся должен сопоставить источники, выявить пространственную связь, объяснить ее и сформулировать практический вывод.

Для географического образования Узбекистана целесообразна поэтапная модель: базовая картографическая грамотность - сопоставительный анализ тематических карт - простые операции в ГИС - работа с открытыми данными и дистанционными материалами - исследовательский проект и аргументированное решение. Эффективность такой модели зависит от регулярного обновления картографических и статистических материалов, доступности цифровых инструментов, качества учебных заданий и системной подготовки педагогов. Результативность географического образования в данном случае определяется не объемом запомненных фактов, а способностью обучающегося анализировать картографическую и статистическую информацию, объяснять взаимосвязи «природа - население - хозяйство» и принимать обоснованные решения по территориальным проблемам.

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РОЛЬ ГЕОГРАФИЧЕСКИХ ФАКТОРОВ В ФОРМИРОВАНИИ И ПРОСТРАНСТВЕННОМ РАЗМЕЩЕНИИ ВОДНЫХ РЕСУРСОВ СУРХАНДАРЬИНСКОЙ ОБЛАСТИ

Аннотация. *В статье проанализированы природные и антропогенные географические факторы, влияющие на формирование, территориальное распределение и сезонные изменения водных ресурсов Сурхандарьинской области. Освещена взаимосвязь орографического строения территории, высотной поясности, климатических особенностей, атмосферных осадков, формирования снежного и ледникового покрова, геолого-литологического строения, речной сети и подземных вод. Обосновано, что хребет Гиссар и прилегающие к нему горные территории, расположенные в северной и северо-восточной частях области, являются основными природными зонами формирования водных ресурсов.*

Ключевые слова: *Сурхандарьинская область, водные ресурсы, географический фактор, рельеф, климат, атмосферные осадки, река, подземные воды, Гиссарские горы, бассейн Сурхандарьи, Шерабаддарья, Тупалангдарья, водохранилища.*

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ROLE OF GEOGRAPHICAL FACTORS IN THE FORMATION AND SPATIAL DISTRIBUTION OF WATER RESOURCES IN SURKHANDARYA REGION

Abstract. *The article analyzes the natural and anthropogenic geographical factors influencing the formation, spatial distribution, and seasonal variations of water resources in Surkhandarya Region. The interrelationships among the orographic structure of the territory, altitudinal zonation, climatic characteristics, atmospheric precipitation, snow and glacier formation, geological and lithological structure, river network, and groundwater are examined. It is substantiated that the Gissar Range and the adjacent mountainous areas located in the northern and northeastern parts of the region constitute the main natural zones of water resource formation.*

Keywords: *Surkhandarya Region, water resources, geographical factor, relief, climate, atmospheric precipitation, river, groundwater, Gissar Mountains, Surkhandarya River Basin, Sherabaddarya, Tupalangdarya, reservoirs.*

Введение. Основные речные сети области берут начало в горных районах. Такие реки, как Сурхандарья, Тупалангдарья, Каратаг, Сангардак и Шерабаддарья, формируются в горных и предгорных районах, а затем обеспечивают поступление воды в равнинную часть области. Следовательно, между территориями формирования водных ресурсов и районами их использования существует значительное географическое различие. Поэтому при изучении водных ресурсов Сурхандарьинской области важно анализировать не только их количественные показатели, но и взаимосвязь рельефа, климата, атмосферных осадков, геологического строения, высотной поясности и антропогенного воздействия [5].

Основная часть. На горных склонах сравнительно большая крутизна способствует быстрому превращению атмосферных осадков в поверхностный сток. Одновременно низкие температуры в высокогорьях обеспечивают более длительное сохранение снежного покрова. В тёплый период таяние снега играет важную роль в обеспечении рек и ручьёв водой [3].

Влияние климата и атмосферных осадков на формирование водных ресурсов Сурхандарьинская область является одним из наиболее южных регионов Узбекистана. Климат области резко континентальный: лето жаркое и сухое, зима относительно мягкая. Такие климатические условия оказывают двойное воздействие на формирование водных ресурсов. С одной стороны, большее количество осадков в горных районах по сравнению с равнинами увеличивает возможности формирования водных ресурсов. С другой стороны, высокая температура воздуха и интенсивное испарение на равнинах приводят к уменьшению водного баланса.

Основные реки области и их роль в формировании водных ресурсов. Гидрографическую сеть Сурхандарьинской области в основном формируют бассейны рек Сурхандарьи и Шерабаддарьи. Многие их притоки формируются в горных и предгорных районах. Сурхандарья образуется в результате слияния рек Тупалангдарьи и Каратаг. Тупалангдарья, в свою очередь, берёт начало в высокогорных районах Гиссарского хребта и имеет значительную площадь водосбора в горной местности. Сведения о районах формирования и основных источниках питания рек Сурхандарьинской области представлены в таблице 3.

Таблица 3. Основные реки Сурхандарьинской области.

Река	Район формирования	Основные источники питания
Сурхандарья	Гиссарские горы и предгорные территории	Снег, дождевые и подземные воды
Тупалангдарья	Гиссарские горы	Снег, ледники и атмосферные осадки
Каратаг	Гиссарский горный хребет	Осадки, снег и подземные воды
Сангардак	Южные склоны Гиссарских гор	Горные осадки и таяние снега
Шерабаддарья	Горные и предгорные территории	Дождевые, снеговые и подземные воды
Ходжаипок	Предгорные территории	Осадки и подземный сток

Формирование подземных вод тесно связано с геологическим и литологическим строением территории. В горных районах трещиноватые и разломные горные породы способствуют проникновению воды в подземные горизонты. Наличие песка, гравия и других водопроницаемых аллювиально-пролювиальных отложений в предгорьях и долинах усиливает процессы инфильтрации. Часть воды, просачивающейся из русел рек, пополняет запасы подземных вод.

Географические и функциональные особенности водохранилищ в Сурхандарьинской области для уменьшения сезонной неравномерности водного стока были построены такие водохранилища, как Тупалангское, Южно-Сурханское, Октепинское, Учкызильское и Дегресское. Их географические и функциональные особенности представлены в таблице 6.

Таблица 6. Географические и функциональные особенности основных водохранилищ Сурхандарьинской области.

Водохранилище	**Географическое положение**	**Основная функция**
Тупалангское	Горная территория	Регулирование воды, водоснабжение и энергетика
Южно-Сурханское	Долина Сурхандарьи	Сезонное регулирование оросительных вод
Октепинское	Бассейн Сурхандарьи	Орошение и регулирование водного стока
Учкызильское	Южная часть Сурхандарьи	Орошение и водоснабжение
Дегресское	Горный склон	Орошение

Географическое расположение водохранилищ определяется рельефом территории, речным стоком, площадью водосборного бассейна, размещением орошаемых земель и возможностями строительства гидротехнических сооружений.

Широкое развитие орошаемого земледелия в Сурхандарьинской области увеличивает потребность в водных ресурсах. Вода, забираемая из рек и водохранилищ, по каналам доставляется на сельскохозяйственные угодья. В

таких условиях естественное географическое распределение водных ресурсов существенно изменяется под воздействием человека. Наряду с естественным поступлением воды из гор в равнинные районы, она также направляется в другие территории посредством каналов и водохранилищ [2].

Заключение. Формирование и пространственное размещение водных ресурсов Сурхандарьинской области происходит под воздействием комплекса сложных природно-географических факторов. На основании результатов исследования можно сделать следующие выводы.

Во-первых, рельеф и орографические условия являются одними из ведущих факторов формирования водных ресурсов. Горные территории северной и северо-восточной частей области выполняют функцию основных водосборных и водоформирующих территорий.

Во-вторых, высотная поясность непосредственно влияет на количество и форму атмосферных осадков, сохранение снежного покрова и сезонный режим речного стока.

В-третьих, климатические условия существенно различают процессы формирования водных ресурсов в горных и равнинных районах. Если в горах условия формирования водных ресурсов относительно благоприятны, то на равнинах высокая температура и интенсивное испарение усиливают дефицит воды.

В-четвёртых, бассейны Сурхандарьи и Шерабаддарьи образуют основные гидрологические системы области. Многие их притоки берут начало в горах и обеспечивают поступление воды в равнинные территории.

В-пятых, геолого-литологическое строение имеет важное значение в формировании и пространственном размещении подземных вод. Трещиноватые горные породы, аллювиальные и пролювиальные отложения создают условия для протекания процессов инфильтрации.

В-шестых, предгорные территории являются природной зоной активного обмена между поверхностными и подземными водами. В связи с этим данные территории необходимо отдельно исследовать с точки зрения управления водными ресурсами.

В-седьмых, равнинные и долинные территории являются основными районами использования водных ресурсов. Особенно развитие орошаемого земледелия увеличивает потребность в воде.

В-восьмых, Тупалангское, Южно-Сурханское, Октепинское, Учкызильское и Дегресское водохранилища имеют важное значение в сезонном и территориальном перераспределении естественного водного стока. В целом географическое формирование водных ресурсов Сурхандарьинской области можно охарактеризовать по принципу: **«формирование воды в горах — перераспределение в предгорьях — использование в долинах и на равнинах»**. Данная закономерность служит важной научной основой для территориальной организации водного хозяйства области, развития орошаемых земель и рационального использования водных ресурсов.

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РОЛЬ ВОДОХРАНИЛИЩ В ЭКОНОМИЧЕСКОМ РАЗВИТИИ СУРХАНДАРЬИНСКОЙ ОБЛАСТИ (НА ПРИМЕРЕ ОК-ТЕПИНСКОГО ВОДОХРАНИЛИЩА)

Аннотация. *В данной статье с научной точки зрения проанализированы роль и значение Ок-Тепинского водохранилища в территориальной организации и развитии отраслей экономики Сурхандарьинской области. Ок-Тепинское водохранилище расположено на территории Джаркурганского района и является одним из важных гидротехнических сооружений, обеспечивающих водой орошаемое земледелие в южной и центральной частях области.*

Ключевые слова: *природные ресурсы, Ок-Тепинское водохранилище, Сурхандарьинская область, ирригация, сельское хозяйство, водные ресурсы, отрасли экономики, рыбоводство, туризм, рекреация, территориальное развитие, производительные силы.*

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THE ROLE OF RESERVOIRS IN THE ECONOMIC DEVELOPMENT OF SURKHANDARYA REGION (A CASE STUDY OF THE OK-TEPA RESERVOIR)

Abstract. *This article provides a scientific analysis of the role and significance of the Ok-Tepa Reservoir in the territorial organization and development of economic sectors in Surkhandarya Region. The Ok-Tepa Reservoir is located in the territory of Jarkurgan District and is one of the important hydraulic structures providing water for irrigated agriculture in the southern and central parts of the region.*

Keywords: *natural resources, Ok-Tepa Reservoir, Surkhandarya Region, irrigation, agriculture, water resources, economic sectors, fish farming, tourism, recreation, territorial development, productive forces.*

Введение.Удовлетворение потребностей населения в продовольствии, а промышленности — в сырье прежде всего зависит от правильного

размещения и развития производительных сил в каждом регионе. Сурхандарьинская область расположена в южной части Узбекистана и характеризуется жарким и сухим климатом, относительно продолжительным вегетационным периодом и развитым орошаемым земледелием. Устойчивое развитие сельского хозяйства области во многом зависит от рационального использования водных ресурсов и их правильного территориального распределения. Особенно в регионах с недостаточным количеством атмосферных осадков водохранилища выступают важным фактором территориальной организации экономической деятельности [1].

Ок-Тепинское водохранилище, расположенное на территории Джаркурганского района, является одним из таких важных водохозяйственных объектов и наполняется водой из Амударьи через систему Аму-Зангского канала [2].

Значение Ок-Тепинского водохранилища не ограничивается только орошением. В настоящее время научно обоснованы возможности развития рекреации и экотуризма на прилегающих территориях, использования потенциала рыбоводства, формирования инфраструктуры сферы услуг и создания новых возможностей для повышения занятости населения.

Основная часть. В территориальной организации сельскохозяйственного производства Сурхандарьинской области водные ресурсы являются одним из основных природно-экономических факторов. В условиях жаркого и сухого климата области стабильность водоснабжения имеет большое значение для сохранения и повышения продуктивности орошаемых земель [3].

Основная экономическая функция Ок-Тепинского водохранилища заключается в улучшении возможностей орошения сельскохозяйственных земель посредством сезонного регулирования водных ресурсов. Согласно официальным данным, в вегетационный период, когда объём воды в других источниках сокращается, водохранилище способно дополнительно подавать до 15 м³ воды в секунду на насосную станцию «Аму-Занг-2» [2].

Водохранилище тесно связано с Аму-Зангской ирригационной системой, использующей водные ресурсы Амударьи. Согласно официальным данным, основные характеристики водохранилища представлены в таблице 1.

ТАБЛИЦА 1. ОСНОВНЫЕ ХАРАКТЕРИСТИКИ ОК-ТЕПИНСКОГО ВОДОХРАНИЛИЩА.

№	Показатель	Данные
1	Местоположение	Джаркурганский район
2	Площадь водного зеркала	11,5 тыс. га
3	Объём водохранилища	120 млн м³
4	Основной источник воды	Амударья
5	Система подачи воды	Система Аму-Зангского канала

6	Основное направление использования	Орошение
7	Возможность дополнительной подачи воды	до 15 м³/с
8	Основные территории обслуживания	Джаркурганский, Кумкурганский, Ангорский, Музрабадский и другие районы
9	Дополнительные экономические направления	Рыбоводство, рекреация, экотуризм

Источник: *составлено на основе данных Министерства водного хозяйства Республики Узбекистан.*

Ок-Тепинское водохранилище играет важную роль в обеспечении водой сельскохозяйственных земель на многих территориях Джаркурганского, Ангорского, Кумкурганского и Музрабадского районов. В отдельных официальных источниках отмечается, что зона обслуживания водохранилища также охватывает посевные площади Термезского, Кызырыкского и Шерабадского районов.

Прежде всего водные ресурсы оказывают влияние на развитие сельского хозяйства. В свою очередь, сельскохозяйственное производство формирует спрос на развитие таких видов экономической деятельности, как хранение, транспортировка, переработка, упаковка и реализация продукции [5].

Таким образом, может формироваться территориальная экономическая цепочка **«водные ресурсы → сельское хозяйство → переработка → транспорт → торговля → сфера услуг»** [3].

Ещё одним важным экономическим направлением водохранилища являются возможности развития рыбоводства. Развитие рыбоводства должно осуществляться одновременно с контролем качества воды, рациональным использованием биологических ресурсов и охраной прибрежных территорий.

В настоящее время одним из новых направлений, повышающих экономическое значение Ок-Тепинского водохранилища, является **туризм и рекреация**.

Территория Ок-Тепинского водохранилища может использоваться как благоприятная зона для рыбалки, отдыха на природе и экотуризма. Кроме того, в рамках государственных программ, направленных на развитие туристической инфраструктуры Сурхандарьинской области, ведутся работы по созданию **туристического центра «Обиҳаёт»** на берегу Ок-Тепинского водохранилища. На территории Ок-Тепинского водохранилища существуют

возможности для развития нескольких направлений туризма, что отражено в таблице 2.

ТАБЛИЦА 2. ПЕРСПЕКТИВНЫЕ НАПРАВЛЕНИЯ РАЗВИТИЯ ТУРИЗМА НА ОК-ТЕПИНСКОМ ВОДОХРАНИЛИЩЕ.

№	Направление туризма	Возможности развития
1	Экотуризм	Использование водоёма и природных ландшафтов
2	Рекреационный туризм	Создание зон отдыха
3	Рыболовный туризм	Организация услуг любительской рыбалки
4	Семейный отдых	Создание прибрежных зон отдыха
5	Гастрономический туризм	Использование местной рыбной и сельскохозяйственной продукции
6	Спортивный туризм	Водные и прибрежные виды спортивной деятельности
7	Фототуризм и природный туризм	Использование ландшафтов в качестве туристического ресурса
8	Сфера услуг	Гостиничные, общественное питание и торговые услуги

В 2025 году в Джаркурганском районе в рамках проекта по развитию экотуризма на территории Ок-Тепинского водохранилища также рассматривались вопросы развития инфраструктуры питьевого водоснабжения. В рамках проекта предусмотрено строительство резервуаров для воды, насосных станций, скважин и водопроводных сетей.

Несмотря на высокое экономическое значение Ок-Тепинского водохранилища, существуют определённые проблемы его эксплуатации. В частности, длительный период эксплуатации водохранилища требует регулярного контроля технического состояния гидротехнических сооружений. Необходимо проводить очистку водоподводящих и водоотводящих каналов от наносов, а также ремонт затворов на водовыпускных сооружениях [6].

Для повышения экономической эффективности водохранилища в перспективе приоритетными можно считать следующие направления:

- регулярная реконструкция гидротехнических сооружений водохранилища;
- сокращение потерь воды;
- регулярная очистка водоподводящих и водоотводящих каналов;
- внедрение современных водоизмерительных приборов и автоматизированных систем управления;
- расширение применения водосберегающих технологий орошения;
- развитие инфраструктуры экотуризма вокруг водохранилища;
- эффективное использование возможностей туристического центра «Обиҳаёт»;

•научно обоснованное развитие рыбоводства;

•расширение зелёных зон на прибрежных территориях;

•усиление экологического мониторинга водоёма [4].

Заключение. Ок-Тепинское водохранилище выступает как многофункциональный территориальный ресурс в экономическом развитии Сурхандарьинской области. Его важнейшей функцией является обеспечение оросительных систем водой и поддержание устойчивости сельскохозяйственного производства.

Возможность сезонного регулирования водных ресурсов в объёме 120 млн м³ имеет большое экономическое значение в условиях дефицита воды, наблюдаемого в Сурхандарьинской области. Роль водохранилища в обеспечении водой сельскохозяйственных земель Джаркурганского, Кумкурганского, Ангорского, Музрабадского и других районов ещё больше повышает его значение в территориальной экономической системе.

Кроме того, существующие природные возможности позволяют развивать вокруг водохранилища рыбоводство, рекреацию и экотуризм. В частности, проводимые работы по созданию туристического центра «Обиҳаёт» на берегу Ок-Тепинского водохранилища являются важной основой для формирования новых экономических функций данного водохозяйственного объекта.

В целом комплексное использование Ок-Тепинского водохранилища на основе принципа **«водное хозяйство + сельское хозяйство + рыбоводство + туризм + рекреация + сфера услуг»** является одним из перспективных направлений повышения экономической активности в южных и центральных районах Сурхандарьинской области, создания новых рабочих мест и увеличения доходов населения.

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ОСНОВНЫЕ УГРОЗЫ ПРИ МИОМЕ МАТКИ КАК ПРОВОЦИРУЮЩИЕ ФАКТОРЫ: КЛИНИКО-ЛАБОРАТОРНЫЕ И ГИСТОЛОГИЧЕСКИЕ АСПЕКТЫ

Аннотация: *Миома матки (лейомиома) является наиболее распространённой доброкачественной опухолью женской репродуктивной системы. Несмотря на доброкачественный характер, заболевание сопровождается выраженными клиническими проявлениями и может приводить к серьёзным осложнениям. В статье рассмотрены провоцирующие факторы развития миомы матки, основные угрозы заболевания, а также представлены современные клинико-лабораторные и гистологические методы диагностики. Показано, что гормональный дисбаланс, метаболические нарушения и хроническое воспаление формируют патологическую внутреннюю среду, способствующую росту миоматозных узлов.*

Ключевые слова: *миома матки, лейомиома, гиперэстрогения, анемия, гистология, иммуногистохимия, факторы риска.*

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THE MAIN THREATS OF UTERINE MYOMA AS PROVOCING FACTORS: CLINICAL, LABORATORY, AND HISTOLOGICAL ASPECTS

Abstract: *Uterine myoma (leiomyoma) is the most common benign tumor of the female reproductive system. Despite its benign nature, the disease is accompanied by pronounced clinical manifestations and can lead to serious complications. The article discusses the triggering factors for the development of uterine fibroids, the main threats of the disease, and presents modern clinical, laboratory, and histological methods of diagnosis. It is shown that hormonal imbalance, metabolic disorders, and chronic inflammation create a pathological internal environment that contributes to the growth of myomatous nodes.*

Keywords: *uterine fibroids, leiomyoma, hyperestrogenism, anemia, histology, immunohistochemistry, and risk factors.*

Введение

Согласно данным World Health Organization, миома матки диагностируется у 20–40% женщин репродуктивного возраста, а к 50 годам признаки заболевания выявляются у большинства пациенток (1). Миома представляет собой моноклональную опухоль, происходящую из гладкомышечных клеток миометрия, рост которой зависит от гормональной стимуляции.

Несмотря на доброкачественную природу, заболевание сопровождается нарушениями менструального цикла, болевым синдромом, бесплодием и осложнениями беременности (2). Существенную роль в прогрессировании миомы играют изменения внутренней среды организма — гиперэстрогения, воспаление, гипоксия и метаболические нарушения.

Цель работы — комплексный анализ провоцирующих факторов миомы матки с учётом клинико-лабораторных и гистологических характеристик заболевания.

Материалы и методы

Проведён анализ современных публикаций за последние 15 лет, клинических рекомендаций и морфологических исследований. Использованы данные лабораторной диагностики, гистологических и иммуногистохимических исследований миоматозных узлов.

Методы исследования включали: клинический анализ симптоматики; лабораторную диагностику (гематологические и гормональные показатели); инструментальные методы (УЗИ, МРТ); гистологический и иммуногистохимический анализ операционного материала.

Результаты

Провоцирующие факторы: Гормональные нарушения-гиперэстрогения и повышенная чувствительность рецепторов к прогестерону являются ключевыми триггерами роста миомы (3). В миоматозных узлах выявляется повышенная экспрессия рецепторов эстрогенов (ER-α) и прогестерона (PR) (4).

Генетические изменения: Мутации гена MED12 обнаруживаются более чем в 60% случаев миомы (5). Эти мутации запускают пролиферацию гладкомышечных клеток и нарушают регуляцию транскрипции.

Метаболические факторы: Ожирение и инсулинорезистентность усиливают ароматизацию андрогенов в эстрогены, формируя гиперэстрогенную среду (6).

Воспаление и гипоксия: Хроническое воспаление активирует цитокины (IL-6, TNF-α), стимулирующие рост опухоли (7). Гипоксия усиливает экспрессию фактора HIF-1α, способствуя ангиогенезу.

Клинико-лабораторные показатели

Общий анализ крови: при обильных менструациях развивается железодефицитная анемия: снижение гемоглобина (<120 г/л); снижение эритроцитов; гипохромия; снижение уровня ферритина. Хроническая анемия является одной из основных угроз заболевания (2).

Биохимический анализ крови. Возможны признаки воспаления (повышение С-реактивного белка), нарушения липидного обмена при метаболическом синдроме.

Гормональный профиль определяются: эстрадиол; прогестерон; ЛГ, ФСГ; пролактин; тиреоидные гормоны. Часто выявляется относительная гиперэстрогения и нарушение соотношения эстроген/прогестерон (3).

Онкомаркеры CA-125 может быть умеренно повышен, однако не является специфичным показателем (8).

Инструментальная диагностика

- **Ультразвуковое исследование (УЗИ)** — основной метод выявления узлов;
- **Магнитно-резонансная томография (МРТ)** — уточняет локализацию и структуру;
- **Гистероскопия** — при субмукозных узлах.

Гистологическая характеристика

Миома матки представлена пучками веретенообразных гладкомышечных клеток с чёткими границами, окружённых соединительнотканной стромой (4).

Микроскопические признаки: мономорфность клеток; низкая митотическая активность; отсутствие выраженной клеточной атипии; наличие фиброзной стромы.

При иммуногистохимическом исследовании выявляется: положительная реакция на десмин; экспрессия гладкомышечного актина (SMA); высокая экспрессия ER и PR;низкий индекс Ki-67 (до 5%).

Повышение Ki-67 и выраженная клеточная атипия требуют дифференциальной диагностики с лейомиосаркомой (9).

Основные угрозы заболевания

1. Хроническая анемия.
2. Бесплодие и невынашивание беременности.
3. Некроз узла и острый болевой синдром.
4. Сдавление соседних органов.
5. Редкая малигнизация (менее 1%) (5).

Обсуждение

Миома матки формируется в условиях изменённой внутренней среды организма, где гормональный дисбаланс сочетается с воспалительными и метаболическими нарушениями. Клинико-лабораторные и гистологические данные подтверждают её гормонозависимую природу и доброкачественный характер при отсутствии признаков атипии.

Комплексная диагностика позволяет своевременно выявить осложнения и определить тактику лечения.

Заключение

Миома матки является многофакторным заболеванием с выраженной зависимостью от состояния гормонального и метаболического гомеостаза. Клинико-лабораторные и гистологические исследования играют ключевую роль в диагностике и дифференциальной оценке риска осложнений.

Ранняя коррекция провоцирующих факторов и мониторинг лабораторных показателей позволяют снизить вероятность прогрессирования заболевания и сохранить репродуктивное здоровье женщины.

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ПОНЯТИЕ И СУЩНОСТЬ ОСВОБОЖДЕНИЯ ОТ УГОЛОВНОЙ ОТВЕТСТВЕННОСТИ

Аннотация: *В статье анализируется институт освобождения от уголовной ответственности в российской правовой доктрине. Отмечается отсутствие единого легального определения, что порождает множественность научных подходов к трактовке данного понятия. Раскрывается двойственная природа института: с одной стороны, он служит интересам общества через гуманизацию политики и стимулирование заглаживания вреда, с другой — предоставляет лицу шанс на исправление без судимости.*

Ключевые слова: *уголовная ответственность, освобождение от уголовной ответственности, прекращение уголовного преследования, государственное принуждение, обвинительный приговор, нереабилитирующие основания, правовые последствия, судебный штраф, согласие обвиняемого, принципы справедливости и гуманизма.*

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THE CONCEPT AND ESSENCE OF EXEMPTION FROM CRIMINAL LIABILITY

Abstract: *The article analyzes the institution of exemption from criminal liability in Russian legal doctrine. It notes the absence of a single legal definition, which gives rise to a multiplicity of scientific approaches to the interpretation of this concept. The dual nature of the institution is revealed: on the one hand, it serves the interests of society through the humanization of policy and encouraging the redress of harm; on the other hand, it provides an individual with a chance for reformation without a criminal record.*

Keywords: *criminal liability, exemption from criminal liability, termination of criminal prosecution, state coercion, conviction, non-rehabilitating grounds, legal consequences, court fine, consent of the accused, principles of justice and humanism.*

Институт освобождения от уголовной ответственности занимает особое место в системе уголовно-правовых средств, поскольку позволяет государству гибко реагировать на совершение преступлений, не прибегая в каждом случае к формальному осуждению и наказанию. В российской юридической науке отсутствует единое легальное определение данного института, что порождает множественность доктринальных подходов и требует глубокого теоретического осмысления.

В отечественной доктрине понятие уголовной ответственности традиционно рассматривается как результат отрицательной оценки преступления и лица, его совершившего, со стороны государства. Такая оценка выражается в осуждении лица путем вынесения обвинительного приговора суда, а также в назначении и исполнении наказания или иной меры уголовно-правового воздействия. Исходя из этого, освобождение от уголовной ответственности трактуется как отказ государства от официального осуждения лица в обвинительном приговоре, то есть от порицания и отрицательной оценки, а также от возложения на него обременений и лишений, составляющих содержание уголовной ответственности.

Рассматривая уголовную ответственность как меру государственного принуждения, назначаемую по приговору суда и заключающуюся в осуждении лица к определенным правоограничениям карательного и не карательного характера, авторы А.А. Нечепуренко и С.Е. Суверов предлагают свое понимание определения «освобождение от уголовной ответственности», - «это не просто снятие обязанности претерпевать ограничения, а замена традиционной реакции государства (обвинительного приговора) на постановление о прекращении уголовного преследования, что сопровождается отрицательной оценкой поведения лица и наступлением для него определенных правовых последствий» [3, с. 308]. Вместе с тем реализация данного потенциала сопряжена с существенными правовыми рисками. Дискреционный характер большинства норм об освобождении создает почву для злоупотреблений со стороны правоохранительных органов. На практике угроза отказа в прекращении дела по ст. 75 или 76 УК РФ может использоваться следователями и дознавателями как инструмент давления, понуждая подозреваемого к возмещению ущерба или выплате судебного штрафа даже при сомнительности доказательственной базы. Это трансформирует институт компромисса и гуманизации в механизм скрытого принуждения, подменяя правосудие торгом. Кроме того, чрезмерная зависимость решения от воли потерпевшего в делах частного обвинения может приводить к необоснованному затягиванию процесса или вымогательству. Для минимизации этих рисков требуется строгий прокурорский надзор за обоснованностью ходатайств о прекращении дел и четкая фиксация судом добровольности действий обвиняемого.

Понятие освобождения от уголовной ответственности, формулирует Г.В. Курбатова, как «полное и безусловное освобождение лица,

совершившего преступление и являющегося его субъектом, от несения каких-либо мер государственного принуждения за содеянное, выраженное в официальном, имеющем юридическую силу, правовом акте компетентного государственного органа. При этом подчеркивается, что данный институт должен использоваться в качестве основы гуманизационной политики государства и реализации принципа справедливости» [2, с. 120].

Собственное определение рассматриваемого понятия предлагает А.Н. Шелест: «Освобождение от уголовной ответственности – это освобождение лица, совершившего преступление, от официального осуждения в обвинительном приговоре суда (то есть от порицания и отрицательной оценки со стороны государства), от возложения на него обременений и лишений, составляющих содержание уголовной ответственности. Это означает, что лицо в данном случае не просто избегает уголовного наказания, но и считается несудимым. С момента освобождения от уголовной ответственности прекращается и уголовное правоотношение: государство прекращает уголовное преследование, реализуя свое право или обязанность (в зависимости от указания закона), а лицо, совершившее общественно-опасное деяние, освобождается от обязанности понести ответственность перед государством» [6, с. 210].

Таким образом, несмотря на различия в деталях, все авторы сходятся во мнении, что освобождение от уголовной ответственности - это не просто отказ от наказания, а сложный правовой институт, связанный с отказом государства от формального осуждения лица при сохранении отрицательной оценки его поведения и возможности наступления определенных правовых последствий.

Сущность освобождения от уголовной ответственности проявляется в его двойственной природе. С одной стороны, данный институт служит интересам общества, позволяя достигать социально полезных целей: стимулировать правопослушное поведение, способствовать заглаживанию вреда, предотвращать излишнюю криминализацию и гуманизировать уголовную политику. С другой стороны, освобождение дает шанс лицу, совершившему преступление, на исправление и предупреждение рецидива, не прибегая к карательным мерам. И, как подчеркивают А. А. Нечепуренко и С. Е. Суверов, - «освобождение от уголовной ответственности следует рассматривать как меру государственного стимулирования» [3, с. 310].

Она применяется только с согласия обвиняемого и сопряжена с выполнением определенных условий (например, заглаживание вреда, раскаяние). При этом освобождение не означает отсутствия отрицательной оценки: государство выражает порицание преступного поведения иным способом - через постановление о прекращении уголовного преследования и возложение на лицо отдельных правовых обременений.

Сущность института освобождения от уголовной ответственности, как подчеркивает Г. В. Курбатова, проявляется в том, что «лицо, осознавшее противоправность своего поступка и устранившее негативные последствия для общественных отношений, должно иметь возможность для

снисхождения. При этом важно учитывать волю самого лица: возможность отказа от освобождения должна быть разъяснена обвиняемому» [2, с. 121].

В целом, сущность освобождения от уголовной ответственности заключается в отказе государства от реализации всех форм уголовной ответственности (осуждение, наказание) при сохранении возможности применения иных мер правового воздействия и наступления для лица определенных правовых последствий. Такой подход обеспечивает баланс между интересами общества и правами личности, способствует реализации принципов справедливости и гуманизма в уголовном праве.

Анализируя позиции ведущих исследователей теории уголовного права, можно выделить ряд отличительных признаков института освобождения от уголовной ответственности.

Прежде чем перейти к анализу этих признаков, необходимо провести внутреннюю классификацию оснований освобождения от уголовной ответственности, так как именно она определяет специфику реализации сущностных характеристик института. В доктрине и законодательстве традиционно выделяют следующие основания:

– дискреционные (факультативные) — решение об освобождении остается на усмотрение правоприменителя (следователя, дознавателя с согласия прокурора или суда). К ним относятся деятельное раскаяние (ст. 75 УК РФ), примирение с потерпевшим (ст. 76 УК РФ), судебный штраф (ст. 76.2 УК РФ) и освобождение несовершеннолетних с применением принудительных мер воспитательного воздействия (ст. 90 УК РФ);

– императивные (обязательные) — при наличии установленных законом условий государство обязано освободить лицо. Классическим примером выступает истечение сроков давности привлечения к уголовной ответственности (ст. 78 УК РФ).

Данная классификация напрямую влияет на содержание выделяемых признаков. Так, четвертый признак — необходимость согласия лица — является абсолютным для дискреционных оснований, но неприменим к императивной давности, где воля обвиняемого не имеет юридического значения для прекращения преследования.

Рассмотрим эти признаки подробнее.

Во-первых, освобождение всегда связано с наличием в деянии лица всех признаков состава преступления. Если деяние не является преступным (например, малозначительное деяние или обстоятельства, исключающие преступность), освобождение невозможно.

Данный тезис требует уточнения границ исследуемого института. Освобождение от уголовной ответственности возможно только тогда, когда деяние формально содержит все признаки состава преступления, однако по тем или иным причинам признается государством социально терпимым при условии выполнения лицом определенных требований. Этим институт принципиально отличается от обстоятельств, исключающих преступность деяния (глава 8 УК РФ — необходимая оборона, крайняя необходимость,

обоснованный риск и др.). При необходимой обороне правомерный вред причиняется общественно полезным способом, вследствие чего само уголовное правоотношение не возникает вовсе, отсутствует основание негативной оценки со стороны государства и нет субъекта ответственности. Лицо в данном случае действует правомерно, поэтому говорить об "освобождении" юридически некорректно — здесь происходит констатация отсутствия самого события преступления в уголовно-правовом смысле.

Во-вторых, решение об освобождении оформляется в особой процессуальной форме, - как правило, это постановление о прекращении уголовного преследования или иное решение компетентного органа. Такое решение означает отказ государства от дальнейшего уголовного преследования по нереабилитирующим основаниям.

В-третьих, освобождение сопровождается отрицательной государственной оценкой поведения лица. Даже если обвинительный приговор не выносится, государство выражает порицание преступного поведения иным способом - через возложение на лицо отдельных обременений (например, судебного штрафа) или иных правовых ограничений.

В-четвертых, применение института возможно только при наличии согласия самого лица на освобождение по нереабилитирующим основаниям. Это требование обеспечивает соблюдение прав личности и принцип справедливости.

Таким образом, институт освобождения от уголовной ответственности представляет собой сложный правовой механизм, сочетающий элементы государственного принуждения и стимулирования, направленный на достижение баланса между интересами общества и правами личности.

Процессуальная форма реализации материально-правового института неразрывно связана с распределением полномочий между участниками уголовного судопроизводства. Инициатива применения дискреционных оснований чаще всего исходит от стороны защиты (ходатайство обвиняемого и его адвоката), однако ключевая роль отводится стороне обвинения. Следователь или дознаватель формируют фактическую базу (подтверждение заглаживания вреда, раскаяния), но окончательное решение во многих случаях принимается исключительно с согласия руководителя следственного органа или прокурора. Суд же выполняет контрольную функцию: он не просто утверждает готовое решение, а обязан проверить законность и добровольность согласия лица на прекращение дела по нереабилитирующим основаниям, разъяснить ему юридические последствия такого шага (в частности, невозможность последующей реабилитации) и убедиться в реальности возмещения вреда. Таким образом, процессуальный механизм служит предохранителем от формального подхода и обеспечивает реализацию гарантий прав личности.

Таким образом, сущность данного института раскрывается через отказ государства от формального осуждения при сохранении отрицательной

оценки поведения лица и возможности наступления для него определенных правовых последствий.

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ПРАГМАЛИНГВИСТИЧЕСКИЕ ХАРАКТЕРИСТИКИ РЕЧЕВОГО ЖАНРА УТЕШЕНИЯ В ВИРТУАЛЬНОМ ПРОСТРАНСТВЕ (НА ПРИМЕРЕ РУССКОЯЗЫЧНЫХ И АНГЛОЯЗЫЧНЫХ ПОСТОВ И КОММЕНТАРИЕВ)

Аннотация: *статья посвящена исследованию прагмалингвистических характеристик речевого жанра утешения в современном виртуальном пространстве на материале русскоязычных и англоязычных постов и комментариев. Актуальность исследования обусловлена активным развитием цифровой коммуникации, в которой социальные сети, тематические сообщества и онлайн-платформы становятся значимым пространством выражения эмоциональной поддержки. Цель работы заключается в выявлении коммуникативно-прагматической организации жанра утешения, определении его основных стратегий и тактик, а также установлении особенностей их языковой реализации в русском и английском виртуальном дискурсе. В качестве основных методов использованы прагмалингвистический, дискурсивный, сравнительно-сопоставительный, контекстуальный и функционально-семантический методы анализа. Установлено, что виртуальное утешение реализуется посредством комплекса взаимосвязанных стратегий: выражения эмпатии, эмоционального присоединения, нормализации переживания, снижения чувства вины, формирования перспективы, предложения помощи и мобилизации эмоциональных ресурсов адресата.*

Ключевые слова: *речевой жанр, утешение, прагмалингвистика, виртуальный дискурс, интернет-коммуникация, эмпатия, речевая стратегия, речевая тактика, эмоциональная поддержка, русский язык, английский язык.*

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PRAGMALINGUISTIC CHARACTERISTICS OF THE SPEECH GENRE OF CONSOLATION IN THE VIRTUAL SPACE (BASED ON RUSSIAN- AND ENGLISH-LANGUAGE POSTS AND COMMENTS)

Abstract: *the article examines the pragmalinguistic characteristics of the speech genre of consolation in contemporary virtual communication based on Russian- and English-language posts and comments. The relevance of the study is determined by the growing role of digital communication as a space for expressing emotional support and interpersonal solidarity. The aim of the research is to identify the communicative and pragmatic organization of consolation, its major strategies and tactics, and the linguistic means used to implement them in Russian and English virtual discourse. The study employs pragmalinguistic, discourse, comparative, contextual and functional-semantic methods. The analysis demonstrates that virtual consolation is realized through a set of interconnected strategies, including empathy, emotional alignment, normalization of negative experience, reduction of guilt, creation of a positive perspective, offers of assistance and emotional mobilization.*

Keywords: *speech genre, consolation, pragmalinguistics, virtual discourse, Internet communication, empathy, communicative strategy, communicative tactic, emotional support, Russian, English.*

ВВЕДЕНИЕ

Цифровизация межличностной коммуникации существенно изменила способы выражения эмоционального отношения к собеседнику. Если в традиционном межличностном общении утешение непосредственно связано с интонацией, мимикой, жестами, физическим присутствием и ситуативным контекстом, то в виртуальной коммуникации значительная часть этих ресурсов оказывается ограниченной или полностью отсутствует. Вместе с тем социальные сети, форумы, блоги, мессенджеры и иные цифровые платформы предоставляют пользователям широкие возможности для выражения сочувствия, эмоциональной поддержки и солидарности.

Виртуальная среда особенно значима для реализации жанра утешения, поскольку пользователь может публично сообщить о неудаче, утрате, конфликте, эмоциональном кризисе или другой проблемной ситуации, после чего получить большое количество реакций и комментариев. Таким образом, индивидуальное переживание преобразуется в коммуникативное событие, а речевой жанр утешения приобретает коллективный характер. В современной прагмалингвистике утешение рассматривается с различных позиций: как речевой жанр, речевой акт, коммуникативная интенция, коммуникативная стратегия и прагмалингвистический феномен. Исследование Е. Ю. Юкиной показывает, что утешение может включать эмоциональные и логические компоненты и реализовываться посредством комплекса коммуникативных стратегий. Исследования речевого жанра утешения также демонстрируют его зависимость от коммуникативной ситуации, статуса участников и культурно обусловленных моделей взаимодействия. Для виртуального дискурса принципиально важным становится вопрос о том, каким образом пользователь языковыми средствами демонстрирует понимание

эмоционального состояния другого человека и каким образом формируется эффект поддержки при отсутствии непосредственного контакта.

СТЕПЕНЬ ИЗУЧЕННОСТИ ПРОБЛЕМЫ

Проблематика речевых жанров связана прежде всего с пониманием жанра как относительно устойчивой модели речевого взаимодействия. В рамках теории речевых жанров важное значение имеет положение о том, что коммуникативная деятельность осуществляется посредством типизированных высказываний, обусловленных целями, условиями и социальной ситуацией общения. Утешение относится к жанрам, в которых особенно отчетливо проявляется межличностная направленность коммуникации. Его основная коммуникативная задача заключается не только в передаче информации, но и в изменении эмоционального состояния адресата. Поэтому утешение имеет выраженный перлокутивный потенциал: говорящий стремится уменьшить эмоциональное напряжение, снизить интенсивность негативного переживания, восстановить чувство психологической устойчивости или показать адресату, что он не остается один на один со своей проблемой.

В исследованиях утешения отмечается его связь с сочувствием, эмпатией, поддержкой и солидаризацией. При этом данные понятия не являются полностью тождественными. Сочувствие прежде всего выражает эмоциональное отношение к переживанию другого человека, эмпатия связана с попыткой понять его состояние и перспективу, а поддержка предполагает коммуникативное действие, направленное на облегчение ситуации. Утешение объединяет данные компоненты и организует их в рамках определенной коммуникативной цели. Современное исследование Е. Ю. Юкиной показывает, что прагматика утешения определяется конкретной коммуникативной ситуацией, а языковые средства могут сочетаться с невербальными и паравербальными компонентами. В исследовании О. В. Гриценко и О. Л. Соляненко утешение также рассматривается как самостоятельный речевой жанр, для которого характерны определенные лексические и грамматические сигналы.

Особое значение для настоящего исследования имеют работы, посвященные поддерживающей коммуникации в интернете. С. Кауфман и К. Уайтхед показали, что в онлайн-форумах поддерживающие действия могут быть адресатом признаны как проявление эмпатии, однако некоторые действия, задуманные говорящим как поддержка, могут интерпретироваться адресатом как неподдерживающие или даже антагонистические. Следовательно, прагматический эффект утешения не определяется исключительно намерением говорящего. Интерес представляют и исследования эмпатических дискурсивных маркеров. В работе Н.-Ён Ким 2026 года показано, что русские дискурсивные маркеры участвуют в формировании эмпатического согласования между коммуникантами и могут регулировать пропозициональную и рецептивную позиции участников общения. Таким образом, несмотря на значительное количество исследований

утешения, его функционирование именно в русскоязычном и англоязычном виртуальном пространстве требует дальнейшего комплексного анализа.

ЦЕЛЬ И ЗАДАЧИ ИССЛЕДОВАНИЯ

Цель исследования заключается в выявлении прагмалингвистических характеристик речевого жанра утешения в русскоязычном и англоязычном виртуальном дискурсе.

Для достижения поставленной цели определены следующие **задачи**:

- уточнить прагмалингвистическое содержание понятия «речевой жанр утешения»;
- определить коммуникативную цель и основные интенции утешения;
- выявить основные стратегии и тактики виртуального утешения;
- охарактеризовать лексические, грамматические и дискурсивные средства реализации жанра;
- сопоставить русскоязычные и англоязычные модели утешения;
- определить влияние специфики виртуальной коммуникации на прагматический потенциал жанра.

МАТЕРИАЛЫ И МЕТОДЫ ИССЛЕДОВАНИЯ

Материалом исследования выступают русскоязычные и англоязычные посты и комментарии, содержащие реакции на сообщения о неудачах, эмоциональных переживаниях, конфликтах, потерях, профессиональных или учебных трудностях и других негативно окрашенных событиях. При анализе использовались прагмалингвистический метод, дискурсивный анализ, контекстуальный анализ, функционально-семантический анализ, метод речевых стратегий и тактик, а также сравнительно-сопоставительный метод.

Особое внимание уделялось следующим параметрам:

- коммуникативной цели высказывания;
- эмоциональному состоянию адресата;
- предполагаемой интенции говорящего;
- степени эксплицитности поддержки;
- типу речевой стратегии;
- языковым средствам выражения утешения;
- характеру предполагаемого перлокутивного эффекта;
- наличию мультимодальных элементов.

В качестве иллюстративного материала ниже используются типичные модели виртуальных высказываний. Они приводятся как аналитические примеры речевых моделей, а не как количественно обработанные цитаты из конкретного корпуса.

1. Утешение как речевой жанр

Речевой жанр утешения представляет собой коммуникативно организованную модель взаимодействия, возникающую в ситуации эмоционального неблагополучия адресата. Его обязательным компонентом является наличие некоторого негативного события или состояния, которое становится основанием для ответной реакции. Структуру ситуации утешения можно представить следующим образом: *негативное событие* →

эмоциональная реакция адресата → осознание состояния адресата → речевая реакция говорящего → прагматическое воздействие.

При этом говорящий может непосредственно называть эмоциональное состояние адресата или лишь косвенно реагировать на него.

Например, русскоязычная модель: «Мне очень жаль, что тебе пришлось через это пройти. Ты не один, всё постепенно наладится».

Англоязычная модель: “I’m really sorry you’re going through this. You’re not alone. Things will get better.”

В обоих случаях присутствуют несколько последовательных компонентов: выражение эмоционального присоединения, обозначение солидарности и формирование позитивной перспективы. Следовательно, утешение представляет собой не одну языковую формулу, а комплекс речевых действий.

2. Прагматическая структура жанра утешения

Прагматическая структура утешения может быть представлена через пять основных компонентов.

Таблица 1. Прагматическая структура речевого жанра утешения

Компонент	Содержание	Типичная реализация
Ситуационный	наличие негативного события	неудача, потеря, конфликт, стресс
Эмотивный	распознавание состояния адресата	«понимаю», «тебе тяжело» / “I understand”, “that must be hard”
Интенциональный	намерение поддержать	«держись», «ты справишься» / “stay strong”, “you’ve got this”
Стратегический	выбор способа воздействия	сочувствие, нормализация, ободрение
Перлокутивный	ожидаемый эффект	снижение тревоги, чувство поддержки, восстановление уверенности

Прагматическая специфика утешения заключается в том, что содержание высказывания не исчерпывается его пропозициональным значением. Фраза «Всё будет хорошо» сама по себе представляет сообщение о будущем, однако в конкретном коммуникативном контексте она функционирует прежде всего как средство эмоционального воздействия.

Подобная особенность соответствует более широкому пониманию поддержки как речевого действия. Э. Дреснер отмечает, что поддержка в определенных случаях может обладать иллокутивной силой речевого акта, а положительные оценочные высказывания способны выполнять функцию поддержки.

3. Основные коммуникативные стратегии виртуального утешения

3.1. Стратегия эмоционального присоединения

Одной из наиболее распространенных стратегий является демонстрация эмоциональной вовлеченности говорящего.

В русском языке: «Мне очень жаль».

«Это действительно тяжело».
«Представляю, как тебе сейчас трудно».
«Очень сочувствую».
«Обнимаю».
В английском языке: “I’m so sorry.”
“That sounds really difficult.”
“I can imagine how hard this must be.”
“Sending you love.”
“I’m here for you.”

Прагматическая функция данных конструкций состоит в подтверждении значимости переживания адресата. Особенно важной является формула «I’m sorry». В зависимости от контекста она может выражать извинение, сожаление или сочувствие. В жанре утешения она функционирует как маркер эмоциональной солидарности.

3.2. Стратегия признания переживания

Данная стратегия предполагает подтверждение права адресата испытывать определенные эмоции.

Русские модели:«Ты имеешь право так себя чувствовать».
«Это нормально, что тебе сейчас тяжело».
«После такого любой бы расстроился».
Английские модели:“It’s okay to feel this way.”
“Your feelings are completely valid.”
“Anyone would feel the same after something like this.”

Прагматический эффект заключается в снижении вторичной эмоциональной нагрузки. Адресату не только плохо из-за исходной ситуации, но он может испытывать чувство вины за собственную реакцию. Нормализация эмоции позволяет устранить подобную дополнительную нагрузку.

3.3. Стратегия ободрения

Ободрение ориентировано на будущее и предполагает восстановление уверенности адресата.Русские формулы:«Ты справишься».
«У тебя всё получится».
«Не сдавайся».
«Ты сильнее, чем думаешь».
Английские:“You can get through this.”
“You’ve got this.”
“Don’t give up.”
“You’re stronger than you think.”

Для виртуального дискурса характерна высокая степень компрессии подобных высказываний. Короткая формула способна выполнять функцию полноценной эмоциональной поддержки.

3.4. Стратегия солидаризации

Солидаризация создает эффект совместности переживания:
«Мы рядом».

«Ты не один».

«Я рядом, если захочешь поговорить».

“You’re not alone.”

“We’re here for you.”

“I’m here whenever you need me.”

Здесь меняется коммуникативная перспектива: внимание переносится с индивидуального переживания адресата на отношения между участниками коммуникации. Исследования онлайн-поддержки показывают, что демонстрация эмпатии является важной частью взаимодействия в виртуальных сообществах, однако ее восприятие зависит от конкретной последовательности взаимодействия и реакции получателя.

3.5. Стратегия формирования позитивной перспективы

Эта стратегия предполагает переосмысление негативной ситуации:

«Сейчас трудно, но это не навсегда».

«Одна неудача не определяет тебя».

«Со временем станет легче».

“This moment doesn’t define you.”

“It won’t always feel this way.”

“Things can get better.”

Важной особенностью является временная перспектива. Говорящий противопоставляет настоящее состояние возможному будущему.

3.6. Стратегия предложения помощи

Утешение может переходить от эмоционального воздействия к потенциальному действию: «Если хочешь поговорить, я рядом».

«Если тебе нужна помощь, напиши».

«Давай попробуем разобраться вместе».

“If you need someone to talk to, I’m here.”

“Let me know if I can help.”

“We can figure this out together.”

Такие конструкции особенно значимы прагматически, поскольку демонстрируют не только эмоциональное отношение, но и готовность к дальнейшему взаимодействию.

4. Лексико-грамматические средства реализации утешения

Прагматический потенциал жанра формируется совокупностью различных языковых средств.

Таблица 2. Основные языковые средства утешения в русском и английском виртуальном дискурсе

Средство	Русский язык	Английский язык	Прагматическая функция
Эмотивная лексика	«жаль», «тяжело», «сочувствую»	“sorry”, “hard”, “painful”	выражение эмоционального участия
Местоимения	«мы», «ты», «тебе»	“we”, “you”, “us”	создание близости
Модальность	«всё получится», «может стать легче»	“you can”, “it may get better”	снижение категоричности

Императив	«держись», «не сдавайся»	“stay strong”, “don’t give up”	мобилизация
Вопросы	«Хочешь поговорить?»	“Do you want to talk?”	открытие канала взаимодействия
Оценочные конструкции	«ты сильный», «ты молодец»	“you’re strong”, “you did your best”	восстановление самооценки
Формулы солидарности	«я рядом», «мы с тобой»	“I’m here for you”, “we’re with you”	социальная поддержка

Особое место занимают местоименные формы. Противопоставление «ты - мы» позволяет представить адресата как участника общей коммуникативной и эмоциональной ситуации.

Сравним:

«Тебе сейчас тяжело, но мы рядом».

“It’s hard right now, but we’re here for you.”

В обоих примерах противопоставление индивидуального переживания и коллективной поддержки создает эффект эмоционального объединения.

5. Специфика утешения в виртуальном пространстве

Виртуальный дискурс существенно изменяет традиционную модель утешения. Главным фактором становится отсутствие физического присутствия. В обычной ситуации утешение может включать объятие, прикосновение, взгляд, изменение интонации, паузу. В интернете эти средства заменяются графическими и лингвистическими элементами. Эмодзи в подобных случаях не являются простым украшением текста. Они выполняют прагматическую функцию, усиливая эмоциональный компонент высказывания. Виртуальное пространство также позволяет использовать публичное утешение. Если в межличностной коммуникации утешение адресовано конкретному человеку, то комментарий под постом может одновременно обращаться к автору и к другим участникам сообщества.

Таким образом, возникает трехкомпонентная модель:

*автор поста → комментатор → виртуальное сообщество***.**

Комментатор выражает поддержку конкретному человеку, но одновременно демонстрирует нормы поведения, принятые в сообществе.

6. Русскоязычный и англоязычный дискурс: сопоставительный аспект

Сопоставление русскоязычного и англоязычного материала показывает наличие значительного универсального ядра жанра утешения.

К универсальным компонентам относятся:

выражение сожаления;

признание негативного эмоционального состояния;

демонстрация солидарности;

предложение помощи;

ободрение;

формирование позитивной перспективы.

Однако способы языкового оформления данных компонентов могут различаться. Для русского виртуального общения характерны достаточно экспрессивные краткие формулы: «Держись!»

«Не переживай».

«Всё будет хорошо».

«Я рядом».

«Обнимаю».

«Ты справишься».

Англоязычный дискурс также использует краткие формулы:

“Stay strong.”

“You’ve got this.”

“It’s going to be okay.”

“I’m here for you.”

“Sending hugs.”

“You can do this.”

При этом английские конструкции “I’m here for you” и “If you need anything, let me know” особенно четко эксплицируют готовность говорящего предоставить поддержку. Для русского материала более характерны формы непосредственного эмоционального присоединения, в том числе краткие императивные формулы и эмоционально окрашенные обращения.

При этом данные различия не следует абсолютизировать. Виртуальная коммуникация характеризуется высокой степенью межкультурного взаимовлияния, поэтому многие англоязычные формулы активно распространяются в русскоязычной цифровой среде.

7. Роль эмпатии в реализации жанра

Эмпатия является одним из ключевых механизмов формирования утешения. Однако эмпатия в дискурсе не должна пониматься исключительно как психологическое состояние говорящего. В прагмалингвистическом отношении она проявляется через конкретные речевые действия.

Например: **«***Понимаю, почему тебе сейчас больно***».**

Здесь говорящий демонстрирует признание эмоционального состояния.

В английском: *“I can understand why you’re hurting right now.”*

Подобные конструкции создают эффект эмоционального присоединения. Современное исследование русских эмпатических дискурсивных маркеров показывает, что такие единицы участвуют в согласовании позиций участников коммуникации и помогают регулировать степень межсубъектной близости. Для виртуального общения это особенно важно, поскольку отсутствие невербальных сигналов требует более явного кодирования отношения средствами языка.

10. Мультимодальность виртуального утешения

Особенность интернет-дискурса состоит в сочетании вербальных и визуально-графических средств.

Наиболее распространенными элементами являются:

эмодзи;

повтор знаков препинания;
прописные буквы;
графическое растяжение слов;
GIF-анимация;
изображения;
реакции;
стикеры.

В первом случае усиление достигается посредством графических средств, во втором - посредством сочетания эмотивной лексики и эмодзи. Таким образом, виртуальный жанр утешения имеет мультимодальную природу. Его прагматический потенциал формируется не только словесной конструкцией, но и визуальным оформлением сообщения.

Заключение

Речевой жанр утешения в виртуальном пространстве представляет собой сложное прагмалингвистическое образование, в котором языковые средства используются для эмоционального воздействия на адресата, выражения сочувствия, формирования солидарности и восстановления чувства психологической устойчивости. Анализ русскоязычных и англоязычных моделей показывает наличие общего прагматического ядра. В обоих языках реализуются стратегии эмоционального присоединения, признания переживания, солидаризации, ободрения, формирования позитивной перспективы и предложения помощи. Специфика виртуальной коммуникации проявляется в высокой степени краткости и стандартизации формул, активном использовании местоименных конструкций, эмотивной лексики, модальности, императивов, вопросов и предложений помощи. Дополнительную роль играют эмодзи, графические средства и другие мультимодальные компоненты. Сопоставительный анализ позволяет говорить не столько о принципиально различных моделях русского и английского утешения, сколько о различных предпочтениях в реализации общей коммуникативной задачи. При этом цифровая коммуникация способствует взаимопроникновению языковых и культурных моделей.

Особое значение имеет проблема прагматической эффективности. Само намерение говорящего поддержать адресата не гарантирует положительного эффекта. Высказывание, предназначенное для утешения, может быть воспринято как обесценивание проблемы, чрезмерная назидательность или неуместное вмешательство. Поэтому успешность жанра определяется соответствием речевой стратегии ситуации, эмоциональному состоянию адресата и степени межличностной близости участников. Таким образом, речевой жанр утешения в виртуальном пространстве следует рассматривать как динамический, интерактивный и мультимодальный тип речевого взаимодействия, в котором прагматический смысл формируется на пересечении интенции говорящего, языкового оформления, контекста и интерпретации адресата.

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МОЯКЛАР САРАТОН КАСАЛЛИГИДА ТАЖРИБА ҲАЙВОНЛАРИ ЧАМБАР ИЧАГИ ҚИСМЛАРИ ТУЗИЛМАЛАРИНИНГ МОРФОЛОГИЯСИ

Аннотация. *Онкологияда нур терапияси танага нурланишни етказиб бериш орқали хавфли ўсмаларга қарши курашишнинг юқори технологияли ва замонавий усули ҳисобланади. Радиация терапияси хавфли ўсмаларни даволашда ишлатиладиган митотик ингибитордир. У ҳужайра бўлинишини блоклайди, ҳужайра микроннайчалари ва айрим оқсил ферментларининг фаолиятини бузади. Улар аминокислоталар, нуклеин кислоталар метаболизмини ва липид синтезини ўзгартиради ва ҳужайра нафас олишига таъсир қилади. Баъзи ҳолларда чамбар ичак эпителий ҳужайраларида биологик ритмларнинг бузилиши замонавий профилактик тиббиётда қийинчилик туғдиради.*

Калит сўзлар: *Онкология, нур терапия, эпителий, саратон, ингибитор, митоз, крипта, қадаҳсимон ҳужайра, устунсимон ҳужайра, нейтрофил, лимфоцит, макрофаг и плазмоцит.*

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MORPHOLOGY OF THE STRUCTURES OF THE COLON SEGMENTS IN EXPERIMENTAL ANIMALS WITH TESTICULAR CANCER

Abstract. *In oncology, radiation therapy is a high-tech and modern method of combating malignant tumors by delivering radiation to the body. Radiation therapy is a mitotic inhibitor used in the treatment of malignant tumors. It blocks cell division, disrupts the function of cellular microtubules and certain protein enzymes. It alters the metabolism of amino acids and nucleic acids, affects lipid synthesis, and influences cellular respiration. In some cases, disruption of biological rhythms in colon epithelial cells creates challenges in modern preventive medicine.*

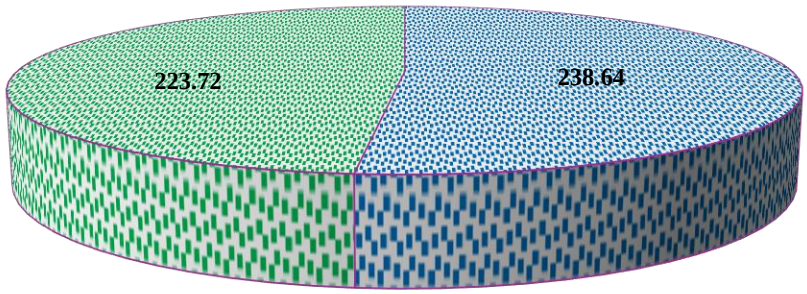
Keywords: *Oncology, radiation therapy, epithelium, cancer, inhibitor, mitosis, crypt, goblet cell, columnar cell, neutrophil, lymphocyte, macrophage, and plasma cell.*

Материалы и методы. Тажрибалар виварий шароитида туғилган 80 та 6 ойлик оқ эркак зотсиз каламушларда ўтказилди. Тажрибаларда ҳайвонлардан фойдаланиш бўйича этика талабларига риоя қилинди. Тажрибалар бошланишидан олдин барча каламушлар бир ҳафта давомида карантинда бўлди, кейинчалик улар одатий бир хил шароитдаги виварий режимига ўтказилди. Каламушлар 2 гуруҳга бўлинди (n = 80): I назорат гуруҳидаги (n = 40); 2 (n = 40) – гуруҳлар тажриба ҳайвонлари 4 ойликдан бошлаб мояклар саратон касаллигини чақириш учун тажриба гурухларда 7,12-диметилбензантрацен канцероген воситаси орқали каламушлар мояклар саратон касаллиги чақирилди. Бунда 68,9% натижага эришилди, яъни 40 та урғочи каламушлар моякларда 7,12-диметилбензантрацен канцерогени мояклар сохаси тери остига 0,1 мг дозада юбориш орқали 28 та каламуш мояклар саратон касаллиги чақирилди. 2-гуруҳ (n = 28) тажрибада мояклар саратон касаллигига чалинган каламушлар.

Долзарблиги.Тажрибавий мояклар саратон касаллигида оқ каламушлар чамбар ичаги қисмлари озиқланиши ва нафас олиши издан чиқа бошлайди [3,5]. Албатта бу касалликнинг дастлабки босқичларида яққол намоён бўлмайди, аммо кейинги босқичларида метоболизмнинг издан чиқиши кузатилади. Бунда ҳужайра бўлиниши, баъзи бир фермент оқсиллари синтези бузилади [1,4]. Улар аминокислоталар ва баъзи бошқа моддалар, масалан нуклеин кислоталар, ёғлар синтези алмашинувини ўзгартириши билан боғлиқ ҳисобланади [2].

6 ойлик каламушларда мояклар саратон касаллигини моделлаштирганимизда турли кўринишдаги патоморфологик ўзгаришларга дуч келдик.

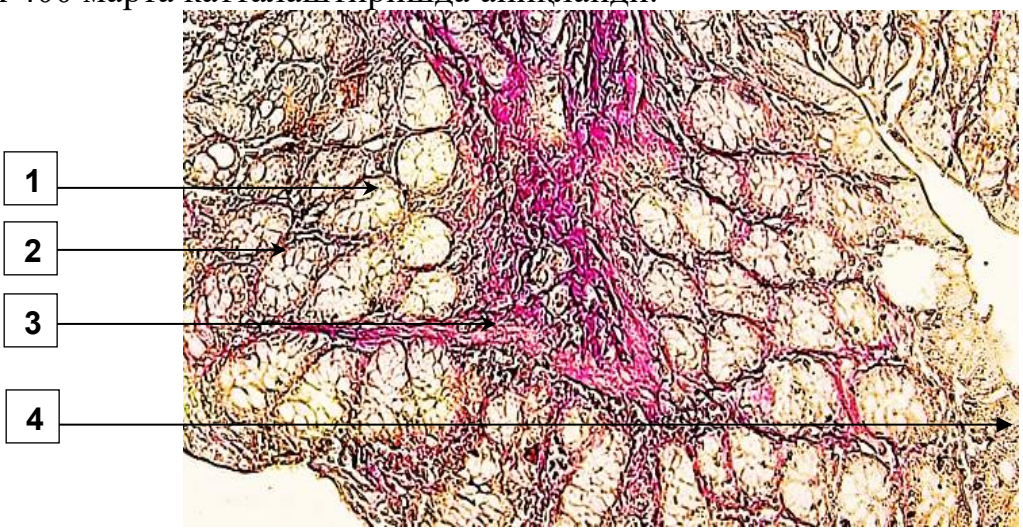
Мояклар саратон касаллигига чалинган 6 ойлик каламушларнинг тана вазни 217,23 грдан 259,34 гргача, ўртача 223,72 ± 2,37 гргача, бу тажрибанинг 1-гуруҳига қараганда 5,94% га кам вазнда эканлигини кўрсатди (1-расм).



1-расм. Назорат гуруҳи ва мояклар саратони чақирилган **тажриба ҳайвонлари тана вазнининг ўзгариши (гр).**

Визуал баҳолашда мояклар саратон касаллигига чалинган 6 ойлик каламушлар гуруҳи экспериментнинг 1-гуруҳи каламушлари чамбар ичаги қисмлари орасида фарқлар аниқламади, аммо чамбар ичаги қисмларининг органометрик параметрлари барча даврларда назорат гуруҳи қийматларидан сезиларли даражада кам бўлиб қолаверди, яъни каламушларнинг чамбар ичаги узунлиги 11,09 смдан 13,07 смгача, ўртача 12,02 ± 0,3 смгачани ташкил қилиб, бу тажрибанинг 1-гуруҳига қараганда 17,84% га кам узунликда эканлигини кўрсатди.

Назорат ва экспериментал гуруҳлардаги каламушларнинг чамбар ичак қисмларини морфологик текшириш гематоксилин ва эозин билан бўялган препаратларда ўтказилди. 1000 ҳужайрага тўғри келадиган нейтрофиллар, лимфоцитлар, плазмоцитлар, фиброцитлар ва фибробластларнинг нисбий сони 400 марта катталаштиришда аниқланди.



2-расм. Тажриба гуруҳ каламушлари чамбар ичак шиллиқ кавати. Вангизон усулида бўялган. ОК 10 х ОБ 40. 1-қадаҳсимон ҳужайралар, 2-устунсимон ҳужайралар, 3-бириктирувчи тўқима, 4-яллиғланиш белгилари.

Тажрибада мояклар саратонида суранкали яллиғланиш характеридаги ўзгаришлар ривожланди ва чамбар ичак шиллиқ қавати архитектоникасини қайта тикланиш ҳодисалари издан чиқиш белгилари кўрилди. Чамбар ичак тушувчи қисми қадаҳсимон ҳужайраларининг сони камая борди, препаратларда ҳужайра таркиби асосан лимфоцитлар, плазма ҳужайралари, макрофаглар ва якка учрайдиган нейтрофиллар билан ифодаланади. Назорат гуруҳи тажриба ҳайвонлари билан солиштирганда семиз ҳужайралар сонининг кескин ўсиши қайд этилган, уларнинг аксарияти дегрануляцияланган шаклда. Олинган маълумотлар бизга саратон таъсирида экспериментал ҳайвонларнинг чамбар ичак қисмларининг гистологик тузилмаларини шикастланишини айтишга имкон беради ва яллиғланиш таъсири ҳақидаги замонавий адабиётларга мос келади. Каламушларнинг чамбар ичагидаги сурункали яллигланиш шароитида шаклланиши, унинг деворида яллиғланиш ва шикастловчи характердаги морфологик ўзгаришларнинг ривожланиши фонида содир бўлди (2-расм).

Морфологик тадқиқотларда назорат ва экспериментал гуруҳларнинг каламушлари чамбар ичагининг дистал кисми эпителий қавати шикастланмаган ва ҳошияли цилиндрсимон эпителий билан қопланган.

Крипталар ингичка ва чуқур бўлиб, 138,64 мкмдан 174,21 мкмгача, ўртача 156,12 ± 14,06 мкмгачани ташкил қилиб, бу тажрибанинг 1-гуруҳига нисбатан 10,02% га кам чуқурликда эканлигини кўрсатди.

Уларнинг эпителий қопламаси юмалоқ ва овал шаклдаги қадаҳсимон ҳужайраларини ўз ичига олади. Крипталар туби эпителийсида митозли йўл билан бўлинган ҳужайралар кўринмайди. Шиллиқ қаватнинг хусусий пластинкаси стромасида жойлашган криптлар орасида диффуз тарқалган ҳолда фибробластлар, фиброцитлар сони камайган, аммо лимфоцитлар, якка-якка нейтрофиллар ва гистоцитлар каби ҳужайра элементлари миқдори ошган. Шунингдек ғовак толали бириктирувчи тўқима элементлари дағаллашган. Шиллиқ қаватнинг хусусий пластинкасининг базал юзасида ғовак толали бириктирувчи тўқима, ҳамда кўплаб миқдордаги диффуз-тарқоқ ҳолда лимфоцитлар и макрофаглар каби ҳужайра элементлари билан ифодаланади. Лимфа томирлари ички бўшлиқлари кенгайган.

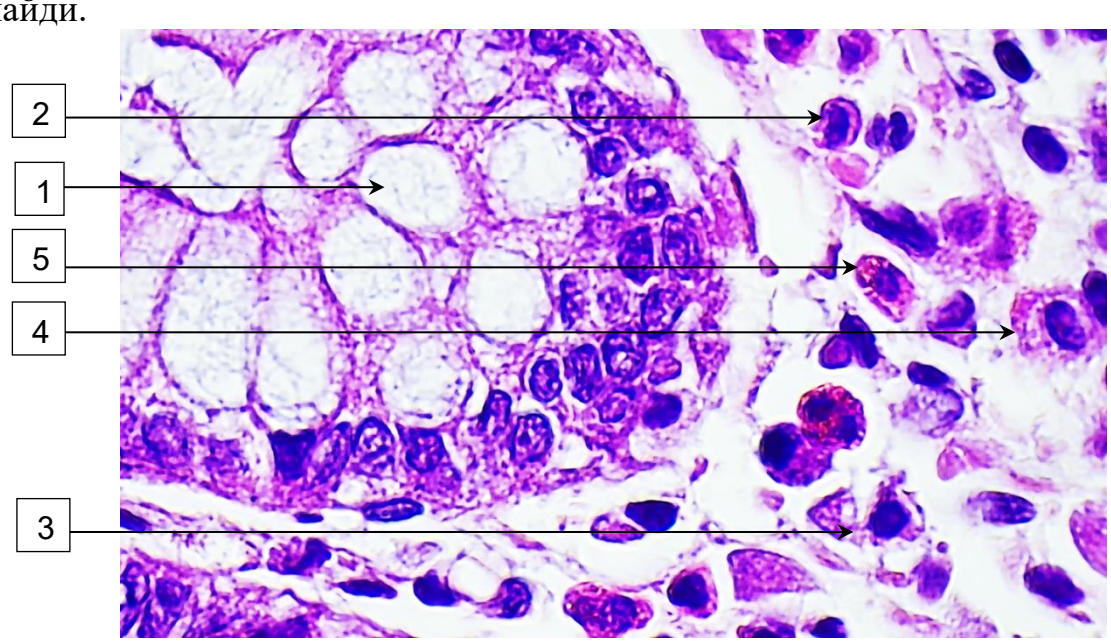
Чамбар ичак қисмлари шиллиқ қавати базал юзаси мушак пластинкаси донадор цитоплазмаси бўлган 3-5 қаватли силлиқ мушак ҳужайраларидан ташкил топган. Шиллиқ ости қаватида ғовак толали бириктирувчи тўқима мавжуд бўлиб, у бир неча лимфоцитлар ва гистиоцитларни ўз ичига олган ҳужайра элементлардан, шунингдек микроваскуляр томирлардан ташкил топган. Алоҳида лимфа томирларида лимфоцитларнинг тўпланиши кузатилади. Кўндаланг ва узунасига йўналган силлиқ мушак қаватлари ҳам донадор цитоплазмасига эга бўлган силлиқ мушак ҳужайралари билан ифодаланади. Сероз қават эса сийрак толали бириктирувчи тўқима ва бир қаватли яссиланган мезотелий ҳужайраларидан иборат.

Назорат гуруҳидан фарқли ўлароқ, мояклар саратон касаллигида каламушларда морфологик тадқиқот давомида қадаҳсимон ҳужайралари

кичикроқ бўлиб, шиллиқ қаватининг хусусий пластинкасидаги ҳужайра элементлари сони кўпайган.

Чамбар ичак қисмлари шиллиқ қаватининг хусусий пластинкасида ўтказилган морфометрик тажрибаларимиз тахлилига кўра, мояклар саратон касаллигида тажриба каламушларда назорат гуруҳига нисбатан крипталар ва базал мембрана юзаси ўртасидаги бириктирувчи тўқимадаги ҳужайрали элементларни сонининг мос равишда 29 - 34% га сезиларли ўсиши қайд этилган (2-расм). Бунда тажрибадаги калламушлар мояклар саратон касаллигида каламушларда назорат гуруҳига нисбатан ҳужайра элементлари орасида лимфоцитлар сони 30,27 тадан 37,41 тагача, ўртача 33,92 ± 1,08 тани ташкил қилиб, бу тажрибанинг 1-гуруҳига қараганда 58,5% га кўп, нейтрофиллар сони эса 1,85 тадан 1,36 тагача, ўртача 2,15 ± 0,5 тани ташкил қилиб, бу тажрибанинг 1-гуруҳига қараганда 57,7% га кўп миқдорда эканлигини кўрсатди.

Таққосланган 1 ва 2 - гуруҳлардаги плазмацитлар сони эса статистик жиҳатдан сезиларли даражада фарқ қилмади. Мояклар саратон касаллигида оқ каламушларда макрофагларнинг сони 5,39 тадан 8,83 тагача, ўртача 7,11 ± 0,68 тани ташкил қилиб, бу тажрибанинг 1-гуруҳига нисбатан 2 бараварга кўпайди.



3-расм. Тажриба гуруҳ каламушлари чамбар ичак шиллиқ кавати. Гематоксилин-эозин билан бўялган. ОК 10 х ОБ 100. 1-қадаҳсимон ҳужайралар, 2-нейтрофиллар, 3-лимфоцитлар, 4-семиз ҳужайралар, 5-макрофаглар.

Овал ва юмалоқ шаклдаги қадаҳсимон хужайралари мояклар саратон касаллигида оқ каламушларда уларнинг сони 44,14 тадан 51,59 тагача, ўртача 47,27±9,07 тани ташкил қилиб, бу тажрибанинг 1-гуруҳига қараганда 17,93% га кам, устунсимон ҳужаралар сони 16,24 тадан 21,63 тагача, ўртача 18,98±3,1 тани ташкил қилиб, бу тажрибанинг 1-гуруҳига қараганда 58,18% га кам миқдорда эканлигини кўрсатди.

Дегрануляцияланган турдаги семиз ҳужайралари сони 10,25 тадан 15,49 тагача, ўртача 12,92±0,3 тани ташкил қилиб, бу тажрибанинг 1-гуруҳига қараганда 39,86% га ошган миқдорда эканлигини кўрсатди (3-расм).

Чамбар ичак қисмларининг гистологик кесимларининг микрофотографияси ёрдамида шиллиқ қаватнинг хусусий пластинкасида ётувчи ҳужайра элементларининг мутлақ сони стандарт майдонда (1000 мкм^2) ҳисобланиб аниқланди. Криптадаги қадаҳсимон ҳужайралари сони ҳисобланиб чиқилди. Эпителий майдонининг стандарт бирлигида (1000 мкм^2) бўялган материалнинг шиллиқ қаватнинг хусусий пластинкасидаги нисбий ҳажм зичлиги аниқланди.

Тажриба якунида саратон касаллигига учраган ҳайвонларнинг чамбар ичак қисмлари шиллиқ қавати крипталар чуқурлиги назорат гуруҳи ҳайвонларникидан кам бўлган. Бу эса мояклар саратон касаллигида метоболизмни издан чиқишидан далолат беради ва салбий таъсир ҳисобланади.

Назорат гуруҳ ҳайвонларидан олинган чамбар ичак қисмлари материали дегенератив ёки атрофик ҳолатларнинг йўқлиги билан тавсифланади, аммо мояклар саратон касаллигига учраган ҳайвонларнинг чамбар ичак қисмлари шиллиқ қавати крипталар чуқурлиги назорат гуруҳи ҳайвонларникидан кам, терминал сохалари қадаҳсимон ҳужайралари кўринишлари эса ёркин, кенгайган, шиллиқ қаватни тенг қоплаган ҳолда. Шиллиқ ости қаватида полилокал равишда меъёрий думалоқ ҳужайра инфилтрацияси кузатилади.

Мояклар саратон касаллигига учраган гуруҳ ҳайвонлари чамбар ичак қисмлари шиллиқ қаватининг намуналарида назорат гуруҳидагига нисбатан шиш ва шиллиқ ости қаватида патологик ўзгаришларга учраган эпителий қавати кузатилади. Чамбар ичак қисмлари шиллиқ ости қаватида коллаген толаларининг қалинлашиши ва бириктирувчи тўқималарнинг кўпайиши кузатилди. Шу билан бирга чамбар ичак бўйлаб барча тўқималарини шикастланиши бутун ичак деворининг қалинлиги ошишига олиб келди. Коллаген толаларининг ҳажм улуши, тарқалишини ва уларнинг нисбатини баҳолаш учун дистал чамбар ичак деворининг Ван Гизон усулида бўялган қисмларининг микрофотографияси ишлатилган.

Тажрибада мояклар саратонида оқ каламушларда назорат гуруҳи билан солиштирганда, крипталар орасидаги шиллиқ қаватининг хусусий пластинкасида коллаген толаларининг нисбий ҳажм улушининг статистик жиҳатдан сезиларли ўсиши ва шиллиқ қаватининг хусусий пластинкасининг базал юзаларида ҳажм улушининг ортиши аниқланди. Шиллиқ қаватининг хусусий пластинкасининг базал юзада толаларнинг нисбий ҳажм улушини ошириш тенденцияси ҳам кузатилди. Шиллиқ қаватининг хусусий пластинкасида коллаген толаларининг ҳажм улуши таққосланган гуруҳлар орасида фарқ аниқланди. Крипталарида коллаген толаларнинг нисбий ҳажм улушининг етук коллагаен толаларга нисбати ўзгарди, аммо тажриба гуруҳлари солиштирилганда крипталарнинг базал юзада ва шиллиқ ости қаватида бу кўрсаткичлар бир-биридан фарқ қилмади.

Хулоса. Шундай қилиб, чамбар ичак қисмлари эпителий қаватида реактив морфологик ўзгаришлар ривожланади, бу қадаҳсимон ҳужайраларининг таркибининг ҳажм улушининг пасайиши билан тавсифланади. Шунингдек, ҳар бир криптидаги қадаҳсимон ҳужайралари сонини камайиш тенденциясига сабаб бўлади. Шиллиқ қаватининг хусусий пластинкасида ҳужайра элементлари сони ва улар орасида лимфоцитлар, нейтрофиллар ва макрофагларнинг нисбий таркиби ортади. Тажрибада мояклар саратонида кимётерапияни қўллаш каламушларда чамбар ичак шиллиқ қаватининг крипталарида дистал ичак деворида назорат гуруҳига нисбатан шаклланган ва шаклланмаган коллаген толалари нисбати ўзгаради. Якка-якка ҳолда эрозив ўзгаришларга учраган ўчоқлар қайд этилди.

Мояклар саратон касаллигига учраган гуруҳ ҳайвонлари чамбар ичак қисмлари шиллиқ қаватининг намуналарида назорат гуруҳидагига нисбатан семиз ҳужайралари миқдори устунлик қилди. Улар асосан тушувчи чамбар ичакнинг пастки учдан бир қисмида ва уларнинг бириктирувчи тўқималарида аниқланди. Бошқача қилиб айтганда, асосан чамбар ичак тўқималарида семиз ҳужайралар периваскуляр тарзда локализация қилинган ва функционал фаолиятнинг турли босқичларида бўлган. Ҳужайра таркиби, яъни макрофаглар ва плазмоцитларининг кўпайиши, лимфоцитлар сонининг ошиши билан тавсифланади. Уларнинг сони мос равишда 26,8 ва 27,1 фоизга ошди. Семиз ҳужайраларида сезиларли фарқлар аниқланди, уларнинг сони мояклар саратон касаллигига учраган гуруҳ ҳайвонлари чамбар ичак шиллиқ қаватининг намуналарида назорат гуруҳидагига нисбатан семиз ҳужайралари миқдори ҳам мос равишда 39,86% га ошди.Қадаҳсимон ҳужайралари сони эса 7,99% га камайди. Уларнинг цитоплазмасида кўплаб донадор гетерогенлик кузатилди.

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ЦИФРОВОЕ ОБРАЗОВАТЕЛЬНОЕ ПРОСТРАНСТВО КАК РЫНОК РЕПУТАЦИОННЫХ АКТИВОВ: ИНСТИТУЦИОНАЛИЗАЦИЯ ПРАВА НА ОШИБКУ И ЭКОНОМИЧЕСКИЕ РИСКИ ПЛАТФОРМЕННОГО СКОРИНГА

Аннотация. *В статье исследована трансформация школьной ошибки из биографического события в цифровой информационный актив при алгоритмизации образования. Проанализированы российская и китайская модели взаимодействия образовательных платформ с государственными и корпоративными системами оценки. Показано, что фиксация поведенческих данных формирует «репутационный залог» и траекторную зависимость в накоплении человеческого капитала. Рассмотрены механизмы алгоритмической непрозрачности, автоматизации неравенства и цифровой окаменелости. Предложены меры защиты: сроки давности данных, независимый аудит и право на объяснение. Результаты демонстрируют необходимость регулирования рыночных провалов образовательных данных, сохраняя гуманистическую функцию школы.*

Ключевые слова: *цифровое образование; право на ошибку; платформенный скоринг; репутационные активы; алгоритмическая непрозрачность; цифровая окаменелость.*

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DIGITAL EDUCATIONAL SPACE AS A MARKET OF REPUTATIONAL ASSETS: INSTITUTIONALIZATION OF THE RIGHT TO ERR AND ECONOMIC RISKS OF PLATFORM SCORING

Abstract. *The article investigates the transformation of a school error from a biographical event into a digital informational asset under the algorithmization of education. The Russian and Chinese models of interaction between educational platforms and state and corporate evaluation systems are analyzed. It is shown that fixation of behavioral data forms a "reputational collateral" and path dependence in human capital accumulation. Mechanisms of algorithmic opacity, automation of inequality, and digital ossification are examined. Protective measures are proposed: data expiration terms, independent audit, and the right to explanation. Results demonstrate the need to regulate market failures of educational data while preserving the humanistic function of school.*

Keywords: *digital education; right to err; platform scoring; reputational assets; algorithmic opacity; digital ossification*

Введение. В условиях ускоренной алгоритмизации социальных отношений школа заметно меняет свой институциональный статус. Образовательная среда уже не выглядит только каналом передачи знаний. Она все больше превращается в инфраструктуру, где генерируются первичные информационные активы – массивы данных о поведении, дисциплине, коммуникации и вовлечённости учащихся. Раньше школьная ошибка воспринималась как естественная часть социализации и формирования человеческого капитала, как элемент биографического опыта, который можно было переосмыслить в педагогическом контексте. Цифровая инфраструктура придает ей другой экономический статус. Ошибка становится фиксируемым, сохраняемым и потенциально конвертируемым информационным активом. Такой актив может влиять на будущие транзакционные издержки и доступ к экономическим возможностям. В этом сдвиге меняется сама логика социальной мобильности.

Как указано в монографии «Цифровое мышление и педагогика будущего: трансформация образования в эпоху искусственного интеллекта»: «преадаптация к неопределённости возможна только при сохранении пространства автономии и права субъекта на изменение своей траектории развития» [1]. Стыковка образовательных платформ с государственными и корпоративными экосистемами делает проблему уже управленческой. Формируется единое информационное поле, которое должно снижать асимметрию информации между институтами образования, государством и будущими работодателями. «Сферум», электронные дневники, «ДОБРО.РФ» в России, «Чжихуа Сяоюань», «Сюэсиньван», «Гоцзя Чжун Сяо Сюэ Чжихуэй Цзяоюй Пинтай» в Китае создают среду, где школьный цифровой след давно выходит за пределы учебного контекста. Он начинает выступать ранним сигнальным механизмом на рынке труда. Отсюда возникает центральный

вопрос. Как защитить несовершеннолетнего от долговременной цифровой стигматизации, если данные, произведённые в школе, начинают циркулировать в межведомственных и платформенных системах оценки? Этот вопрос связан и с проблемой прав человека в условиях алгоритмического управления, и с рисками преждевременного скоринга, который искажает инвестиционные траектории в человеческий капитал.

Методология. Исследование построено на сравнительном институциональном анализе российской и китайской моделей цифровизации образования. Дополнительно использовано концептуальное моделирование института «права на ошибку». Аналитическая рамка объединяет экономику информации, институциональную теорию и правовой анализ цифровых прав. Образовательную среду мы рассматриваем не только как социальную систему. Она выступает и как экономическая инфраструктура производства и обработки данных, где формируются репутационные активы и издержки. Методологически важно различать явную и скрытую институционализацию скоринга. В одном случае речь идет о формализованных государственных системах. В другом – о неформальной, но структурно значимой совместимости образовательных и репутационных платформ.

Обзор источников. Теоретическая база объединяет исследования надзорного капитализма, алгоритмической справедливости и институционального скоринга. Ш. Зубофф [3] анализирует платформенное изъятие поведенческого излишка. Это превращает человеческий опыт в предсказуемый ресурс для монетизации. Работы К. О'Нил [4] и Ф. Паскуале [5] раскрывают проблему алгоритмической непрозрачности и скрытого социального предубеждения в математических моделях. Для понимания китайской модели используются исследования Ж. Костка [6], которая рассматривает социальный кредит как распределённую инфраструктуру доверия. А. Д. Трахтенберг [7] выделяет внешнее, то есть контрольное, и внутреннее, то есть нормативное, действие системы. Риски автоматизации неравенства через цифровое профилирование исследует В. Юбэнкс [8]. Литература дает инструменты для анализа экономических механизмов данных и институциональных форм их использования в образовательном контексте.

Результаты исследования. Цифровые образовательные платформы России, включая «Сферум», электронные дневники, «ДОБРО.РФ», «Сетевой город. Образование», формируют пересекающиеся массивы данных об учащихся. Эти контуры пока не сведены в единую систему скоринга. Но их техническая совместимость уже создает потенциал для межплатформенного сцепления школьных метрик. В итоге посещаемость, темп выполнения заданий, дисциплинарные замечания, волонтёрская и конкурсная активность постепенно перестают быть только педагогическими индикаторами. Они становятся элементами формирующегося цифрового профиля.

Иная степень институционализации прослеживается в Китае. Там образовательные платформы встроены в более широкую инфраструктуру

оценки доверия [7]. Но экономический смысл подобной датафикации носит универсальный характер. Образовательные данные генерируются в повседневной деятельности школы, а платформенная логика стремится сделать это поведение измеримым [1; 2]. Проблема в том, что измеряемое далеко не всегда совпадает с тем, что действительно важно для оценки развития ребёнка.

Алгоритмы, которые агрегируют такие данные, склонны оптимизировать простые прокси-переменные вместо реальных образовательных целей [4]. Низкая активность в чате, нерегулярное выполнение заданий или ограниченное участие в инициативах могут интерпретироваться как недостаточная надёжность. Хотя за этим могут стоять семейные обстоятельства, особенности развития, перегрузка или неравный доступ к цифровым ресурсам. При бессрочном хранении таких показателей временный, возрастно обусловленный эпизод закрепляется в цифровом профиле. Он теряет свой контекстуальный и преходящий характер. И это уже влияет на саму логику оценки.

Дополнительно этот риск усиливает отсутствие прозрачности оценочных механизмов. Когда учащийся не знает, какие именно его показатели учитываются и как они могут быть интерпретированы, нарушается баланс информационной асимметрии между образовательной платформой и её несовершеннолетним пользователем [5]. Это создает предпосылки для того, чтобы школа начала преждевременно ранжировать учащихся. То есть закреплять различия вместо того, чтобы их компенсировать [6].

Дискуссия. Центральное противоречие состоит в необходимости балансировать между легитимной образовательной аналитикой и долговременным социальным маркированием. Государство действительно заинтересовано в диагностике рисков и в повышении качества образования. Но бессрочное сохранение поведенческих метрик несовершеннолетних превращает детскую и подростковую ошибку в своего рода «репутационный долг». Такой долг необоснованно дисконтирует будущие возможности человека.

Особую остроту это противоречие получает в связи с социальным неравенством. Дети располагают разными ресурсами для формирования «благоприятного» цифрового следа. Одни активно участвуют в проектах и конкурсах. Другие по объективным обстоятельствам не могут этого делать. Использование унифицированных цифровых индикаторов в такой ситуации, без учета контекста, ведет к закреплению неравенства, а не к его сглаживанию [6]. Расширение сцепления образовательных данных с другими государственными и кадровыми сервисами увеличивает горизонт возможного использования школьного цифрового следа. Это усиливает отложенные риски для наиболее уязвимых учащихся.

Для предупреждения этих рисков нужна институциональная архитектура защиты. Прежде всего целесообразно ввести принцип давности для негативных поведенческих данных школьников. Они не должны

сохранять управленческую значимость бессрочно. Нужны и внешний алгоритмический аудит образовательных платформ, и реальное право учащегося и его родителей на объяснение того, на основании каких данных и по какой логике формируется та или иная оценка [5]. Как подчеркивается применительно к автоматизированным решениям, такие гарантии должны носить не декларативный, а действенный характер [8]. Эти меры не снижают требовательности к учащимся. Они институционализируют само «право на ошибку». Они проводят принципиальную границу между воспитательной обратной связью и пожизненным цифровым клеймом.

Заключение. Интеграция образовательных систем с государственными и корпоративными механизмами скоринга меняет не только техническую организацию школы. Она меняет и саму структуру жизненных шансов учащегося, прямо влияя на траекторию накопления человеческого капитала и потенциальные доходы. Российская модель развивается через нарастающее сцепление «Сферума», «Госуслуг», электронных дневников, федеральных реестров и платформ вроде «ДОБРО.РФ». Китайская модель развивается через более институционализированную связку «Сюэситун», «Сюэсиньван», «умных кампусов» и систем доверия. В обеих конфигурациях школьное поведение рискует выйти за пределы педагогической оценки и стать частью раннего социального ранжирования.

Сохранить гуманистическую функцию образования можно только при иной нормативной архитектуре, которая учитывает специфические провалы рынка данных. Речь идет не только о регулировании технологий. Речь идет и о том, каким общество видит ребёнка – субъектом развития или объектом ранней сортировки. Если право на несовершенство не будет институционально защищено через амортизацию репутационных издержек, внешний аудит и право на объяснение, школа может стать первым этапом алгоритмического распределения жизненных шансов задолго до того, как человек получит возможность самостоятельно определить собственную траекторию. В долгосрочной перспективе это снижает инновационный потенциал экономики за счет сужения разнообразия человеческих траекторий и преждевременной сегрегации талантов..

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СОВРЕМЕННЫЕ ОПЕРАЦИОННЫЕ СИСТЕМЫ: ТЕНДЕНЦИИ РАЗВИТИЯ И ИНТЕГРАЦИЯ LINUX-РЕШЕНИЙ В ГОСУДАРСТВЕННЫЙ АППАРАТ В УСЛОВИЯХ ИМПОРТОЗАМЕЩЕНИЯ

Аннотация*: В статье исследуются фундаментальные изменения в архитектуре и кибербезопасности информационных систем государственного управления, вызванные глобальным переходом к цифровому и технологическому суверенитету. На основе анализа международных ИТ-трендов, нормативно-правовой базы и результатов авторского анкетирования рассмотрены процессы миграции с проприетарных систем семейства Windows на решения с открытым исходным кодом на базе ядра Linux в странах Европы, Китая и СНГ. Детально изучены ключевые технологические векторы развития операционных систем, включающие контейнеризацию, модули безусловного контроля доступа, адаптацию под архитектуры ARM и RISC-V. Выявлены основные системные и кадровые барьеры миграции: проблемы совместимости специализированного программного обеспечения, дефицит профильных компетенций у государственных служащих и инерционность пользовательского опыта. Предложен комплексный научно-практический подход, объединяющий развитие отечественных программно-аппаратных стеков, виртуализацию унаследованных приложений и системную модернизацию профильного ИТ-образования с базовой ориентацией на дистрибутивы Linux. Результаты исследования могут быть использованы при формировании региональных стратегий импортозамещения и разработке учебных программ для подготовки специалистов в области сетевого и системного администрирования.*

Ключевые слова*: операционные системы, Linux, импортозамещение, цифровой суверенитет, Windows, государственное управление, информационная безопасность, контейнеризация, кадровый потенциал, профессиональные компетенции.*

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MODERN OPERATING SYSTEMS: DEVELOPMENT TRENDS AND INTEGRATION OF LINUX SOLUTIONS INTO THE STATE APPARATUS IN THE CONTEXT OF IMPORT SUBSTITUTION

Annotation*: The article examines fundamental changes in the architecture and cybersecurity of public administration information systems caused by the global transition towards digital and technological sovereignty. Based on the analysis of international IT trends, regulatory frameworks, and results of the authors' survey, the processes of migration from proprietary Windows systems to open-source solutions based on the Linux kernel in Europe, China, and the CIS are considered. Key technological vectors in the evolution of operating systems, including containerization, mandatory access control modules, and hardware adaptation for ARM and RISC-V architectures, are analyzed in detail. The main systemic and staffing barriers to migration are identified: compatibility issues of specialized software, a deficit of specialized competencies among public servants, and user habit inertia. A comprehensive scientific and practical approach is proposed, uniting the development of sovereign software and hardware stacks, virtualization of legacy applications, and systemic modernization of specialized IT education oriented toward Linux distributions. The results of the study can be applied in forming regional import substitution strategies and developing educational programs for network and system administration specialists.*

Keywords*: operating systems, Linux, import substitution, digital sovereignty, Windows, public administration, information security, containerization, human capital, professional competencies.*

Глобальная трансформация цифрового пространства и обострение геополитической обстановки выдвинули вопросы обеспечения кибербезопасности и технологической независимости на уровень фундаментальных приоритетов государственной политики. Операционная система, традиционно воспринимавшаяся как связующее программное звено между аппаратной частью и пользователем, сегодня превратилась в базовый элемент критической информационной инфраструктуры. Многолетнее доминирование проприетарных платформ, в первую очередь семейства Microsoft Windows, сформировало высокий уровень рисков, связанных с проприетарной закрытостью исходного кода, наличием потенциальных

скрытых уязвимостей, сбором телеметрических данных и постоянной угрозой одностороннего отзыва лицензий или прекращения технической поддержки. В ответ на данные вызовы мировым трендом становится формирование концепции «цифрового суверенитета», ключевым инструментом реализации которой выступают операционные системы, построение которых базируется на ядре Linux с открытым исходным кодом. Однако практический переход государственного аппарата на альтернативные платформы сталкивается с комплексом проблем как технико-технологического, так и кадрового характера. Цель настоящего исследования заключается в глубоком анализе мировых и отечественных тенденций развития операционных систем, системном выявлении барьеров импортозамещения и разработке рекомендаций по эффективной интеграции Linux-решений в структуры государственного управления.

Теоретико-методологическую основу работы составили концепции национальной информационной безопасности, теория институциональных изменений и современные подходы к построению доверенных вычислительных сред. В отечественной научной мысли ключевые аспекты цифрового суверенитета и импортозамещения программных продуктов освещены в трудах Касперской, Смирнова, Иванова, Макарова и Семенова, а теоретические основы построения открытых систем заложены в фундаментальных работах Торвальдса и Столлмана. Современный этап развития операционных систем характеризуется сдвигом от реактивного обеспечения безопасности к проактивному, при котором механизмы защиты интегрируются непосредственно в архитектуру ядра. Тем не менее системный анализ отраслевых и региональных специфик перехода госслужащих на Linux-платформы, а также роль профильных образовательных учреждений в адаптации кадрового потенциала остаются недостаточно раскрытыми, что определяет научную и практическую значимость данной статьи.

Методология исследования включает методы системного, логического и сравнительного анализа, статистическую обработку данных, метод экспертных оценок и эмпирический опрос. Эмпирическую базу исследования составили официальные статистические сборники, аналитические доклады Министерства цифрового развития, связи и массовых коммуникаций Российской Федерации, нормативно-правовые акты, а также результаты авторского анкетирования, проведенного среди ИТ-специалистов, системных администраторов и сотрудников государственных учреждений Чеченской Республики (общий объем выборки составил восемьдесят пять респондентов). Анкетирование проводилось в период с сентября по ноябрь при непосредственном участии студентов и преподавателей ГБПОУ «Грозненский Государственный колледж информационных технологий», что позволило собрать объективный первичный материал и оценить реальную степень готовности инфраструктуры и кадров к работе в новой программной среде.

Анализ современных тенденций в архитектуре операционных систем показывает, что ключевым вектором их эволюции выступает глубокая интеграция технологий контейнеризации и микросервисного подходи. Повсеместное внедрение таких инструментов, как Docker, Podman и Kubernetes, требует от ОС минималистичности, высокой производительности ядра и изоляции исполняемых сред. Вторым важнейшим трендом является усиление контроля безопасности на уровне системных вызовов: применение модулей мандатного разграничения доступа (SELinux, AppArmor, Parsec) и внедрение языков с безопасной работой с памятью (в частности, интеграция компонентов на языке Rust в ядро Linux). Третья тенденция заключается в необходимости обеспечения мультиплатформенности: современные ОС должны одинаково эффективно функционировать не только на традиционных процессорах архитектуры x86_64, но и на энергоэффективных архитектурах ARM64 и RISC-V, а также на отечественных процессорных архитектурах «Эльбрус» и «Байкал».

Изучение международного опыта интеграции Linux-систем в государственный аппарат демонстрирует различие подходов в зависимости от нормативных и геополитических факторов. Наиболее радикальную и глубокую модель демонстрирует Китайская Народная Республика. В рамках реализации программы полного вытеснения иностранного стека технологий доля госучреждений, переведенных на национальные операционные системы OpenKylin, Deepin и UnionTech OS (UOS), превысила восемьдесят пять процентов. Специфика китайской модели заключается в синхронном импортозамещении: операционные системы развиваются в неразрывной связке с отечественными процессорами Loongson, Sunway и Kunpeng, что создает замкнутую доверенную экосистему, полностью исключающую аппаратно-программные закладки.

В странах Европейского союза главным драйвером перехода на свободное программное обеспечение выступают жесткие стандарты защиты персональных данных (GDPR) и стремление избавиться от финансовой зависимости перед транснациональными корпорациями. Ярким примером служит германская федеральная земля Шлезвиг-Гольштейн, где в рамках правительственной программы начата миграция более тридцати тысяч рабочих мест государственных служащих с Windows и Microsoft Office на Linux и LibreOffice. Во Франции проект GendBuntu, реализуемый в рамках Национальной жандармерии, охватил более семидесяти тысяч рабочих станций, позволив снизить совокупную стоимость владения ИТ-инфраструктурой на сорок процентов за счет исключения лицензионных платежей и оптимизации аппаратно-ресурсных требований.

В Российской Федерации и странах СНГ процессы замещения иностранного ПО приняли системный и законодательно закрепленный характер. Основными регуляторными драйверами выступают Федеральный закон № 187-ФЗ «О безопасности критической информационной инфраструктуры», а также Постановления Правительства РФ № 1236 и №

1912. На отечественном рынке сформировался зрелый сегмент дистрибутивов, среди которых ведущие позиции занимают Astra Linux, РЕД ОС, «Альт» (Базальт СПО) и РОСА. Лидирующие отечественные ОС характеризуются наличием собственных сертифицированных графических оболочек (Fly), интегрированными средствами защиты от несанкционированного доступа и полной соответственностью требованиям ФСТЭК и ФСБ России. По имеющимся статистическим данным, доля российских ОС в органах государственной власти и на объектах КИИ к текущему периоду превысила семьдесят процентов.

Детальный анализ кадровых и технологических аспектах миграции, проведенный на базе ГБПОУ «Грозненский Государственный колледж информационных технологий», выявил ряд существенных проблем. Результаты проведенного анкетирования показали, что семьдесят шесть процентов государственных служащих и сотрудников подведомственных организаций имеют непрерывный стаж работы исключительно в операционной системе Windows более десяти лет. При этом лишь двадцать два процента опрошенных проходили специализированные курсы повышения квалификации по администрированию или работе в Linux-среде за последние два года. Более пятидесяти восьми процентов респондентов указали на психологический барьер и трудности адаптации к новому графическому интерфейсу, иному принципу работы файловой системы и структуре прав доступа. Около сорока пяти процентов специалистов ИТ-служб отметили проблемы совместимости специализированного прикладного ПО (бухгалтерские комплексы, специализированные ГИС, графические системы и клиентские модули криптографической защиты), изначально разработанного под платформу Win32.

Кроме того, среди главных барьеров респонденты выделили проблемы с драйверами для унаследованного периферийного оборудования (сканеры, специфические принтеры, оргтехника прошлых поколений) и отсутствие нативных версий некоторых ведомственных программных продуктов. Вместе с тем восемьдесят четыре процента участников анкетирования признают необходимость и неизбежность полного перехода на отечественные операционные системы, определяя ключевым фактором успеха наличие доступного и качественного обучения. Исследование также показало возрастной разрыв: молодые ИТ-специалисты и выпускники колледжей легко осваивают работающие под Linux серверные роли и инструменты автоматизации, но сталкиваются с необходимостью поддержки устаревших Windows-сервисов, тогда как опытные сотрудники испытывают сложности именно при переходе на новые операционные среды.

На основе проведенного анализа сформулирован комплексный подход к преодолению выявленных барьеров, объединяющий три ключевых направления. Технологическое направление требует широкого внедрения технологий виртуализации рабочих мест (VDI) и средств эмуляции (WINE, Proton, контейнеризация) в качестве переходного решения для запуска

специализированных Windows-приложений, параллельно с процессом их переписывания под кроссплатформенные или веб-архитектуры. Организационно-методическое направление предполагает создание единых стандартов совместимости периферийного оборудования, включение в государственные закупки требований о наличии нативных Linux-драйверов, а также создание централизованных баз знаний и государственных репозиториев проверенного софта.

Кадровое направление является центральным звеном успешного импортозамещения. Нами обоснована необходимость кардинальной перестройки образовательного процесса в средних профессиональных и высших учебных заведениях ИТ-профиля. Наглядным практическим примером выступает ГБПОУ «Грозненский Государственный колледж информационных технологий», где, начиная с 2026 года, всё компьютерное оборудование и лаборатории были полностью переведены под управление отечественной операционной системы РЕД ОС, а все рабочие учебные программы адаптированы под активное использование и администрирование Linux-систем. Это позволило сформировать полноценную доверенную среду для обучения, интегрировать вендорские сертификационные программы в учебный план подготовки техников и системных администраторов, а также проводить курсы повышения квалификации для действующего штата госслужащих. Интеграция наставничества и практико-ориентированного обучения позволяет сократить адаптационный период пользователей на тридцать-сорок процентов и снизить количество обращений в службы технической поддержки при миграции.

Подводя итог, следует констатировать, что переход государственных структур на операционные системы на базе ядра Linux представляет собой объективный, закономерный и необратимый процесс, продиктованный логикой формирования национальной безопасности. Международный опыт Китая и стран Европы, а также практика российских регионов доказали готовность Linux-платформ к выполнению самых сложных задач государственного управления. Основным узким местом текущего этапа выступает не недостаток функционала операционных систем, а кадровый дефицит и нехватка адаптированного прикладного ПО. Реализация предложенного комплекса технологических и образовательных мер позволит обеспечить плавный переход государственной информационно-коммуникационной инфраструктуры на суверенные платформы, повысив ее надежность, защищенность и эффективность.

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СИСТЕМА УЧЕБНЫХ ЗАДАНИЙ ПО РАЗВИТИЮ ОСНОВАННОЙ НА ДОКАЗАТЕЛЬСТВАХ ЧИТАТЕЛЬСКОЙ ГРАМОТНОСТИ НА МАТЕРИАЛЕ МУЛЬТИМОДАЛЬНЫХ ТЕКСТОВ

Аннотация. *Цель исследования состояла в разработке и эмпирической апробации системы учебных заданий, направленной на развитие у студентов навыков доказательного (evidence-based) чтения мультимодальных текстов, сочетающих вербальный, визуальный и графический компоненты. В условиях цифровизации образования обучающиеся всё чаще сталкиваются с составными текстами, требующими интеграции сведений из разных семиотических источников и обоснования выводов прямыми отсылками к тексту. Разработанная система включает четыре последовательных уровня заданий: локализацию информации, интерпретацию мультимодальных связей, критическую оценку достоверности источников и аргументированное письменное обоснование позиции. В пилотном исследовании приняли участие 96 студентов бакалавриата технического университета (экспериментальная группа n = 48, контрольная группа n = 48); использован квазиэкспериментальный план с предварительным и итоговым тестированием. Результаты показали статистически значимый прирост показателей доказательного чтения в экспериментальной группе по сравнению с контрольной ($p < 0,01$; $d = 0,71$); наибольший эффект зафиксирован для заданий на критическую оценку источников. Обсуждаются дидактические механизмы, обеспечивающие перенос навыков между модальностями, а также ограничения исследования. Полученные данные могут быть использованы при проектировании курсов академической грамотности и при подготовке студентов к написанию научных текстов.*

Ключевые слова: *мультимодальные тексты, читательская грамотность, доказательное чтение, учебные задания, академическая грамотность, критическое мышление.*

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A SYSTEM OF LEARNING ASSIGNMENTS FOR DEVELOPING EVIDENCE-BASED READING LITERACY USING MULTIMODAL TEXTS

Abstract. *The purpose of this study was to develop and empirically test a system of learning assignments aimed at developing students' evidence-based reading skills in multimodal texts that combine verbal, visual, and graphical components. In the context of digitalization of education, students increasingly encounter composite texts that require integrating information from different semiotic sources and substantiating conclusions with direct references to the text. The developed system includes four sequential levels of assignments: information localization, interpretation of multimodal connections, critical assessment of the credibility of sources, and reasoned written justification of a position. A pilot study involved 96 undergraduate students from a technical university (experimental group n = 48, control group n = 48); a quasi-experimental design with pre- and post-testing was used. The results showed a statistically significant increase in evidence-based reading scores in the experimental group compared to the control group ($p < 0.01$; $d = 0.71$); the greatest effect was recorded for tasks involving critical evaluation of sources. Didactic mechanisms that ensure skill transfer between modalities, as well as the limitations of the study, are discussed. The findings can be used in designing academic literacy courses and preparing students for scientific writing.*

Keywords: *multimodal texts, reading literacy, evidence-based reading, learning tasks, academic literacy, critical thinking.*

Введение

Способность читателя извлекать информацию не только из связного вербального текста, но и из сочетаний текста, графиков, диаграмм, схем и изображений становится одним из ключевых компонентов академической грамотности. Международные рамки оценки читательской грамотности, в частности концептуальная модель PISA, уже более десяти лет включают в состав измеряемых конструктов работу с множественными и составными («мультимодальными») источниками, требующую от читателя не простого узнавания фактов, а сопоставления, оценки достоверности и обоснования выводов ссылками на конкретные фрагменты источников [1]. Тем не менее массовая практика преподавания чтения, в том числе в системе высшего технического образования, по-прежнему во многом ориентирована на работу с линейным вербальным текстом, что создаёт разрыв между тем, что реально требуется от студента при подготовке курсовой или научной работы, и тем, чему его целенаправленно обучают.

Теоретической основой предлагаемой системы заданий послужили несколько взаимодополняющих направлений. Модель построения-интеграции В. Кинча описывает понимание текста как процесс формирования ситуационной модели на основе пропозиционального анализа и активации

фоновых знаний [2]. Когнитивная теория мультимедийного обучения Р. Мейера объясняет, каким образом одновременная переработка вербальной и визуальной информации в рабочей памяти влияет на глубину понимания и запоминания [3]. Документная модель понимания Ж.-Ф. Руэ и М. Бритт переносит акцент с отдельного текста на комплекс источников, подчёркивая роль оценки надёжности и релевантности каждого источника при построении итогового представления [4; 5]. Наконец, работы по социальной семиотике мультимодальности Г. Кресса задают понятийный аппарат для описания того, как смысл распределяется между модальностями и как читатель координирует их интерпретацию [6].

Несмотря на развитость теоретической базы, в методической литературе ощущается дефицит операционализированных, пригодных для тиражирования систем учебных заданий, которые бы последовательно переводили обучающегося от простого извлечения информации к аргументированному, основанному на доказательствах суждению о мультимодальном тексте. Особенно это заметно в неязыковых, инженерно-технических образовательных программах, где обучение академическому письму нередко сводится к формальным требованиям к оформлению работы и почти не затрагивает читательские стратегии, лежащие в основе качественной работы с источниками.

Цель настоящего исследования — разработать систему учебных заданий по развитию доказательного чтения мультимодальных текстов и оценить её эффективность в условиях краткосрочного формирующего эксперимента со студентами технического университета. В соответствии с целью были сформулированы следующие исследовательские вопросы: (1) обеспечивает ли работа с разработанной системой заданий статистически значимый прирост показателей доказательного чтения по сравнению с традиционной практикой; (2) на каком из четырёх уровней заданий (локализация, интерпретация, критическая оценка, аргументация) наблюдается наибольший эффект обучения. Рабочая гипотеза состояла в том, что систематическая практика с мультимодальными заданиями по всем четырём уровням приведёт к более выраженному приросту показателей доказательного чтения в экспериментальной группе, причём наибольший прирост будет зафиксирован на уровне критической оценки источников как наиболее когнитивно нагруженном компоненте.

Материалы и методы

В исследовании приняли участие 96 студентов 2-го курса бакалавриата инженерно-технических направлений подготовки (возраст M = 19,4 года, SD = 0,8; 41 % женщин, 59 % мужчин). Участники были распределены по двум учебным потокам, один из которых случайным образом был определён как экспериментальная группа (n = 48), другой — как контрольная (n = 48). Исходное распределение групп по успеваемости и уровню владения языком обучения статистически значимо не различалось ($p > 0,05$).

Использован квазиэкспериментальный план с предварительным и итоговым тестированием двух неэквивалентных групп (pretest–posttest nonequivalent control group design). Обе группы проходили предварительное тестирование доказательного чтения мультимодальных текстов, восьминедельное обучение по соответствующей программе курса и итоговое тестирование по параллельной форме того же инструмента.

Разработанная система включает четыре последовательных уровня заданий, различающихся по когнитивной нагрузке и характеру требуемого доказательства (табл. 1). На каждом занятии студенты экспериментальной группы работали с составным текстом, включающим не менее двух модальностей (например, научно-популярный текст и график, инструкцию и схему, новостную заметку и инфографику), и выполняли задания последовательно всех четырёх уровней.

Табл. 1. Уровни системы учебных заданий по развитию доказательного чтения мультимодальных текстов

Уровень	Тип задания	Требуемое доказательство
I	Локализация информации	Точное указание фрагмента текста и/или элемента изображения, содержащего запрошенные сведения
II	Интерпретация мультимодальных связей	Объяснение соответствия/расхождения между вербальным и визуальным компонентами с опорой на оба источника
III	Критическая оценка источников	Аргументированная оценка достоверности, полноты и возможной предвзятости источника
IV	Аргументированное письменное обоснование	Связный письменный ответ с явными ссылками на конкретные фрагменты как минимум двух модальностей

Для измерения доказательного чтения мультимодальных текстов использовался авторский тест, включающий четыре субшкалы, соответствующие уровням системы заданий (табл. 1), по шесть заданий на каждую субшкалу (всего 24 задания, максимум 48 баллов). Внутренняя согласованность теста на предварительном срезе составила $\alpha = 0{,}81$; параллельные формы предварительного и итогового тестов были уравнены по трудности методом экспертной оценки и предварительного пилотирования на независимой выборке ($n = 30$).

Формирующий эксперимент продолжался восемь учебных недель. Студенты экспериментальной группы еженедельно выполняли по одному комплексному заданию на основе нового мультимодального текста в рамках практических занятий по академическому письму; преподаватель предоставлял структурированную обратную связь по каждому уровню задания. Студенты контрольной группы в течение того же периода занимались по традиционной программе курса, включавшей работу с

линейными вербальными текстами и написание рефератов без целенаправленной отработки мультимодальных читательских стратегий.

Для сравнения групп на предварительном срезе применялся независимый t-критерий Стьюдента. Основной анализ прироста показателей проводился методом ковариационного анализа (ANCOVA) с предварительным баллом в качестве ковариаты и группой в качестве фактора; величина эффекта оценивалась с помощью d Коэна. Уровень значимости был установлен на отметке $\alpha = 0,05$. Расчёты выполнены в среде R (версия 4.3).

Результаты

На предварительном срезе группы статистически значимо не различались по общему баллу доказательного чтения (M_эксп = 24,6, SD = 4,1; M_контр = 24,9, SD = 4,3; t(94) = 0,35; p = 0,73). На итоговом срезе экспериментальная группа продемонстрировала более высокий средний балл по сравнению с контрольной (табл. 2).

Табл. 2. Средние значения (M) и стандартные отклонения (SD) по субшкалам на итоговом срезе

Субшкала (уровень)	Экспериментальная группа, M (SD)	Контрольная группа, M (SD)
I. Локализация информации	10,8 (1,2)	9,7 (1,4)
II. Интерпретация связей	9,4 (1,5)	8,1 (1,6)
III. Критическая оценка источников	8,9 (1,7)	6,8 (1,9)
IV. Аргументированное обоснование	9,2 (1,6)	7,9 (1,8)
Общий балл	38,3 (4,4)	32,5 (4,9)

Ковариационный анализ с контролем предварительного балла показал статистически значимое влияние фактора группы на итоговый общий балл ($F(1, 93) = 41,2$; $p < 0,001$; частный $\eta^2 = 0,31$), что соответствует большому размеру эффекта ($d = 0,71$). При анализе субшкал наибольшее различие между группами зафиксировано на уровне III («Критическая оценка источников»; $d = 1,15$) и уровне IV («Аргументированное обоснование»; $d = 0,76$), тогда как на уровне I («Локализация информации») различие было наименьшим ($d = 0,42$), хотя и статистически значимым ($p = 0,01$). Эта картина согласуется с рабочей гипотезой о том, что задания, требующие более высокого уровня критического осмысления источника, обладают наибольшим развивающим потенциалом при систематической практике.

Обсуждение

Полученные результаты в целом согласуются с представлением о том, что доказательное чтение мультимодальных текстов представляет собой навык, поддающийся целенаправленному формированию при условии систематической, структурированной по уровням практики и регулярной обратной связи. Наибольший прирост на уровне критической оценки источников можно объяснить тем, что именно этот компонент в наименьшей

степени отрабатывается в традиционной практике чтения и поэтому обладает наибольшим резервом для развития; кроме того, задания этого уровня напрямую требуют вербализации критериев оценки достоверности, что, согласно модели построения-интеграции, способствует более глубокой переработке информации и закреплению соответствующей стратегии [2].

С практической точки зрения полученные данные подтверждают целесообразность включения мультимодальных заданий на всех четырёх уровнях в курсы академического письма, в том числе в инженерно-технических образовательных программах, где обучающиеся систематически работают с составными источниками (техническая документация, отчёты с графиками, патентная информация) уже на этапе подготовки квалификационных работ. Систематическая практика доказательного чтения может рассматриваться как пропедевтический этап перед обучением написанию научных статей по схеме IMRaD, поскольку требует тех же базовых умений: точной локализации данных, их интерпретации, критической оценки источников и построения аргументации со ссылками на конкретные данные.

Ограничения исследования включают небольшой размер выборки в пределах одного вуза, что ограничивает возможность обобщения результатов; отсутствие отсроченного среза для оценки устойчивости эффекта; а также использование единственного авторского инструмента измерения без независимой внешней валидизации на более широкой выборке. Дальнейшие исследования могли бы включить многоцентровой дизайн, отсроченное тестирование через 3–6 месяцев после завершения интервенции и сопоставление эффективности предложенной системы заданий с альтернативными подходами к развитию мультимодальной грамотности.

Заключение

Разработанная четырёхуровневая система учебных заданий (локализация информации, интерпретация мультимодальных связей, критическая оценка источников, аргументированное обоснование) продемонстрировала статистически значимую эффективность в развитии доказательного чтения мультимодальных текстов у студентов технического университета, с наибольшим эффектом на уровне критической оценки источников. Результаты позволяют рекомендовать включение подобных заданий в курсы академической грамотности и академического письма как средство подготовки студентов к самостоятельной работе с источниками при написании научных текстов. Направления дальнейшей работы включают расширение выборки, введение отсроченного контроля и адаптацию системы заданий для дистанционного и смешанного форматов обучения.

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ОТ PICFU К РОССИЙСКОЙ РЕАЛЬНОСТИ: АДАПТАЦИЯ ЗАПАДНЫХ ВОРОНОЧНЫХ МЕТРИК (CTR, CR, EPC) В УСЛОВИЯХ «СЕРОГО» ТРАФИКА И ВЫСОКОЙ КОНКУРЕНЦИИ ОДНОТИПНЫХ ТОВАРОВ

Аннотация: *Метрики CTR, CR и EPC привычно воспринимаются как универсальный язык описания воронки продаж. Однако их логика сформировалась в среде с прозрачной аналитикой и относительно однородной аудиторией - прежде всего на Amazon, - и при переносе на российские маркетплейсы она даёт заметные сбои. «Серый» трафик, самовыкупы, массивы почти неразличимых между собой карточек - всё это искажает показатели настолько, что привычные ориентиры перестают работать. В работе на материале практик Wildberries и Ozon, отраслевых исследований и юридических прецедентов последних двух лет предлагается рамка адаптации вороночных метрик, учитывающая эти искажения. Отдельный сюжет — вопрос о том, какие показатели ещё сохраняют диагностическую ценность, а какие уже превратились в шум.*

Ключевые слова: *воронка продаж, CTR, CR, EPC, серый трафик, маркетплейс, Wildberries, Ozon, однотипные товары, адаптация метрик.*

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FROM PICFU TO THE RUSSIAN REALITY: ADAPTING WESTERN SALES FUNNEL METRICS (CTR, CR, EPC) IN THE CONTEXT OF “GRAY” TRAFFIC AND HIGH COMPETITION AMONG SIMILAR PRODUCTS

Abstract: *CTR, CR, and EPC metrics are commonly perceived as a universal language for describing the sales funnel. However, their logic was developed in an environment with transparent analytics and a relatively homogeneous audience—primarily on Amazon—and when applied to Russian marketplaces, it leads to significant discrepancies. “Gray” traffic, self-purchases, and arrays of product listings that are nearly indistinguishable from one another—all of this distorts the metrics to such an extent that familiar benchmarks cease to function. Drawing on case studies from Wildberries and Ozon, industry research, and legal precedents from the past two years, this paper proposes a framework for adapting sales funnel metrics that accounts for these distortions. A separate issue is determining which metrics still retain diagnostic value and which have already become noise.*

Keywords: *sales funnel, CTR, CR, EPC, gray traffic, marketplace, Wildberries, Ozon, similar products, metric adaptation.*

1. Введение

Метрики воронки продаж - CTR, CR, EPC - пришли в российский e-commerce из западной аналитической традиции. Их логика проста и привлекательна: пользователь видит товар, кликает, покупает; на каждом переходе остаётся след, который можно измерить и улучшить. Amazon десятилетиями оттачивал эту схему, и неудивительно, что российские селлеры, выходя на Wildberries или Ozon, по умолчанию тянутся к тем же показателям.

Проблема в том, что российская реальность отличается от западной не деталями, а структурой. Здесь «серый» трафик - не маргинальное явление, а значимая часть рынка. Здесь самовыкупы и накрутка отзывов были массовой практикой, пока антифрод-системы не начали с ними бороться. Здесь, наконец, конкуренция в ряде категорий идёт между товарами, которые потребитель воспринимает как взаимозаменяемые, - и в этой ситуации воронка ведёт себя иначе, чем в условиях дифференцированного предложения.

Возникает вопрос: можно ли вообще доверять CTR и CR на российском маркетплейсе, если часть трафика искусственная, часть отзывов куплена, а выдача формируется алгоритмом, который сам обучается на этих искажённых данных? Ответ, который предлагается в этой работе, не сводится к «да» или «нет». Речь о том, какие метрики сохраняют диагностическую ценность, какие требуют модификации и какие превращаются в фикцию.

2. Западная рамка: что именно мы переносим

Прежде чем разбираться с адаптацией, имеет смысл вспомнить, откуда вообще взялась эта модель. В западной традиции путь покупателя на маркетплейсе принято раскладывать на этапы: показ, клик, добавление в корзину, оформление заказа, выкуп. У каждого этапа своя метрика. Клики делят на показы - получают CTR. Покупки делят на клики — получают CR. Доход делят на клики - получают EPC. Схема простая, почти механическая, и именно в этой простоте её сила - и её слабость.

Эта модель предполагает несколько допущений. Во-первых, что трафик, попадающий в воронку, имеет естественное происхождение. Во-вторых, что поведение пользователя отражает его реальный интерес, а не действия ботов или мотивированных покупателей. В-третьих, что алгоритм ранжирования обучается на «чистых» сигналах и вознаграждает карточки, которые действительно лучше конвертируют.

Инструменты вроде PickFu, широко используемые на Amazon, работают именно в этой парадигме: они позволяют протестировать изображение или заголовок на фокус-группе, получить прогноз CTR и CR, а затем внедрить изменения с уверенностью, что метрики отражают реальную реакцию покупателей. Логика красивая — и именно она ломается при переносе.

3. Российская специфика: два фактора искажения

3.1. СЕРЫЙ ТРАФИК КАК СТРУКТУРНАЯ ОСОБЕННОСТЬ

На российских маркетплейсах «серый» трафик - не аномалия, а устойчивая практика. Речь идёт о самовыкупах, накрутке просмотров и кликов, заказных отзывах. До недавнего времени эти схемы были настолько распространены, что формировали значимую долю сигналов, на которые ориентировались алгоритмы ранжирования.

В 2026 году ситуация изменилась: антифрод-системы Wildberries и Ozon научились выявлять самовыкупы по отпечаткам устройств, временным кластерам заказов, маршрутам возврата и стилистике отзывов. Штрафы за эпизод достигают 30–50 тысяч рублей, а карточка или весь аккаунт блокируются. Юридическая практика также начала формироваться: суды признают искусственное завышение рейтинга через самовыкупы недобросовестной конкуренцией.

Но сам факт ужесточения борьбы не означает, что метрики очистились. Более того, блокировки за «искусственный трафик» затрагивают и добросовестных продавцов: алгоритмы не всегда отличают ботов от реальных пользователей, что приводит к ложным срабатываниям. Для аналитика это означает, что CTR и CR могут быть искажены в обоих направлениях: завышены из-за остаточных серых схем или занижены из-за блокировок, отсекающих часть реального трафика.

3.2. ОДНОТИПНЫЕ ТОВАРЫ И КОЛЛАПС ДИФФЕРЕНЦИАЦИИ

Второй фактор - высокая доля товаров, которые потребитель воспринимает как идентичные. В категориях электроники, расходников, базовой одежды карточки конкурируют не качеством, а ценой и позицией в выдаче. Исследования показывают, что в таких нишах аудитория просматривает 40–60 позиций и прекращает сравнение, потому что «дальше всё одинаковое».

В этой ситуации воронка теряет чувствительность. CTR может быть высоким, потому что пользователь кликает по инерции, а CR - низким, потому что решение откладывается до момента, когда цена станет решающим аргументом. Более того, алгоритм ранжирования, обученный на таких данных, начинает вознаграждать не лучший товар, а тот, который чаще выбирают из-за позиции, и закрепляет случайное преимущество.

4. Что происходит с метриками

4.1. CTR: РОСТ БЕЗ СМЫСЛА

CTR на российском маркетплейсе подвержен двум противоположным искажениям. С одной стороны, накрутка кликов завышает его механически. С другой - эффект «перегрева» выдачи, когда пользователь кликает по инерции, не различая карточки, также inflates CTR, но уже по естественным причинам.

Диагностическая ценность CTR сохраняется только при одном условии: если его интерпретировать не изолированно, а в связке с глубиной просмотра и временем на карточке. Высокий CTR при низком времени просмотра -

сигнал не интереса, а любопытства или инерции. Высокий CTR при глубоком просмотре - сигнал реального совпадения с запросом.

4.2. CR: ГЛАВНАЯ ЖЕРТВА СЕРОГО ТРАФИКА

CR - конверсия в покупку - страдает сильнее всего. Самовыкупы напрямую inflate CR: если продавец выкупает часть собственного товара, числитель растёт без изменения знаменателя. Накрутка отзывов косвенно влияет на CR, формируя завышенный рейтинг, который привлекает реальных покупателей, но не отражает качество товара.

Отраслевые данные дают ориентир: средний CR в российском e-commerce составляет 2,3–2,9%. Но эта цифра скрывает огромный разброс. В нишах с активными серыми схемами реальный CR может быть вдвое ниже зафиксированного. В нишах, где алгоритм уже «вычистил» недобросовестных игроков, CR приближается к естественному уровню.

4.3. EPC: ДОХОД НА КЛИК КАК ИНТЕГРАЛЬНЫЙ ПОКАЗАТЕЛЬ

EPC - доход на клик - теоретически более устойчив, потому что объединяет кликабельность и конверсию в один показатель. Но и он искажается: если часть кликов куплена, EPC занижается, потому что эти клики не приносят дохода. Если часть покупок - самовыкупы, EPC завышается, потому что доход фиксируется, хотя реального спроса нет.

Тем не менее EPC остаётся одним из немногих показателей, который можно «очистить» постфактум: сравнивая EPC по разным источникам трафика, можно выявить аномалии. Источник, который даёт высокий CTR, но нулевой EPC, с высокой вероятностью является источником накрученного трафика.

5. Рамка адаптации: что делать с метриками

5.1. ПРИНЦИП ТРИАНГУЛЯЦИИ

Ни одна метрика воронки не должна интерпретироваться изолированно. CTR, CR и EPC необходимо рассматривать в связке с дополнительными сигналами: глубиной просмотра, временем на карточке, долей возвратов, динамикой рейтинга. Расхождение между метриками - например, высокий CTR при низком CR и высоком проценте возвратов - является индикатором искажения.

5.2. ПРИНЦИП БЕНЧМАРКА ПО «ЧИСТОМУ» СЕГМЕНТУ

Поскольку абсолютные значения метрик искажены, имеет смысл сравнивать не со средними по нише, а с сегментом, который с высокой вероятностью свободен от серых практик. Wildberries в 2025 году запустил сервис обезличенной аналитики, позволяющий сравнивать показатели с рыночными, но скрывающий названия конкурентов. Такой инструмент даёт возможность построить более честный бенчмарк, исключив из выборки карточки с аномальными паттернами.

5.3. ПРИНЦИП ДИНАМИКИ ВМЕСТО СРЕЗА

Разовые замеры метрик малоинформативны. Динамика CTR и CR во времени позволяет отличить естественные колебания от искусственных

всплесков. Резкий рост CTR без изменения креатива - сигнал накрутки. Плавный рост CR после оптимизации карточки - сигнал реального улучшения.

5.4. ПРИНЦИП ИНКРЕМЕНТАЛЬНОЙ ОЦЕНКИ

Для внешнего трафика и рекламных каналов корректнее считать не общий CR, а инкрементальный: прирост продаж относительно базовой линии, делённый на расходы канала. Эта метрика устойчивее к искажениям, потому что отсекает продажи, которые произошли бы и без данного канала.

6. Эмпирическая иллюстрация: кейс с визуальным кодом

Один из показательных примеров адаптации западной логики к российской реальности - конкуренция между российскими брендами и прямыми поставками из КНР после того, как Wildberries уравнял условия для продавцов из обеих стран. Ожидался тотальный демпинг, но реальность оказалась иной. Китайский селлер с себестоимостью на 25% ниже проигрывал российскому бренду, потому что CTR его карточки составлял 2% при CR 5%, тогда как российский бренд получал CTR 8% при CR 15%.

Разница объясняется не ценой, а визуальным кодом: попаданием в культурный контекст, качеством инфографики, пониманием болей аудитории. В этой ситуации воронка работала не как механическая последовательность, а как система, где каждый элемент усиливает следующий. Российский продавец покупал трафик дешевле, потому что алгоритм вознаграждал его за более высокую конверсию, - и это создавало накопительное преимущество.

Этот кейс важен методологически: он показывает, что при правильной адаптации вороночные метрики не просто измеряют, а формируют исход. Игнорирование этого эффекта - одна из главных ошибок при переносе западных моделей.

7. Практические следствия

Для селлера, работающего на российском маркетплейсе, адаптация вороночных метрик сводится к нескольким решениям.

Во-первых, отказ от «средних по нише» как ориентира. Средние значения включают искажённые данные, поэтому сравнение с ними систематически вводит в заблуждение. Нужен бенчмарк по сегменту, очищенному от аномалий.

Во-вторых, приоритет инкрементальных метрик над абсолютными. Общий CR карточки менее информативен, чем прирост CR относительно базовой линии после конкретного изменения.

В-третьих, интеграция качественных сигналов. Воронка - это не только числа. Глубина просмотра, время на карточке, тексты отзывов, динамика возвратов - всё это дополняет картину и позволяет отличить реальный интерес от накрученного.

В-четвёртых, осторожность с CTR как самостоятельной метрикой. Сам по себе CTR на российском маркетплейсе почти ничего не говорит. Его ценность раскрывается только в связке с другими показателями.

8. Заключение

Западные вороночные метрики - CTR, CR, EPC - не являются универсальным инструментом. Они работают в условиях, для которых были созданы: прозрачный трафик, дифференцированные товары, алгоритмы, обучающиеся на честных сигналах. Российский маркетплейс не соответствует этим условиям полностью, и попытка механического переноса приводит к ошибочным выводам.

Адаптация, однако, возможна. Она требует триангуляции метрик, отказа от средних по нише, приоритета инкрементальных оценок и интеграции качественных сигналов. Это не отказ от западного инструментария, а его переосмысление - с учётом того, что воронка на российском маркетплейсе работает в среде, где часть сигналов искусственна, а часть товаров неразличима для потребителя.

Формальных методов, которые позволяли бы вычистить вороночные метрики от следов серого трафика, пока никто не предложил. Возможно, они появятся - но вряд ли раньше, чем платформы начнут делиться данными, которые сегодня держат закрытыми. До тех пор аналитику приходится опираться на то, что есть: на дисциплину в обращении с цифрами и на понимание того, как искажается конкретный показатель в конкретной категории. Решение не идеальное, но рабочее .

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ЁШЛАР ОРАСИДА НАРКОЖИНОЯТЧИЛИККА ҚАРШИ КУРАШИШ МАСАЛАЛАРИ

Аннотация: *Дунёда ҳозирги глобаллашув жараёни жадаллашган XXI асрда уюшган жиноятчиликнинг трансмиллий характер касб этиши бу муаммога етарли эътибор берилишини тақозо этиб, айниқса, ёшлар ўртасида гиёҳвандлик воситалари ва психотроп моддаларни билан боғлиқ ҳуқуқбузарликларни аниқлаш чораларини фаоллаштиришга халқаро миқёсда жиддий эътибор қаратилмоқда. Шу боис, ёшлар ўртасида гиёҳвандлик воситалари ва психотроп моддалар билан боғлиқ ҳуқуқбузарликларни аниқлаш, жиноят предметлари бўлган гиёҳвандлик воситалари, уларнинг аналоглари ва психотроп моддаларни ноқонуний муомиласи билан боғлиқ ҳаракатларга чек қўйиш фаолияти самарадорлигини ошириш мақсадида қонунчилик базасини такомиллаштириш муҳим аҳамият касб этмоқда.*

Калит сўзлар: *ёшлар, гиёҳвандлик воситалари ва психотроп моддалар, синтетик гиёҳвандлик воситалари ва кучли таъсир қилувчи моддалар, қонунчилик, қарши курашиш, ҳамкорлик.*

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ISSUES OF COMBATING DRUG-RELATED CRIME AMONG YOUTH

Abstract: *In the 21st century, as the process of globalization has accelerated worldwide, the transnational nature acquired by organized crime requires due attention to be paid to this issue. In particular, at the international level, serious attention is being devoted to intensifying measures aimed at identifying offenses related to narcotic drugs and psychotropic substances among young people. In this regard, improving the legislative framework is of particular importance in order to enhance the effectiveness of activities aimed at identifying offenses involving narcotic drugs and psychotropic substances among youth and suppressing actions related to the illicit trafficking of narcotic drugs, their analogues, and psychotropic substances that constitute the subject matter of criminal offenses.*

Keywords: *youth, narcotic drugs and psychotropic substances, synthetic and potent substances, legislation, counteraction, cooperation.*

Наркобизнес минтақалараро ва трансмиллий миқёсдаги уюшган жиноятчилик кўриниши сифатида нафақат жиноий, балки сиёсий тусга ҳам

эга бўлиб бормоқда. Шу билан бирга, глобаллашув жараёнлари шиддатли тус олган ҳозирги замонда халқимизда, айниқса ёшлар қалбида миллий ғурур, ёт ғоялардан сақловчи мафкуравий иммунитетни ошириш талаб этилади.[1]

Бирлашган Миллатлар Ташкилотининг Наркотиклар ва жиноятчилик бўйича бошқармасининг маълумотларига кўра, дунёда 500 миллиондан ортиқ одам гиёҳвандлик дардига йўлиққан бўлиб, уларнинг аксарият қисмини 30 ёшгача бўлганлар ташкил этмоқда. Бунинг оқибатида ҳар йили жаҳонда 200 мингдан ортиқ киши ҳаётдан кўз юмади, содир этилаётган жиноятларнинг 57 фоизи гиёҳвандлар ҳиссасига тўғри келади. Шу боис, сўнгги йилларда БМТ томонидан аъзо давлатларга гиёҳвандлик воситалари ва психотроп моддаларни билан боғлиқ ҳуқуқбузарликларни аниқлашни кучайтириш бўйича мажбуриятлар юкланмоқда[2].

Жамият тараққиётининг қайси босқичида бўлмасин, умуминсоний яшаш қоидаларининг бузилиши кишилар томонидан кескин қораланган ва айбдорларга нисбатан жазо чоралари қўлланилган[3]. Вояга етмаганлар ораси гиёҳванд моддаларининг ноқонуний муомаласи билан боғлиқ жиноятларга қарши курашиш, Ўзбекистон Республикасининг келгуси авлод хавфсизлигининг кафолати бўлиб, мазкур жиноятларга қарши курашиш давлатнинг муҳим стратегик вазифаларидан ҳисобланади.

Мамлакатимизда амалга оширилаётган кенг кўламли ислоҳотлар доирасида аҳоли орасида соғлом турмуш тарзини тарғиб қилиш, уларнинг гиёҳвандлик воситалари ва психотроп моддаларга нисбатан қарши иммунитетни шакллантириш, шунингдек, инсон саломатлигини таъминлашга қаратилган ишларга алоҳида эътибор қаратилмоқда. Дархакикат, бугунги кунда мамлакат ахолисининг 40 фоизини 18 ёшгача булган болалар, 64 фоизини 30 ёшгача булган ёшлар ташкил этган Ўзбекистон учун баркамол авлодни тарбиялаш, уларга эртанги кунимизнинг хал килувчи кучи сифатида ишонч билдириш, шунингдек уларнинг хаётда, шу жумладан, жамиятда тинчлик ва осойишталикни, жамоат тартибини саклаш, хар кандай куринишдаги хукукбузарликларга карши курашда фаол иштирок этишини таъминлаш канчалик долзарб вазифа эканлиги барчамизга маълум.

Шу билан бирга, сўнгги йилларда янги турдаги синтетик гиёҳвандлик воситалари ва кучли таъсир қилувчи моддалар пайдо бўлаётганлиги, улар инсон омилисиз интернетнинг ижтимоий тармоқларидан фойдаланган ҳолда аҳоли, айниқса ёшлар орасида осон тарқатилаётганлиги масъул давлат тузилмаларининг бу борадаги фаолиятини “Барча саъй-ҳаракатлар инсон қадри учун” деган устувор ғоя асосида сифат жиҳатидан янги босқичга олиб чиқиш зарурлигини тақозо этмоқда.

Ўзбекистон Республикаси Президентининг 2024 йил 6 майдаги ПФ-73-сон Фармони билан “Ўзбекистон Республикасида гиёҳвандлик ва наркожиноятларга қарши курашиш бўйича 2024 — 2028 йилларга мўлжалланган миллий стратегия” тасдиқланиб, унда 1-мақсад сифатида “Аҳоли, айниқса, ёшларда гиёҳвандликка қарши иммунитетни шакллантиришга қаратилган таъсирчан чоралар комплексини амалга

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Гиёҳвандлик воситалари ва психотроп моддалар билан боғлиқ ҳуқуқбузарликларнинг ижтимоий хавфлилик даражаси юқори бўлиб, асосан уюшган гуруҳлар таркибида, пухта ниқобланган, мураккаб жиноий схемалардан фойдаланган ҳолда содир этилиб, давлатнинг жамоат хавфсизлигига тажовуз қилади.

Ёшлар ўртасида гиёҳвандлик воситалари ва психотроп моддалар билан боғлиқ ҳуқуқбузарликлар билан боғлиқ вазият таҳлили шундан далолат беради, Ўзбекистон гиёҳвандлик воситалари ва бошқа тақиқланган товарлар ноқонуний айланмасининг халқаро экспансияси объектига айланиб қолди. Жиноятчилардан олиб қўйилаётган ёшлар ўртасида гиёҳвандлик воситалари ва психотроп моддалар билан боғлиқ ҳуқуқбузарликлар предметларининг асосий қисми хорижий давлатлар маҳсулоти ҳисобланади.

Таҳлиллар кўрсатишича, аниқланган ёшлар ўртасида гиёҳвандлик воситалари ва психотроп моддалар билан боғлиқ ҳуқуқбузарликлар жиноятларининг субъектлари қаторида ўз фуқароларимиздан ташқари хорижий давлатлар фуқароларининг ҳам фаол қатнашаётганлари, бу жиноятнинг халқаро тавсифга эгалигини кўрсатиб турибди.

Ёшлар ўртасида гиёҳвандлик воситалари ва психотроп моддалар билан боғлиқ ҳуқуқбузарликларга қарши кураш муаммоларининг таниқли тадқиқотчиси Ю.Сучков фикрига кўра, гиёҳванд моддалар ва психотроп воситаларнинг тарқалиши алоҳида хавфли бўлиб, уларни асосан ёшлар истеъмол қилади. Шу сабабли, жамиятнинг давлатнинг янги интеллектуал ва ишлаб чиқарувчи элитасини ташкил этиши мумкин бўлган қисми эрта жисмоний ва маънавий таназзулга учрайди. Сурункали гиёҳвандлар ҳеч қандай меҳнат фаолиятига лаёқатсиз бўлиб, кўпинча 30-35 ёшдан ортиқ яшамаслиги туфайли, улар бу элитага айлана олмайди. [5]

Гиёҳванд ва психотроп моддаларни суиистеъмол қилиш ҳар қандай давлатнинг долзарб ижтимоий муаммоси ҳисобланади, шу боис давлатлар томонидан ноқонуний айланмага қарши курашиш бўйича самарали чоралар кўрилиши лозим. 1988 йил 20 декабрда Венада имзоланган "БМТнинг гиёҳванд воситалари ва психотроп моддаларнинг ноқонуний айланишига қарши кураш тўғрисидаги конвенцияси"га кўра, гиёҳванд воситалари ва психотроп моддаларнинг ноқонуний айланиши жамиятда кечаётган маданий, иқтисодий ва сиёсий жараёнларга салбий таъсир кўрсатмоқда. Шундай қилиб,

аҳолининг соғлиғини муҳофаза қилиш соҳасидаги муносабатларни таъминлаш зарурати давлатни гиёҳванд моддалар, психотроп воситалар ва уларнинг аналогларининг айланишини тартибга солиш масаласини ҳал этишга мажбур қилади.[6]

Туркиялик ҳуқуқ доктори Фаридун Енисей таърифига кўра, Туркия жиноят қонунчилигида гиёҳванд моддалар билан боғлиқ жиноятлар учта гуруҳ бўлиниб, гиёҳванд моддалар ишлаб чиқаришда ишлатиладиган ўсимликларни экиш, гиёҳванд моддалар таъминоти ва гиёҳванд моддалар моддаларни суиистеъмол қилиш жиноятларидан иборат [7].

Н.Ф. Мурашов таъкидлашича, амалда гиёҳвандлик жиноятчилигига нисбатан тушунчалар алмаштирилиб, гиёҳванд моддалар жиноят содир этиш воситаси бўлса-да, унинг предмети сифатида намоён бўлмоқда.[8]

М.С.Ивашченконинг фикрича, жамоат саломатлигига қарши жиноятларнинг бевосита нишони сифатида давлатнинг миллий хавфсизлик манфаатларини амалга ошириш соҳасида ривожланаётган ижтимоий муносабатларни тан олиш керак. Бу муносабатлар давлат томонидан аҳолининг нисбатан тўлиқ жисмоний ва руҳий фаровонлигини (соғлиғини) таъминлаш, уни мустаҳкамлаш ва ошириш билан боғлиқ бўлиб, аҳолининг меҳнат қилиш муддатини узайтириш ва мамлакатдаги умумий демографик кўрсаткичларни яхшилаш мақсадида амалга оширилади.[9]

Е.Ф.Галанжиннинг таъкидлашича, ёшлар ўртасида гиёҳвандлик воситалари ва психотроп моддалар билан боғлиқ ҳуқуқбузарликлар, бир томондан, давлатнинг иқтисодиётига жиддий таҳдид солса, иккинчи томондан, инсонларнинг саломатлиги, аҳолининг тинч ва осойишта ҳаёт кечиришига ҳам хавф туғдиради.[10]

Мазкур олим томонидан ёшлар ўртасида гиёҳвандлик воситалари ва психотроп моддалар билан боғлиқ ҳуқуқбузарликларга таъриф Россия Федерацияси, Белорусь, Қозоғистон, Қирғизистон Республикалари жиноят қонунларидан келиб чиқиб берилган бўлиб, Ўзбекистон қонунчилиги бўйича эса ёшлар ўртасида гиёҳвандлик воситалари ва психотроп моддалар билан боғлиқ ҳуқуқбузарликлар жамоат хавфсизлиги, жамоат тартиби ва аҳоли саломатлигига тажовуз қилувчи қилмиш бўлиб, иқтисодиётга алоқаси йўқлигини кўришимиз мумкин. Шу боис, Ўзбекистон Республикасининг қонун чиқарувчи органи “гиёҳвандлик воситалари ва психотроп моддалар билан боғлиқ ҳуқуқбузарликлар” деб номланувчи ижтимоий хавфли қилмишни жиноят сифатида Жиноят кодексининг 270-276-моддаларида белгилаб, жамоат хавфсизлигига қарши жиноятлар сирасига киритган.

М.Х.Рустамбаевга кўра, гиёҳвандлик воситалари ва психотроп моддалар билан боғлиқ ҳуқуқбузарликлар жиноятининг объекти - жамоат хавфсизлиги, жамоат тартиби ва аҳоли саломатлиги бўлиб, ёшлар ўртасида гиёҳвандлик воситалари ва психотроп моддалар билан боғлиқ ҳуқуқбузарликлар предметларини давлат чегараси орқали қонунга хилоф равишда ўтказиш, тегишли шартлар мавжуд бўлганда ЖКнинг 246-моддаси билан таснифланиши лозим.[11]

Е.В.Шаназарованинг ёзишича, ҳар қандай жиноят инсон хулқ атворининг ташқи кўриниши, яъни онг ва ирода назорати остида содир қилинадиган ҳаракат ёки ҳаракатсизлик кўринишидаги қилмишдир.[12]

Юқорида билдирилган фикр мулоҳазалардан келиб чиқиб, ёшлар орасида гиёҳвандлик воситалари ёки психотроп моддаларнинг қонунга хилоф муомаласи билан боғлиқ жиноятларни аниқлаш ва фош этишга маъсул бўлган ҳуқуқни муҳофаза қилувчи органлар барча зарурий чораларни амалга ошириши лозим.

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ГИДРОЭКОЛОГИЧЕСКИЕ ИЗМЕНЕНИЯ И МЕДИКО-ЭКОЛОГИЧЕСКИЕ РИСКИ ЮЖНОГО ПРИАРАЛЬЯ

Аннотация: *В статье рассмотрены основные гидроэкологические изменения Южного Приаралья, их влияние на качество воды и атмосферного воздуха, а также связанные с ними риски для здоровья населения. Обоснована необходимость комплексного мониторинга по системе* ***«вода — почва — воздух — биота — население»*** *для оценки экологических рисков и выявления наиболее уязвимых групп населения.*

Ключевые слова*: гидроэкология, медицинская экология, Амударья, минерализация, засоление, пыле-солевой перенос, экологические риски.*

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HYDRO-ECOLOGICAL CHANGES AND MEDICAL-ECOLOGICAL RISKS IN THE SOUTHERN ARAL SEA REGION

Abstract: *This article examines the major hydro-ecological changes in the Southern Aral Sea region, their impact on water and air quality, and the associated risks to public health. It substantiates the need for comprehensive monitoring across the "water–soil–air–biota–population" system to assess ecological risks and identify the most vulnerable population groups.*

Key words: *hydro-ecology, medical ecology, Amu Darya, mineralization, salinization, dust-salt transport, ecological risks.*

Южное Приаралье относится к территориям, где экологические процессы тесно связаны с изменением водного режима и антропогенной деятельностью. Масштабное развитие орошаемого земледелия во второй половине XX века привело к сокращению речного стока, резкому уменьшению площади Аральского моря и деградации дельтовых и прибрежных экосистем.

Последствия трансформации водной системы носят комплексный характер и включают гидрологические, гидрохимические, почвенные, климатические и биологические изменения. Особую опасность представляют ухудшение качества питьевой воды, высокая минерализация, загрязнение агрохимикатами, деградация водно-болотных экосистем и перенос солей и загрязняющих веществ с высохшего дна моря.

В статье рассматривается взаимосвязь между гидроэкологическим состоянием Южного Приаралья и рисками для здоровья населения, обусловленными воздействием загрязнённой воды, атмосферного воздуха и пылевых аэрозолей, продуктов питания и почвы.

Современные исследования Каракалпакстана подтверждают сохранение проблемы минерализации воды и присутствия остаточных органохлорных пестицидов в окружающей среде. В связи с этим необходим комплексный медико-гидроэкологический мониторинг, включающий оценку состояния воды, почв, атмосферного воздуха, водных экосистем и показателей здоровья населения.

Особую уязвимость представляет население Каракалпакстана, расположенного в нижнем течении Амударьи и прилегающего к бывшей акватории Аральского моря. Экологическая деградация региона связана с рисками респираторных заболеваний, анемии, нарушений питания, заболеваний почек и печени, аллергических и других хронических состояний. Многофакторный характер этих воздействий требует интегрального гидроэкологического и медико-экологического анализа.

Основой экологической трансформации Южного Приаралья стало изменение водного баланса Аральского бассейна. Сокращение притока воды привело к уменьшению площади Аральского моря, повышению минерализации и трансформации дельты Амударьи. Естественные протоки, озёра и водно-болотные территории во многом стали зависеть от искусственного регулирования стока, что существенно повлияло на водную растительность, рыбные ресурсы, птиц и другие компоненты водных экосистем

Современная гидроэкологическая ситуация Южного Приаралья характеризуется сокращением стока, изменением режима водоёмов, ростом минерализации воды и грунтовых вод, засолением почв, деградацией водно-болотных и дельтовых экосистем, а также усилением пыле-солевого переноса.

Изменение водного режима стало основным фактором экологической трансформации региона. Важнейшим звеном его влияния на здоровье населения является качество питьевой воды, зависящее от гидрохимических процессов, сельскохозяйственного водопользования и состояния ирригационно-дренажной инфраструктуры.

Особую проблему представляет повышенная минерализация воды. Исследование 2023 г. в Каракалпакстане, охватившее 140 образцов из 79 пунктов, выявило содержание общего количества растворённых веществ (TDS) 563–3852 мг/л, а также остаточные органохлорные пестициды.

Повышенная минерализация может увеличивать нагрузку на организм, что обусловливает необходимость постоянного мониторинга качества питьевой воды и её основных химических показателей (Таблица 1).

Особое значение имеет контроль качества воды из различных источников — Амударьи, каналов, коллекторов, скважин и локальных систем водоснабжения. Исследования Каракалпакстана показывают длительное сохранение сельскохозяйственных загрязнителей в окружающей среде и необходимость сезонного и многолетнего мониторинга.

Сокращение площади Аральского моря привело к формированию пустыни Аралкум на бывшем морском дне. Высохшая поверхность содержит соли и остаточные загрязнители, которые при сильных ветрах вовлекаются в пылевые аэрозоли и переносятся на значительные расстояния.

Таблица 1.

Основные показатели контроля качества питьевой воды в Южном Приаралье

Группа показателей	**Основные параметры**
Минерализация	TDS, сухой остаток
Основные ионы	Cl^-, SO_4^{2-}, HCO_3^-, Ca^{2+}, Mg^{2+}, Na^+
Азотистые соединения	NH_4^+, NO_2^-, NO_3^-
Токсичные элементы	Pb, Cd, Hg, Cr, As
Органические загрязнители	пестициды, нефтепродукты
Микробиологические показатели	общее микробное число, санитарно-показательные микроорганизмы
Физические показатели	мутность, цветность, температура, электропроводность
Кислотно-щелочные характеристики	pH

Таким образом, сформировался новый путь воздействия: высохшее дно → ветер → пылевой аэрозоль → атмосферный воздух → дыхательные пути → организм человека. Пыль с бывшего морского дна может переносить соли и остаточные сельскохозяйственные загрязнители на значительные расстояния. Поэтому оценка качества атмосферного воздуха является важной частью медико-экологического анализа Южного Приаралья.

Исследования конца XX – начала XXI века выявили ухудшение здоровья населения Аральского региона, особенно женщин и детей, связывая его с неблагоприятными экологическими факторами, качеством воды и пищевых продуктов. Экологическая катастрофа также повлияла на психосоциальное состояние населения, включая экологическую тревожность и субъективную оценку здоровья. Южное Приаралье представляет собой природно-социальную систему, где гидрологические изменения тесно связаны с состоянием окружающей среды и здоровьем населения. Основными факторами риска являются дефицит и ухудшение качества воды, остаточное сельскохозяйственное загрязнение, а также перенос солей и пыли. Это обусловливает необходимость комплексного мониторинга по системе «вода

— почва — воздух — биота — население» для выявления источников и путей воздействия экологических факторов.

Таким образом, устойчивое развитие Южного Приаралья требует перехода от реагирования на отдельные экологические последствия к комплексному управлению экологическими рисками. В центре такой системы должна находиться не только охрана водных ресурсов, но и обеспечение экологической безопасности и здоровья населения.

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СОВРЕМЕННАЯ ПРАКТИКА ПРИМЕНЕНИЯ ПРОЕКЦИИ ГАУССА–КРЮГЕРА И СИСТЕМЫ КООРДИНАТ В ИНЖЕНЕРНО-ГЕОДЕЗИЧЕСКИХ И МАРКШЕЙДЕРСКИХ РАБОТАХ

Аннотация: *В данной статье выполнен анализ существующих геодезических проекций, даны расчеты необходимых предельных точностей в зависимости от предьяляемых к инженерно-геодезическим городским и маркшейдерским работам требований различным отраслими народного хозяйства в Кыргызской Республики.*

Рассмотрены недостатки проекции Гаусса-Крюгера для городских, инженерно-геодезических и маркшейдерских работ. Отмечены преимущества стереографических проекций перед другими для этих видов геодезических работ.

Ключевые слова*: топографическая съемка, координат, проекции Гаусса –Крюгера, стереографическая проекция, погрешность, горные районы, тоннель, переваль,геодезическая сеть.*

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MODERN APPLICATION OF THE GAUSS–KRÜGER PROJECTION AND COORDINATE SYSTEM IN ENGINEERING-GEODETIC AND MINING SURVEYING WORKS

Annotation: *This article analyzes existing geodetic projections and provides calculations of the required maximum accuracy depending on the requirements for urban geodetic and surveying work by various sectors of the national economy in the Kyrgyz Republic.*

The disadvantages of the Gauss-Kruger projection for urban, geodetic and surveying works are considered. The advantages of stereographic projections over others for these types of geodetic work are noted.

Keywords*: topographic survey, coordinates, Gauss-Kruger projection, stereographic projection, error, mountainous areas, tunnel, pass, geodetic network.*

Однако прежде чем приступить к решению этой задачи, рассмотрим современную практику применения проекции и координат Гаусса-Крюгера в инженерных городских геодезических и маркшейдерских работах.

С развитием инженерно-геодезических и городских работ недостатки системы координат Гаусса-Крюгера привели к тому, что ее стали постепенно

заменять условными местными системами прямоугольных координат, которые более или менее отвечали требованиям градостроительной и маркшейдерской практики в территории Кыргызстана[12] .

Кратко проследим современную практику применения проекции и системы координат в главнейших областях инженерной деятельности, в частности:

- В инженерно-геологических и геофизических работах;
- В гидро-энерго-строительстве;
- В градостроительстве;
- В промышленном и гражданском строительстве;
- В горно-маркшейдерских работах.

При инженерно-геологических и геофизических работах Кыргызстана

сравнительно невысокая относительная точности, порядка 1:1000-1:1500, производимых геологических и геофизических работ позволяет применять проекцию и координаты Гаусса-Крюгера независимо от расположения исследуемого участка от осевого меридиана 3-х или 6°-ти зоны.

Однако, предъявляемые требования к точности инженерно-геодезических и съемочных работ, выполняемых в масштабах 1:2000 -1:500 для инженерной геологической практики коренным образом меняют постановку вопроса о выборе целесообразной проекции [11].

Примем предельную графическую точность m_D топографической съемки для точки D (рисунок 1), определяемой из геодезической привязки, тогда, следуя рассуждениями среднюю квадратическую ошибку точки к сети сгущения, как опорной, в худшем случае нужно иметь в два раза меньшую, чем m_D, т.е.

$$m_k=\frac{m_D}{2} \qquad (1)$$

При соблюдении такого требования в государственной геодезической сети (пункты A, B, C) необходимо иметь точность в 2-3 раза выше, чем точность развиваемой сети сгущения, поскольку она предназначена не только для топографической съемки, но и для целого ряда геодезических измерений, выполняемых для проектных и строительных работ.

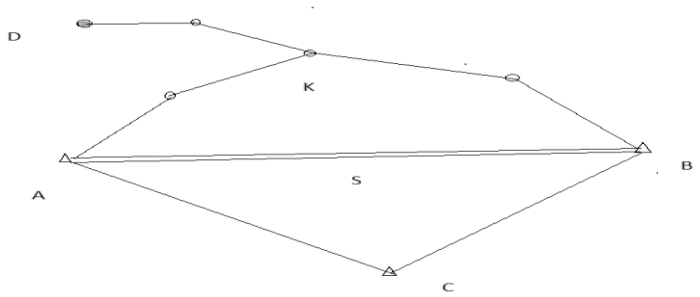


Рисунок 1 − Топографической съемки для точки D

Следовательно, $m_B=m_s=\frac{m_k}{z}=\frac{m_D}{4}$ (2)

где m_s- *средняя квадратическая ошибка в длине стороны триангуляции, приравненная к ошибке определения пункте.*

Таким образом согласно инструкции для последней ступени съемки в масштабе 1:500 при точности построения топографической основы геологических карт равной ±0,3мм, имеем m_D*=0,15 м,* m_k*=0,075 м,* m_s*=0,038 м.*

Другими словами, самая слабая сторона триангуляции 4 класса длиной 2 км должна определяться с относительной ошибкой $\frac{m_s}{4} = \frac{0.038}{2000} = \frac{1}{50000}$

Относительная ошибка сети сгущения, проложенной между пунктами триангуляции 4 класса, определяется по формуле.

$$\frac{1}{N} = \frac{2m_k}{2500} = \frac{1}{17000} \quad (3)$$

Для съемочного обоснования, при длине теодолитного хода между точками полигонометрии равной 0.5 км, получим $\frac{1}{N} = \frac{2m_D}{d} = \frac{2\times0.15}{500} = \frac{1}{1700}$

Откуда следует, что если пользоваться численными результатами съемок в проекции Гаусса-Крюгера, то при выносе проектов инженерно-геологических объектов в натуру мы должны и углы, рассчитанные по координатам, вводить поправки за переход с плоскости на эллипсоида. Это, конечно, доставляет больше неудобства в вычислениях. Поэтому, чтобы избежать этого на практике весьма часто пользуются местной системой координат[12,13].

В гидро-энергостроительство планы выполняются в масшабе 1:5000-1:500 влибо в проекции Гаусса-Кюгера в 3^0-х зонах, либо в местной системе координат.

В зависимости от вида за проектированного гидротехнического сооружения определяется и рассчитывается точность инженерно-геодезических работ, которая согласно инструкциям по инженерно-геодезическим работам для гидротехнического стрительства достаточно высокая и составляет от 20 до 1 мм.

Точность обычных геодезических сетей в таких случаях не всегда удовлетворяет указанному допуску. Поэтому для этих целей используется специальная гидротехническая триангуляция трех разрядов. Особенность ее заключается в том, что при наличии коротких сторон сети, она обеспечивает получение длин сторон, углов и координат с высокой степенью точности[15].

Показывают результаты исследований точности государственной геодезической сети Кыргызстана, что относительная ошибка наиболее слабой стороны гидротехнической триангуляции находится в пределах от 1:70000 до 1:200000. Государственное обоснование не может представить исходных данных для указанной сети специального назначения, т.к. ошибки этих данных одного порядка с соботвенно ошибками измерения наиболее ответственных сторон. Следовательно, чтобы не вносить ошибок исходных данных в сети специального назначения, госуларственные геодезические сети Кыргызстана должны иметь относительные ошибки слабо определленых

сторон от 1:40000 до 1:400000.

Поэтому геодезичекие сети гидротехнической триангуляции следует создавать на собственных базисах, используя лишь ориентировку направлений и координаты одного изпунктов гооударственной геодезической сети. Высокоточная гидротехническая геодезическая сеть должна обрабатываться в такой проекции котороя дала бы неощутимме искажения расстояний и редукции углов[11,13].

По этой причине вопросы целесообразного выбора повериности относимости и осевого меридиана в гидро-энергостроительстве имеют большое принципиальное значение.

Так, к примеру, при обработке высокоточный гидротехнический триангуляции 2 разряда, выполненной автором для строительства выскогорного Кировского водохранилища в территории Кыргызстана, пришлось вообще отказаться от проекции Гаусса-Крюгера, поскольку длина плотины в 257 м, вычисленная в ней, на 50 мм больше действительной, а отводного тоннеля длиной 360 м, - соответственно на +68 мм.

По Токтогульской ГЭС соответствущие величины значительно больше.

Естественно, что на практике при использовании геодезических данных, если они вычислены в проекции Гаусса-Крюгера, в проектировании и строительстве возникают определенные трудности [12-13].

Для проектирования и строительства городов согласно СНиП КР 10-01:2017 необходимо иметь топографические карты и планы в масштабов 1:10000 -1:500.

Настоящие строительные нормы определяют основные требования, предъявляемые на территории Кыргызстана к составу и содержанию материалов, порядку разработки, рассмотрения, согласования и утверждения всех стадий градостроительной документации.

Из всех перечисленных картаграфических материалов карты и планы масштабов 1:10000-1:5000 выполняются обычно в проекции и по координатам Гаусса-Крюгера, а остальные либо в условнной, либо в местной системе координат.

Чтобы обеспечить точность изображаемых предметов городских территортий со сложым надземним и подземным хозяйством в поледней стадии съемок в масштабе 1:500, необходимо определять точки съемочных ходов со средней квадратической ошибкой ±0,2 мм на плане что соответствует m_d=±0,10 м на местности.

Тогда относительная ошибка определения слабой стороны городской триангуляции 4 класса при S=2 км должна быть $\frac{m_s}{s} = \frac{0{,}025}{2000} = \frac{1}{80000}$

Относительная ошибка для сети сгущения проложенной между пунктами триангуляции равно $\frac{m_k}{s} = \frac{2 \times 0{,}05 \text{ м}}{2500} = \frac{1}{2500}$

Для съемочного обоснования при длине теодолитного хода 0,8 км между точками полигонометрии, при масштабе 1:500 аналогично прежнему получим

$\frac{m_d}{d}=\frac{2\times0,010}{800}=\frac{1}{4000}$ Соответственно, при длине теодолитного хода d=500м, вместо данной точности 1:2000, относительная ошибка будет $\frac{m_d}{d}=\frac{2\times0,10}{500}=\frac{1}{2500}$

Очевидно, созданное постоянное обоснование такой точности будет достаточным при решении многих инженерно-технических задач градостроительства.

Перенесение в натуру проектов планировки и застройки городов производится действием обратным съемке местности. Геодезические разбивочные работы в большинстве случаев по точности в несколько раз выше точности работ, производимых при съемке. Для обеспечение разбивки, а также для контроля ее необходимо, чтобы положение пунктов разбивочной опорной сети было определено с точностью в 2 раза больше той которая принята при разбивке сооружений. Поэтому предельная относительная ошибка взаимного положения пунктов плановой опорной сети в последней стадии должна быть принята соответственно 1:5000, что соответствует 2 разряду по классификации городской полигонометрии [12-15].

Созданное плановое обоснование такой точности в системе координат Гаусса-Крюгера во многих случаях практики городских работ потребует обратного перехода к натуральным значениям длин сторон и углов.

В противном случае, при выполнение инженерно-геодезических работ с относительной ошибкой выше 1:2500 для разбивки уникальных сооружений и коммуникаций потребуются специальные локальные сети ограниченного распространения, или на собственных базисах, измеренных с высокой степенью точности без введения каких-либо поправок в длины сторон и углов.

Геодезические съемки территорий промышленных предприятий, за исключением специальных объектов, по методу выполнения близки к городским крупномасштабным. Следовательно, точность триангуляции, полигонометрии и сетей сгущения одинаковой с рассчитанной для градостроительства. Относительные невязки теодолитных ходов не должны превышать 1:2500 при максимальной длине хода 0,5 км.

Однако при современных методах строительства из сборных конструкций и элементов требуется наибольшая точность при разбивке зданий по сравнению с точностью разбивки кирпичных сооружений. В связи с этим, требования промышленного и гражданского строительства к инженерно-геодезическим работам увеличиваются и как следствие этого, чаще возникает потребность в создании специального высокоточного геодезического обоснования [11-13].

Поэтому много проектные и строительные организации пользуются топографическими планами масштабов 1:2000-1:500 и аналитическими данными в условной или местной системах координат, так как размеры крупнейших сооружений длиной более 1км вынесенные в натуру по геодезическому обоснованию в проекции Гаусса-Крюгера, на краю 3°-х зон увеличиваются до 20 см, что значительно превышает технические допуски в строительстве.

В горно-маркшейдерских работа Кыргызстана гораздо чаще, чем в других из-за отсутствия исходных данных и значительных искажений проекции Гаусса-Крюгера, применяется условная система координат, приведенная к средней уровненной поверхности участка горных работ.

Так к примеру, если использовать плановое обоснование для автодорожного тоннеля Тоо-Ашуу по трассе Бишкек-Ош длиной 2370 м в проекции Гаусса-Крюгера, то для края 3°-й зоны (у $_{m=}$120 $_{км}$) под широтой 45°, получим $\Delta S_{3^\circ} = S\frac{y^2 m}{2R^2 m} = S\frac{1}{5000} = 0{,}474$ м

А если учесть широкий размах горно-маркшейдерских работ (например, строительство тоннеля через перевал Кок-Арт длиной 3,8 км в Кыргызстане. Всего на объекте пройдено 3 861,9 метра из 3 890), то станет ясным и вопрос несоответствия между точностью специального обоснования и искажениями проекции. При исследованиях была выбрана реально существующая территория в Кыргызской Республике, а именно, район высокогорного тоннеля Тоо-Ашуу и "Кок-Арт".

Знаменитый перевал Тоо-Ашуу находится в горах Ала-Тоо на стратегической трассе Бишкек-Ош, которая соединяет северные и южные регионы Кыргызстана. Высота перевала - 3 400 метров над уровнем моря.

А так же тоннеля "Кок-Арт" находится на границе Тогуз-Тороуского и Сузакского районов, на 334-338-м км альтернативной дороги Север - Юг.

Согласно требованиями, предъявляемым к строительству и эксплуатации горных предприятий устанавливается классификация локальных геодезическо-маркшейдерских сетей по типу гидротехнической триангуляции с относительной ошибкой слабо определяемой стороны 1:70000 -1:200000. Подобная триангуляция, создаваемая для контроля неподвижности пунктов, от которых ведутся наблюдения за горизонтальными и вертикальными смещениями сооружений должна обеспечивать положения этих пунктов со средней квадратической ошибкой не более ±3-5 мм. Допуски смещений сооружений рассчитываются в зависимости от ожидаемых величин оседаний и горизонтальных с движений[12-15].

Результаты

Таким образом, этот краткий обзор современной практики инженерно-геодезических и маркшейдерских работ по применению проекции и координат Гаусса-Крюгера показывает, что без перерасчета топографо-геодезических данных из государственной системы координат, особенно на краях зон, в непосредственно измеренные величины, этими данными пользоваться нельзя.

Вследствие с этим, на территориях крупнейших строительств и городов со сложным наземным и подземным хозяйством, топографические и инженерно-геодезические работы в территории Кыргызстана выполняются на специальной геодезической основе и эти материалы обрабатываются в местных системах, причем такие работы зачастую занимают значительные территории.

В целях правильного и полного использования геодезических и маркшейдерских измерений и съемок, выполняемых проектными и строительными организациями, необходимо упорядочить вопрос с единой проекции и системе координат для этих видов работ.

Отмеченные недостатки проекции Гаусса-Крюгера имеют и другой аспект в нашей инженерной практике, а именно, значительные линейные искажения привели к тому, что формат топографических планов по своим размером не дает полного представления о местности в целом. Для более правильного и быстрого доведения этой информации до потребителя карт и планов становится выгодными применять не стандартную разграфку, а увеличенную, чтобы разместить на таком планшете весь комплекс сооружений.

Поэтому при разработке специальной проекции для инженерных городских геодезических работ необходимо тщательно исследовать вопросы искажений, удобства практического применения и связи с общегосударственной системой.

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ИНТЕГРАЦИЯ GNSS И ДИСТАНЦИОННОГО ЗОНДИРОВАНИЯ ДЛЯ МОНИТОРИНГА ЗЕМНОЙ ПОВЕРХНОСТИ

Аннотация: *На данный момент одной из важнейших задач современной геодезии является наблюдение за земной поверхностью. Отдельные методы наблюдений имеют ряд различных ограничений: спутниковые навигационные наблюдения (GNSS) обеспечивают высокоточные измерения смещений, однако являются точечными. Методы дистанционного зондирования позволяют получать пространственно непрерывную информацию, но обладают рядом недостатков, связанных с влиянием погодных условий, перегревом оборудования и другими факторами.*

В данной работе рассматривается вариант интеграции данных GNSS и дистанционного зондирования для мониторинга земной поверхности. GNSS используется для получения временных рядов координат и оценки векторных смещений в отдельных пунктах, а данные интерферометрической радиолокационной съёмки (InSAR) для построения пространственных карт исследуемой территории. Совместное использование этих данных позволяет повысить достоверность результатов и обеспечить взаимную валидацию измерений.

Ключевые слова: *GNSS; InSAR; мониторинг ; дистанционное зондирование; геодезические измерения; интеграция данных.*

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INTEGRATION OF GNSS AND REMOTE SENSING FOR MONITORING THE EARTH’S SURFACE

Abstract: *Monitoring of the Earth's surface is currently one of the most important tasks in modern Geodesy. Individual observation methods have a number of limitations. Satellite navigation observations based on Global Navigation Satellite System (GNSS) provide highly accurate displacement measurements but are limited to point observations. In contrast, Remote Sensing methods allow obtaining spatially continuous information; however, their results may be affected by atmospheric conditions, equipment limitations, and other external factors.*

This study considers an approach to integrating GNSS and remote sensing data for monitoring surface deformations. GNSS observations are used to obtain coordinate time series and estimate displacement vectors at individual observation points, while data from Interferometric Synthetic Aperture Radar (InSAR) are used

to construct spatial deformation maps of the study area. The combined use of these data improves the reliability of the results and enables cross-validation of measurements.

Keywords: *GNSS; InSAR; deformation monitoring; remote sensing; geodetic measurements; data integration.*

Введение

Мониторинг земной поверхности является одной из важнейших задач современной Geodesy. Деформационные процессы могут возникать как под воздействием природных факторов (сейсмическая активность, геодинамические процессы, оползни), так и в результате антропогенной деятельности человека, включая интенсивную урбанизацию, строительство инженерных сооружений и развитие горнодобывающей промышленности. Своевременное выявление и анализ позволяют снизить риски возникновения чрезвычайных ситуаций и обеспечить безопасность инфраструктуры и населения.

В настоящее время для наблюдения за деформациями широко применяются спутниковые геодезические методы, в частности технологии Global Navigation Satellite System. Использование GNSS обеспечивает получение высокоточных трёхмерных координат пунктов наблюдений и позволяет формировать временные ряды смещений с миллиметровой точностью. Однако данный метод имеет ряд ограничений, включая зависимость от качества спутникового сигнала, высокую стоимость оборудования и уязвимость к радиопомехам [1, 2].

Наряду с GNSS активно используются методы Remote Sensing, в частности радиолокационная интерферометрия Interferometric Synthetic Aperture Radar. Данный подход позволяет получать пространственную информацию о смещениях земной поверхности на региональном и локальном уровнях, а также анализировать деформационные процессы на больших территориях. Вместе с тем результаты обработки радиолокационных данных могут быть подвержены влиянию атмосферных эффектов, особенностей геометрии съёмки и временной декорреляции сигнала, что может снижать точность получаемых результатов при отсутствии наземных измерений.

В связи с указанными ограничениями отдельных методов возрастает интерес к интеграции данных GNSS-наблюдений и спутниковых методов дистанционного зондирования. Совместное использование этих подходов позволяет объединить высокую точность точечных GNSS-измерений с пространственной информативностью радиолокационных данных. GNSS-наблюдения могут использоваться для калибровки и контроля точности спутниковых измерений, тогда как данные дистанционного зондирования обеспечивают детальное пространственное представление деформационных процессов.

Таким образом, интеграция GNSS и данных дистанционного зондирования представляет собой перспективное направление развития

современных методов мониторинга земной поверхности. Исследование возможностей и эффективности такого подхода является актуальной научно-практической задачей.

Актуальность темы исследования

Актуальность данного исследования обусловлена необходимостью повышения эффективности мониторинга земной поверхности, возникающих под воздействием природных и антропогенных факторов, таких как урбанизация территорий, строительство инженерных сооружений и развитие горнодобывающей промышленности [3-5]. Деформационные процессы могут представлять потенциальную угрозу для устойчивости сооружений, транспортной инфраструктуры и безопасности населения.

Современные методы наблюдения земной поверхности, включая технологии Global Navigation Satellite System и методы Remote Sensing, широко применяются в геодезических исследованиях. GNSS-измерения обеспечивают высокоточные точечные наблюдения и позволяют формировать непрерывные временные ряды координат. В то же время спутниковые радиолокационные методы позволяют получать пространственную информацию о деформациях на больших территориях.

Несмотря на значительные преимущества, каждый из указанных методов имеет определённые ограничения. В частности, GNSS-наблюдения характеризуются точечным характером измерений, тогда как радиолокационные методы требуют дополнительной наземной проверки и могут быть подвержены атмосферным и геометрическим искажениям.

В связи с этим интеграция данных GNSS и дистанционного зондирования является актуальным направлением исследований. Совместное использование этих методов позволяет повысить достоверность результатов мониторинга и обеспечить более полное представление о пространственно-временной динамике геодинамических процессов.Целью данного исследования является анализ и возможность интеграции данных глобальных навигационных спутниковых систем (GNSS) и дистанционного зондирования Земли для повышения надёжности и точности мониторинга земной поверхности использованием платформы Google Earth Engine.

Цель и задачи исследования

Целью данного исследования является анализ возможности интеграции данных глобальных навигационных спутниковых систем (GNSS) и данных дистанционного зондирования Земли для повышения надёжности и точности мониторинга земной поверхности с использованием платформы Google Earth Engine.

Для достижения поставленной цели были сформулированы следующие задачи:

- Выполнить подбор и подготовку спутниковых данных дистанционного зондирования Земли на платформе Google Earth Engine для анализа земной поверхности.

- Провести обработку и анализ GNSS-данных с целью получения временных рядов координат и оценки векторных смещений в пунктах наблюдений.

- Реализовать обработку радиолокационных данных для получения пространственной информации о динамике земной поверхности.

- Выполнить сопоставление результатов GNSS-измерений с результатами анализа спутниковых данных в среде Google Earth Engine.

- Оценить согласованность и достоверность результатов интегрированного подхода и определить его возможности и ограничения при мониторинге .

Методика исследования

Для интеграции разнородных данных использовалась облачная платформа Google Earth Engine, позволяющая выполнять обработку больших массивов спутниковых данных без необходимости их локальной загрузки. В рамках исследования были использованы данные спутниковых миссий Sentinel-1 и Sentinel-2. Все этапы обработки данных были реализованы на языке программирования JavaScript в среде Google Earth Engine.

Обработка данных дистанционного зондирования

Для интеграции разнородных данных использовалась облачная платформа Google Earth Engine (GEE) [6-7]. Это позволило унифицировать обработку спутниковых снимков Sentinel-1 (SAR) и Sentinel-2 (оптический диапазон) без локальной загрузки больших объемов данных. Весь вычислительный конвейер реализован на языке JavaScript.

На первом этапе была определена область исследования (AOI) радиусом 5 км от центра карьера. Для анализа деформационной активности использовался косвенный индикатор - изменчивость коэффициента обратного рассеяния радиолокационного сигнала (рисунок 1).



Рисунок 1. Спутниковое изображение исследуемой территории по данным Sentinel-2 в цветовой композиции RGB

На основе временной серии радиолокационных изображений Sentinel-1 (режим IW, нисходящий виток) было рассчитано стандартное отклонение значения поляризации VV (VV_stdDev) за период 2020–2024 гг (рисунок 2). Данный показатель использовался в качестве прокси-переменной, характеризующей нестабильность поверхности, связанную с возможными деформационными процессами, такими как осыпи, оползни и техногенные изменения рельефа.



Рисунок 2. Среднее значение коэффициента обратного рассеяния радиолокационного сигнала (VV Mean), полученное по данным Sentinel-1 за исследуемый период

Дополнительно по данным Sentinel-2 были рассчитаны спектральные индексы: нормализованный вегетационный индекс (NDVI), индекс застроенных территорий (NDBI) и индекс влажности (NDWI). Использование данных индексов позволило учитывать влияние растительности и поверхностной влажности на характеристики радиолокационного сигнала

Координаты трёх постоянно действующих GNSS-станций, расположенных на ключевых элементах карьера (борта и дно), были загружены в среду Google Earth Engine в виде точечных объектов. Для каждой станции методом выборки (sampleRegions) из растра нестабильности (VV_stdDev) было извлечено числовое значение индекса, характеризующее интенсивность изменений поверхности в непосредственной близости от пункта наблюдений.

Полученные значения позволили выполнить количественное сопоставление точечных геодезических измерений с площадными спутниковыми данными и оценить пространственную согласованность между наблюдаемыми смещениями и характеристиками радиолокационного сигнала.

Результаты пространственного анализа представлены на рисунке 5. Зоны с высокими значениями индекса нестабильности (красный спектр)

пространственно приурочены к бортам карьера и его дну, что согласуется с высокой скоростью смещений, зафиксированной GNSS-станциями GNSS_01 и GNSS_03 (). Напротив, слабонарушенные участки (синий спектр) характеризуются минимальной изменчивостью SAR-сигнала.

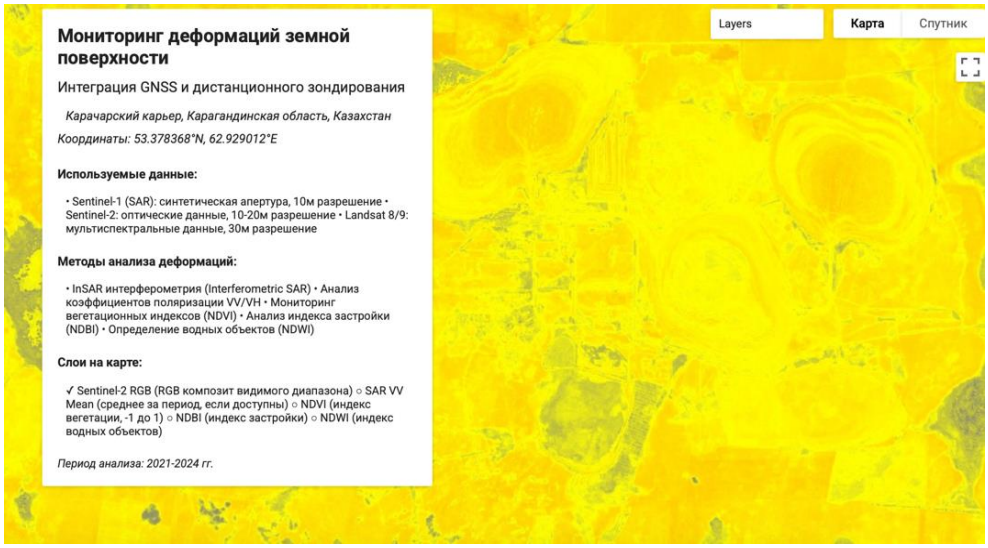


Рисунок 2. Пространственное распределение нормализованного водного индекса (NDWI), рассчитанного по данным Sentinel-2

Результаты и их обсуждение

Результаты пространственного анализа показали, что зоны с повышенными значениями индекса нестабильности радиолокационного сигнала пространственно приурочены к бортам карьера и его дну. Эти участки характеризуются повышенной динамикой поверхности и совпадают с пунктами GNSS-наблюдений, на которых фиксируются наибольшие значения смещений.

В частности, станции GNSS_01 и GNSS_03 демонстрируют повышенные скорости , что согласуется с высокими значениями показателя VV_stdDev, полученного по данным радиолокационных наблюдений. Напротив, участки с низкой изменчивостью радиолокационного сигнала характеризуются стабильным состоянием поверхности и минимальными значениями смещений.

Анализ временных рядов коэффициента обратного рассеяния (VV) в точках размещения GNSS-станций показал наличие резких изменений амплитуды сигнала в определённые периоды времени. Эти изменения коррелируют с известными датами проведения взрывных работ и обрушения уступов карьера, что подтверждает чувствительность радиолокационных данных к техногенным изменениям рельефа.

Полученные результаты свидетельствуют о возможности использования интегрированного подхода для выявления активных зон

деформации и повышения достоверности мониторинга геодинамических процессов.

Заключение

В рамках данного исследования был разработан метод интеграции спутниковых данных дистанционного зондирования и наземных GNSS-наблюдений для мониторинга земной поверхности с использованием платформы Google Earth Engine.

Результаты исследования показали, что использование изменчивости коэффициента обратного рассеяния радиолокационного сигнала в качестве косвенного индикатора деформационных процессов позволяет выявлять зоны повышенной динамики поверхности. Сопоставление этих данных с результатами GNSS-наблюдений подтверждает пространственную согласованность выявленных аномалий.

Предложенный подход демонстрирует высокую эффективность при локальном мониторинге территорий, связанных с горнодобывающей деятельностью, и может быть использован для анализа деформационных процессов в других регионах. Использование облачной платформы Google Earth Engine позволяет существенно упростить обработку больших объёмов спутниковых данных и повысить оперативность геодезического мониторинга.

Перспективным направлением дальнейших исследований является использование интерферометрических методов обработки радиолокационных данных, а также расширение сети GNSS-наблюдений для повышения точности оценки деформационных процессов.

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ЭФФЕКТИВНОСТЬ И ПЕРСПЕКТИВЫ МЕТОДА ПРОЕКТНО-ОРИЕНТИРОВАННОГО ОБУЧЕНИЯ (PBL) В МЕДИЦИНСКОМ ОБРАЗОВАНИИ

Аннотация. *В данной статье анализируется роль метода проектно-ориентированного обучения (Project-Based Learning — PBL/PrBL) в современном медицинском образовании, а также его влияние на академическую успеваемость, критическое мышление, практические и коммуникативные навыки студентов. Анализ исследований показывает, что метод PBL по сравнению с традиционным обзором литературы и пассивными методами обучения позволяет формировать у студентов междисциплинарную интеграцию, повышать оригинальность авторских исследований и заданий, а также существенно улучшать показатели академической успеваемости. Кроме того, в статье освещен опыт интеграции цифровых технологий (например, Medical Cloud Dictionary) и инженерных подходов с PBL, а также описаны педагогические и организационные сложности, возникающие при внедрении данного метода.*

Ключевые слова: *проектно-ориентированное обучение (PBL), медицинское образование, академическая успеваемость, междисциплинарная интеграция, конструктивизм, цифровая педагогика.*

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EFFECTIVENESS AND PROSPECTS OF THE PROJECT-BASED LEARNING (PBL) METHOD IN MEDICAL EDUCATION

Abstract. *This article analyzes the role of the Project-Based Learning (PBL/PrBL) method in modern medical education, as well as its impact on students' academic performance, critical thinking, practical skills, and communication abilities. An analysis of research indicates that, compared to traditional literature reviews and passive learning methods, the PBL approach enables students to develop interdisciplinary integration, enhances authorial originality in research and assignments, and significantly improves academic achievement scores. Furthermore, the article highlights experiences in integrating digital technologies (e.g., Medical Cloud Dictionary) and engineering approaches with PBL, alongside*

describing the pedagogical and organizational challenges encountered during its implementation.

Keywords: *project-based learning (PBL), medical education, academic performance, interdisciplinary integration, constructivism, digital pedagogy.*

1. Введение и теоретические основы

В последние годы глобализация и стремительное развитие медицинских наук ставят перед медицинским образованием новые педагогические задачи. Традиционные модели обучения, основанные на заучивании и пассивном восприятии информации, оказываются недостаточными для формирования у будущих врачей клинического мышления, навыков критического анализа и командного взаимодействия. В связи с этим особое внимание в современной медицинской педагогике уделяется использованию проектно-ориентированного обучения (Project-Based Learning — PBL) **[10]**.

Теоретический фундамент метода PBL тесно связан с конструктивистской теорией обучения (Ж. Пиаже и Л. Выготский) **[10]**. Если Ж. Пиаже подчеркивал, что приобретение знаний происходит индивидуально в процессе взаимодействия с окружающей средой, то Л. Выготский в своей концепции социального конструктивизма показывал, что знания формируются в процессе общения и сотрудничества **[10]**. Проектно-ориентированная деятельность охватывает этапы планирования, постановки проблемы, исполнения и оценки результатов, обеспечивая неразрывную связь между теорией и практикой **[10, 5]**.

2. Академическая успеваемость и оригинальность исследований

Эмпирические исследования, проведенные в сфере медицины и смежных дисциплин, подтверждают положительное влияние метода PBL на академические показатели:

– **Рост академических результатов:** В квазиэкспериментальном исследовании E. Kldiashvili и соавторов (n = 179) при сравнении студентов 12-го семестра медицинского факультета средний академический балл экспериментальной группы, обучавшейся по методу PBL, составил **82.5**, тогда как в контрольной группе, выполнявшей традиционный обзор литературы, этот показатель составил **66.5** ($t(177)=-20.53, p<0.01$) **[5]**. Также в исследовании J. Zhang и др. (2025) экспериментальная группа набрала в среднем **83.57** балла против **73.94** балла в контрольной группе ($U=22037.5, p<0.001$) **[12]**.

– **Снижение плагиата и текстовых совпадений:** Метод PBL побуждает студентов не к простому копированию готовой информации, а к самостоятельному анализу данных. В исследовании E. Kldiashvili и др. процент текстовых совпадений (similarity percentage), оцененный с помощью системы Turnitin, составил **12.62%** в контрольной группе и снизился до **4.17%** в группе PBL ($t(177)=13.74, p<0.01$) **[5]**.

Показатели	Контрольная группа (Традиционная)	Экспериментальная группа (PBL)	Статистика (p-значение)	Источник
Средний академический балл (Kldiashvilietal.)	66.5	82.5	p<0.01	**[5]**
Текстовое совпадение / Similarity (Turnitin)	12.62%	4.17%	p<0.01	**[5]**
Средний академический балл (Zhangetal.)	73.94	83.57	p<0.001	**[12]**
Показатель отличных оценок (Zhangetal.)	2.9%	22.9%	p<0.001	**[12]**

3. Междисциплинарная интеграция и клинический подход

На доклиническом этапе (pre-clerkship) интеграция фундаментальных дисциплин с клинической практикой является ключевым фактором эффективности обучения **[2]**.

В исследовании F. A. A. Elkhamisy и др. (2022) (n = 694) **84.6%** студентов предпочли выполнение одного интегрированного междисциплинарного проекта (PtBL) решению отдельных изолированных задач по каждой дисциплине **[2]**. Уровень осознания студентами взаимосвязи между дисциплинами вырос с 3.46 балла до проведения проекта до **3.66** балла после его завершения ($P = 0.000$) **[2]**. В процессе проектирования тем также были выявлены пробелы в модульных учебных программах и определены изолированные темы, требующие межпредметной интеграции **[2]**.

4. Развитие профессиональных и «гибких» навыков (soft skills)

PBL в учебном процессе не только укрепляет теоретические знания, но и формирует практические и профессиональные компетенции:

– **Коммуникативные и речевые навыки:** В работах N. I. Yelahina (2024) **[10]** и N. Hekmati (2022) **[3]** показано, что подготовка видеопроектов и презентаций на занятиях по медицинскому английскому языку существенно повышает свободу общения и развивает устную речь студентов **[10, 3]**.

– **Информационная грамотность и тайм-менеджмент:** R. Saliba и др. (2017) отмечают, что методология PBL учит студентов эффективно использовать научные базы данных, критически оценивать достоверность источников, расставлять приоритеты в задачах и управлять временем в команде **[7]**.

– **Креативность и творческое мышление:** В исследовании R. Rinto и др. (2022), проведенном среди студентов фармацевтического направления на

основе подхода Ethno-STEM, зафиксирован умеренно-высокий рост показателей гибкости мышления ($N\text{-gain} = 70.95\%$), беглости (69.65%) и оригинальности (69.50%) **[6]**.

5. Образовательные технологии и инновационная интеграция

Современная практика PBL активно обогащается цифровыми платформами и инженерными методологиями:

– **Медицинский облачный словарь (Medical Cloud Dictionary):** Проект облачного словаря на базе 5G-технологий, интегрированный с PBL, дал студентам возможность обновлять информацию в режиме реального времени и эффективно работать в командах. 82% студентов отметили, что этот инструмент улучшил запоминание материала, а 76% указали на снижение уровня стресса во время занятий **[12]**.

– **UBORA и методология CDIO:** A. Ahluwalia и др. (2018) продемонстрировали успешный международный опыт проведения проектной школы для студентов биомедицинской инженерии из Европы и Африки на основе принципов CDIO (Concept-Design-Implement-Operate), где более 82% участников оценили полученный опыт как крайне полезный **[1]**.

6. Мотивация и практические барьеры

Согласно исследованию D. Stentoft и др. (2014), проектно-ориентированное обучение (Project-PBL) вызывает у студентов более высокую мотивацию по сравнению с традиционным кейс-обучением (Case-PBL) (75.0% против 43.7%) и предоставляет больше возможностей для самостоятельного изучения научных тем (autonomy) (57.6% против 45.4%) **[9]**.

Тем не менее, при внедрении метода существуют следующие организационные и педагогические сложности:

– **Затраты времени и ресурсов:** Планирование метода PBL, обеспечение техническими средствами и менторское сопровождение требуют от преподавателя значительных временных и трудовых затрат **[11]**.

– **Ощущение недостатка направляющих указаний:** Студенты, не привыкшие к автономному обучению, на начальных этапах испытывают сложности из-за некоторой неопределенности и дефицита четких инструкций **[7]**.

– **Неравномерная ответственность в группах:** Иногда наблюдается неравномерное распределение задач между членами группы и пассивность отдельных студентов **[9]**.

Выводы

Научный обзор и статистический анализ показывают, что проектно-ориентированное обучение (PBL) является высокоэффективным методом подготовки специалистов в области медицины и смежных дисциплин. Оно не только повышает академическую успеваемость студентов, но и формирует у них академическую честность, критическое мышление и культуру общения. Для повышения эффективности метода рекомендуется систематическое повышение педагогической квалификации преподавателей, широкое

внедрение цифровых образовательных технологий и составление проектных заданий на основе четких критериев и руководств.

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ГИБРИДНАЯ МОДЕЛЬ И АЛГОРИТМ ИНТЕЛЛЕКТУАЛЬНОЙ ОЦЕНКИ ЭФФЕКТИВНОСТИ ТРУДА СОТРУДНИКОВ НА ОСНОВЕ МЕТОДОВ KNN И RANDOM FOREST

Аннотация. *Статья посвящена разработке модели и алгоритмов интеллектуальной оценки эффективности труда сотрудников на основе гибридных методов машинного обучения. Показано, что существующие подходы к оценке персонала — от традиционных бумажных форм до современных электронных HR-систем — опираются на фиксированный набор критериев и не используют методы машинного обучения для классификации уровня эффективности, что ограничивает их точность и адаптивность. Предложена математическая модель, представляющая эффективность сотрудника в виде нормализованного многомерного вектора признаков по пяти измерениям деятельности, а также модель адаптивного формирования и взвешивания критериев на основе метода анализа иерархий (МАИ/AHP) и корреляционного анализа Пирсона. Разработан гибридный алгоритм классификации, объединяющий метод k-ближайших соседей (KNN) и случайный лес (Random Forest) через механизм маршрутизации по уровню достоверности с калиброванным порогом. Порог отбирался методом пятикратной перекрёстной проверки. Экспериментальная проверка показала повышение точности классификации с 76,2% до 92,8% и сокращение времени обработки данных с 12,4 до 6,1 секунды по сравнению с использованием одного базового алгоритма. Полученные результаты подтверждают эффективность предложенного гибридного подхода и могут быть использованы при построении интеллектуальных систем управления персоналом.*

Ключевые слова: *оценка эффективности труда, гибридные алгоритмы машинного обучения, метод k-ближайших соседей, случайный лес, метод анализа иерархий, многокритериальный анализ, управление персоналом.*

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HYBRID MODEL AND ALGORITHM FOR INTELLIGENT ASSESSMENT OF EMPLOYEE PERFORMANCE BASED ON KNN AND RANDOM FOREST METHODS

Abstract. *This article focuses on the development of a model and algorithms for the intelligent assessment of employee performance using hybrid machine learning methods. It demonstrates that existing personnel assessment approaches—ranging from traditional paper-based forms to modern electronic HR systems—rely on a fixed set of criteria and fail to utilize machine learning methods to classify performance levels, thereby limiting their accuracy and adaptability. A mathematical model is proposed that represents employee performance as a normalized multidimensional feature vector across five activity dimensions, alongside a model for the adaptive generation and weighting of criteria based on the Analytic Hierarchy Process (AHP) and Pearson correlation analysis. A hybrid classification algorithm was developed, combining the k-Nearest Neighbors (KNN) method and Random Forest via a confidence-level routing mechanism with a calibrated threshold. The threshold was selected using five-fold cross-validation. Experimental testing demonstrated an increase in classification accuracy from 76.2% to 92.8% and a reduction in data processing time from 12.4 to 6.1 seconds compared to using a single base algorithm. The obtained results confirm the effectiveness of the proposed hybrid approach and can be used in the development of intelligent personnel management systems.*

Keywords: *performance assessment, hybrid machine learning algorithms, k-nearest neighbors method, random forest, Analytic Hierarchy Process, multi-criteria analysis, personnel management.*

Введение

Повышение объективности и оперативности оценки эффективности труда сотрудников является одной из ключевых задач современного управления персоналом. В условиях роста масштабов организаций и усложнения структуры трудовой деятельности традиционные методы оценки — периодические аттестации, экспертные заключения руководителей, бумажные формы отчётности — не обеспечивают необходимой скорости обработки данных и не позволяют учитывать множество разнородных критериев одновременно [1].

Анализ существующих решений показывает, что современные подходы к оценке персонала можно условно разделить на три группы: традиционные методы (периодические письменные отчёты и аттестации), методы целевого управления (Management by Objectives, система ключевых показателей эффективности KPI, метод «360 градусов») и электронные системы управления персоналом (HRIS, e-HRM). Несмотря на автоматизацию отдельных процессов, электронные системы по-прежнему используют жёстко заданные, статические наборы критериев оценки, изменение которых требует модификации структуры базы данных [2].

На основании проведённого анализа выделены три взаимосвязанные проблемы, определяющие научную задачу исследования. Во-первых, критерии оценки жёстко привязаны к структуре базы данных, что затрудняет их адаптацию под специфику конкретной организации. Во-вторых, существующие алгоритмы классификации сталкиваются с компромиссом между скоростью и точностью: быстрые методы, такие как KNN, уступают в точности на пограничных случаях, тогда как более точные ансамблевые методы, такие как Random Forest, требуют значительных вычислительных ресурсов [3, 4]. В-третьих, отсутствуют оптимизированные модели, специально предназначенные для многокритериальной, управляемой данными оценки эффективности труда.

Целью настоящего исследования является разработка моделей и алгоритмов интеллектуальной оценки эффективности труда сотрудников на основе гибридных методов машинного обучения, обеспечивающих повышение точности оценки и вычислительной эффективности процесса классификации.

Для достижения поставленной цели решались следующие задачи: 1) разработка формализованной многокритериальной математической модели эффективности труда сотрудника; 2) разработка модели адаптивного формирования и взвешивания критериев оценки на основе метода анализа иерархий и корреляционного анализа; 3) разработка гибридного алгоритма классификации, объединяющего KNN и Random Forest с маршрутизацией по уровню достоверности, а также метода выбора оптимального порогового значения; 4) создание программного комплекса и экспериментальная проверка предложенных моделей и алгоритмов.

Материалы и методы

Формальная модель эффективности. Эффективность труда сотрудника формализована в виде нормализованного вектора признаков x = (x1, x2, x3, x4, x5), где компоненты соответствуют пяти измерениям трудовой деятельности: выполнение задач, качество работы, профессиональное поведение, взаимодействие и коммуникация, развитие и инициативность. Каждый компонент приводится к диапазону [0, 1] методом min-max нормализации:

$$xi' = \frac{xi - xi\,min}{xi\,\max - xi\,min} \qquad (1)$$

что обеспечивает сопоставимость разнородных по природе показателей и корректность последующего вычисления расстояний между наблюдениями.

Модель формирования критериев. Для формирования системы весовых коэффициентов критериев применён метод анализа иерархий (МАИ, AHP): на основе матрицы парных сравнений экспертов вычисляются относительные веса критериев wi, при этом согласованность суждений контролируется индексом согласованности (Consistency Ratio) [5]. Для устранения избыточности показателей дополнительно проводится корреляционный анализ Пирсона: критерии с высоким коэффициентом взаимной корреляции

(r > 0,85) объединяются либо исключаются из модели, что снижает мультиколлинеарность признакового пространства.

Гибридный алгоритм классификации. Классификация уровня эффективности сотрудника выполняется гибридным алгоритмом, объединяющим метод k-ближайших соседей и случайный лес через механизм маршрутизации по уровню достоверности. На первом этапе алгоритм KNN определяет класс объекта на основе взвешенного евклидова расстояния до k ближайших соседей в обучающей выборке и одновременно формирует оценку достоверности классификации $c \in [0, 1]$, отражающую степень согласованности соседей:

$$d(x, xj) = \sqrt{\Sigma\, wi\, (xi - xji)^2}, \qquad (2)$$

Если оценка достоверности превышает пороговое значение θ, результат KNN принимается как окончательный (быстрый путь обработки). В противном случае, когда $c \leq \theta$, наблюдение считается пограничным и передаётся на дообработку алгоритму Random Forest, ансамблю решающих деревьев, обеспечивающему более устойчивую классификацию за счёт агрегирования решений [3]. Такой подход позволяет сочетать вычислительную скорость KNN с точностью ансамблевого метода без потери качества классификации.

Оптимальное пороговое значение θ определялось методом пятикратной перекрёстной проверки (5-fold cross-validation) на диапазоне значений от 0,5 до 0,95 с шагом 0,02. Критерием выбора служило сочетание максимальной точности классификации и минимальной доли наблюдений, направляемых на дообработку алгоритмом Random Forest. По результатам перекрёстной проверки оптимальным признано значение $\theta = 0{,}72$, при котором около 78% наблюдений обрабатываются по быстрому пути.

Программная реализация. Для верификации предложенных моделей разработан программный комплекс, включающий реляционную базу данных из десяти сущностей в третьей нормальной форме, модуль формирования и хранения критериев оценки, реализацию гибридного алгоритма классификации и модуль формирования рекомендаций по ключевым показателям эффективности. Архитектура комплекса допускает реконфигурацию критериев оценки без изменения структуры базы данных, что соответствует задаче адаптивного формирования критериев.

Результаты

Экспериментальная проверка предложенного гибридного алгоритма проводилась в сравнении с применением одного базового алгоритма классификации (без маршрутизации по достоверности). Сравнительные результаты по основным метрикам качества классификации представлены в таблице 1.

Точность (Accuracy)	76,2%	92,8%	+16,6 п.п.
Точность (Precision)	75,1%	91,3%	+16,2 п.п.
Полнота (Recall)	74,3%	90,5%	+16,2 п.п.
F1-мера	74,7%	90,9%	+16,2 п.п.
Время обработки	12,4 с	6,1 с	−50,8%

Таблица 1. Сравнение метрик качества классификации до и после применения гибридного алгоритма

Как видно из таблицы 1, применение гибридного алгоритма обеспечило прирост точности классификации на 16,6 процентных пункта при одновременном сокращении времени обработки более чем в два раза. Показатели точности (precision), полноты (recall) и F1-меры превысили 90%, что свидетельствует об отсутствии значимого смещения классификатора в сторону какого-либо из классов эффективности.

Анализ зависимости точности классификации от порогового значения θ показал немонотонный характер: при заниженных значениях порога ($\theta < 0,6$) на дообработку Random Forest направляется избыточно большая доля наблюдений, что увеличивает время обработки без существенного прироста точности; при завышенных значениях ($\theta \geq 0,9$) точность классификации снижается до 87,4%, поскольку часть пограничных случаев ошибочно принимается по результатам KNN без дополнительной проверки. Значение $\theta = 0,72$ обеспечило оптимальное соотношение между точностью и вычислительными затратами.

Разработанный программный комплекс подтвердил практическую применимость предложенных моделей: реализованная база данных из десяти сущностей позволяет хранить многомерные данные об эффективности сотрудников без потери гибкости при изменении состава критериев, а модуль формирования критериев на основе МАИ и корреляционного анализа обеспечивает исключение избыточных показателей на этапе настройки системы под конкретную организацию.

Обсуждение

Полученные результаты подтверждают гипотезу о том, что объединение быстрого, но менее устойчивого к пограничным случаям алгоритма KNN с более точным, но вычислительно затратным алгоритмом Random Forest через механизм маршрутизации по достоверности позволяет получить решение, превосходящее по совокупности показателей каждый из базовых алгоритмов в отдельности. Аналогичный вывод о преимуществе гибридных и ансамблевых схем над одиночными классификаторами при

решении задач классификации с несбалансированными или неоднородными признаками отмечается и в более ранних работах [3, 4].

Предложенная модель формирования критериев на основе МАИ и корреляционного анализа отличается от подходов, используемых в существующих HR-системах, тем, что позволяет адаптировать состав и веса критериев под специфику организации без изменения структуры базы данных, тогда как в системах типа HRIS и e-HRM набор критериев остаётся статическим и требует программной доработки при изменении требований к оценке [2].

Вместе с тем необходимо отметить ряд ограничений выполненного исследования. Во-первых, найденное пороговое значение $\theta = 0{,}72$ является оптимальным для использованного набора данных и организационного контекста; при переносе модели на данные другой организации требуется повторная калибровка порога методом перекрёстной проверки. Во-вторых, для окончательной оценки эффективности предложенного гибридного алгоритма необходимо его сопоставление с альтернативными ансамблевыми методами (например, градиентным бустингом) на выборках большего объёма, что определяет направление дальнейших исследований. В-третьих, оценка вычислительной сложности алгоритма выполнена эмпирически и подлежит строгому теоретическому обоснованию.

Дальнейшее развитие исследования предполагает: теоретическое обоснование и формализацию предложенной многокритериальной модели; сравнительный анализ гибридного алгоритма с иными ансамблевыми методами классификации на данных большего объёма и из разных организаций; а также практическое внедрение разработанного программного комплекса в деятельность организаций с последующей оценкой экономического эффекта.

Заключение

В работе предложены математическая модель многокритериальной оценки эффективности труда сотрудников, модель адаптивного формирования и взвешивания критериев на основе метода анализа иерархий и корреляционного анализа, а также гибридный алгоритм классификации, объединяющий методы KNN и Random Forest посредством маршрутизации по уровню достоверности с калиброванным пороговым значением $\theta = 0{,}72$. Экспериментальная проверка на программном комплексе показала повышение точности классификации с 76,2% до 92,8% и сокращение времени обработки данных с 12,4 до 6,1 секунды по сравнению с использованием одного базового алгоритма.

Полученные результаты имеют как теоретическое значение — предложенная схема маршрутизации по достоверности может быть распространена на другие задачи многокритериальной классификации, — так и практическую значимость для построения интеллектуальных систем управления персоналом, обеспечивающих гибкую настройку критериев оценки без изменения структуры информационной системы. Дальнейшие

исследования будут направлены на теоретическое обоснование модели, сопоставление с альтернативными ансамблевыми методами и практическое внедрение результатов в организациях различного профиля.

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О РОЛИ БУХГАЛТЕРСКОГО УЧЕТА В ИНФОРМАЦИОННЫХ РЕСУРСАХ ОРГАНИЗАЦИИ

Аннотация: *В статье рассмотрена роль информационных ресурсов в управлении предприятием, их классификация и место бухгалтерского учета в корпоративной информационной системе. Обозначены изменения в бухгалтерском учете под влиянием процессов цифровизации.*

Ключевые слова: *информационные ресурсы, учетная система, управление, информационная система, бухгалтерский учет, учет затрат.*

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ON THE ROLE OF ACCOUNTING IN AN ORGANIZATION'S INFORMATION RESOURCES

Abstract: *The article examines the role of information resources in enterprise management, their classification, and the place of accounting within the corporate information system. It outlines changes in accounting driven by digitalization processes.*

Keywords: *information resources, accounting system, management, information system, accounting, cost accounting.*

В условиях стремительной цифровой трансформации экономики информационные ресурсы являются важнейшими инструментами в качестве

средств поддержки бизнеса любого субъекта хозяйствования. С каждым годом в нашей стране все больше организаций вовлекаются в информационный процесс. Промышленные предприятия и другие организации используют наиболее актуальные информационные системы для решения различных управленческих, экономических и организационных задач, пользуются электронными справочно-правовыми системами, искусственным интеллектом, а также активно используют электронный документооборот и электронную финансовую отчетность. Однако рассмотрение вопросов о роли информационных ресурсов в эффективном ведении бизнеса не является достаточно проработанной областью в современном научном обществе.

Информационные ресурсы предприятия — это совокупность всех данных, сведений и знаний, накопленных организацией. Они включают базы данных, документы, архивы и технологии их обработки, выступая важнейшим нематериальным активом, который, к сожалению, не находит отражения в бухгалтерском балансе организации.

Условно информационные ресурсы организации можно разделить на внутренние и внешние. К внутренним относятся:

– Корпоративные базы данных (CRM , ERP-системы).
– Финансовая, налоговая и бухгалтерская отчетность.
– Документооборот, архивы, приказы и регламенты.
– Производственная, конструкторская и техническая документация.
– Интеллектуальная собственность (патенты, ноу-хау).

Внешние информационные ресурсы включают:

– Маркетинговые исследования рынка и анализ конкурентов.
– Нормативно-правовая база, законы и государственные стандарты.
– Открытые статистические данные и отраслевая информация.

Говоря о внутренних информационных ресурсах, надо отметить, что ядром информационной системы организации выступает бухгалтерский учет. Он обеспечивает до 70-80 процентов всей количественной и стоимостной информации, необходимой для принятия управленческих решений, контроля ресурсов и оценки финансового состояния бизнеса [1]. Бухгалтерский учет обеспечивает сбор, непрерывную регистрацию и обобщение всех хозяйственных операций в денежном выражении, формируя достоверную базу для принятия управленческих решений, контроля и выполнения обязательств перед государством.

В архитектуре корпоративных информационных систем бухучет выполняет ключевые задачи:

Информационная функция: предоставляет исчерпывающие данные о финансовом положении, активах и обязательствах компании.

Контрольная функция: позволяет отслеживать целевое использование ресурсов и соблюдение финансовой дисциплины.

Аналитическая база: Данные бухучета служат основой для финансового анализа и налогового планирования.

Современные бухгалтерские информационные системы не работают изолированно, а интегрируются со следующими модулями:

– ERP-системы (например, 1С, SAP): автоматизируют ввод данных. Операции в логистике или продажах автоматически формируют бухгалтерские проводки.

– CRM-системы: связывают клиентские сделки и платежи с дебиторской задолженностью в учете.

– Банк-клиент: обеспечивает онлайн-выгрузку выписок и автоматическое проведение оплат [2].

Цифровая трансформация качественно меняет саму парадигму учета, особенно учета затрат. Традиционная модель учета, при которой сбор, обработка и обобщение данных о затратах производится дискретно – по окончании отчетного периода (месяца, квартала), – постепенно уступает место модели учета в режиме реального времени (on-line costing). Здесь данные о потреблении ресурсов (отпуске материалов, отработанном времени, начисленной амортизации, потребленной электроэнергии и т.д.) фиксируются в информационной системе в момент совершения хозяйственной операции (или непосредственно после него) с использованием средств автоматической идентификации – штрихкодирования, RFID-меток, интеграции с производственным оборудованием (промышленный интернет вещей, IIoT). Это позволяет:

– повысить оперативность управления затратами – информация о перерасходе или экономии поступает не через месяц, а в режиме, близком к реальному времени, что дает возможность немедленного реагирования;

– устранить временные лаги между возникновением затрат и их отражением в учете, что особенно важно для предприятий с непрерывным производственным циклом (металлургия, химическая промышленность, электроэнергетика);

– повысить точность калькулирования за счет минимизации ошибок, связанных с ручным вводом данных, запаздыванием первичных документов, субъективным распределением косвенных расходов;

– сократить трудоемкость учетных работ в части сбора, группировки и разноски данных по счетам бухгалтерского учета.

Реализация такого подхода требует внедрения современных ERP-систем (1С:ERP, SAP S/4HANA, Oracle E-Business Suite и др.), интеграции учетной системы с производственными модулями (MES – Manufacturing Execution Systems) и системами управления складом (WMS).

Для белорусских промышленных предприятий переход к онлайн-учету сопряжен со значительными первоначальными инвестициями в программное обеспечение и обучение персонала, однако в долгосрочной перспективе такие инвестиции окупаются за счет повышения эффективности управления и снижения потерь.

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АНАЛИЗ РЕЗУЛЬТАТОВ МОНИТОРИНГА И ГЕОБОТАНИЧЕСКИХ ИССЛЕДОВАНИЙ, ПРОВЕДЁННЫХ НА ПАСТБИЩНЫХ ЗЕМЛЯХ МИРИШКОРСКОГО РАЙОНА

Аннотация. *В статье представлены результаты мониторинговых и геоботанических исследований, проведённых с целью оценки современного состояния, продуктивности, растительного покрова и процессов деградации пастбищных земель Миришкорского района Кашкадарьинской области Республики Узбекистан. Исследования охватили 208 000 га пастбищных угодий, включая 30 мониторинговых площадок общей площадью 12 000 га. Результаты показали, что средняя продуктивность пастбищ по сухой массе в 2025 году составила 1,80 ц/га по сравнению с 1,98 ц/га в 2024 году. Средняя степень покрытия территории растительностью в 2025 году составила 48%. Сравнительный анализ за 2022–2025 годы выявил изменения продуктивности пастбищ и растительного покрова, связанные с колебаниями количества атмосферных осадков, температурного режима, пастбищной нагрузки и антропогенного воздействия.*

Ключевые слова: *деградация пастбищ, геоботанический мониторинг, продуктивность пастбищ, растительный покров, биомасса, кормовые растения, выпас скота, пастбищеоборот, восстановление пастбищ.*

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ANALYSIS OF MONITORING AND GEOBOTANICAL RESEARCH ON THE PASTURE LANDS OF MIRISHKOR DISTRICT

Abstract. *This article presents the results of monitoring and geobotanical studies conducted to assess the current condition, productivity, vegetation cover, and degradation processes of pasture lands in Mirishkor District, Kashkadarya Region, Uzbekistan. The study covered 208,000 hectares of pasture lands, including 30 monitoring sites with a total area of 12,000 hectares. The results showed that the average dry biomass productivity of the district's pastures in 2025 was 1.80 centners per hectare, compared with 1.98 centners per hectare in 2024. The vegetation cover averaged 48% in 2025. Comparative analysis for 2022–2025 revealed fluctuations in pasture productivity and vegetation cover, which were associated with variations in precipitation, temperature conditions, grazing pressure, and anthropogenic impacts.*

Keywords: *pasture degradation, geobotanical monitoring, pasture productivity, vegetation cover, biomass, forage plants, livestock grazing, rotational grazing and pasture restoration.*

Введение. Пастбищные земли являются важнейшим природным ресурсом для развития животноводства, обеспечения кормовой базы и сохранения устойчивости природных экосистем. Рациональное использование пастбищ, поддержание их продуктивности и предотвращение деградационных процессов имеют особое значение для засушливых и пустынных территорий Узбекистана.

Деградация земель представляет собой форму ухудшения природного потенциала земельных ресурсов, сопровождающуюся снижением долгосрочной экологической продуктивности, сокращением естественного биологического разнообразия и уменьшением устойчивости экосистем к внешним воздействиям. В более общем понимании деградация земель выражается в снижении их первоначальной продуктивности.

Одним из наиболее важных индикаторов состояния пастбищ является растительный покров. Использование агрометеорологических данных, результатов аэрофотометрических обследований и материалов дистанционного зондирования Земли позволяет осуществлять многолетний мониторинг продуктивности пастбищ, выявлять пространственно-временные изменения растительного покрова и определять территории, подверженные деградационным процессам.

В связи с этим проведение комплексного мониторинга и геоботанических исследований пастбищных земель Миришкорского района Кашкадарьинской области имеет важное научное и практическое значение. Полученные результаты могут быть использованы для совершенствования системы рационального использования пастбищ, восстановления деградированных территорий и повышения кормовой продуктивности пастбищных угодий.

Материалы и методы. Общая площадь пастбищных земель Миришкорского района составляет 208 000 га. В рамках проведённых исследований были установлены 30 мониторинговых пунктов, каждый

площадью 400 га. Таким образом, исследованиями было охвачено 12 000 га пастбищных земель. По результатам мониторинга установлено, что средняя урожайность пастбищ в пересчёте на сухую массу (биомассу) в 2025 году составила 1,80 ц/га, тогда как в 2024 году данный показатель составлял 1,98 ц/га. Таким образом, по сравнению с 2024 годом среднегодовая урожайность снизилась на 0,18 ц/га. Основными причинами снижения урожайности стали неблагоприятные погодные условия зимнего периода 2025 года для кустарников и полукустарников, а также относительно среднее количество естественных осадков в весенний период.

Согласно данным Управления статистики Кашкадарьинской области, поголовье крупного рогатого скота в 2024 году составляло 98 880 голов, а в 2025 году - 101 241 голову. Таким образом, по сравнению с 2024 годом поголовье увеличилось до 102,3 %. В том числе в фермерских хозяйствах поголовье увеличилось с 10 350 до 11 113 голов, что составляет 106,9 % от уровня 2024 года; в дехканских хозяйствах - с 86 620 до 87 928 голов (101,2 %); в других сельскохозяйственных предприятиях - с 1 627 до 2 200 голов (135,5 %).

Поголовье овец и коз в 2024 году составляло 457 250 голов, а в 2025 году - 457 990 голов, что соответствует 101,6 % от уровня 2024 года. В фермерских хозяйствах их численность увеличилась с 31 575 до 32 993 голов (104,3 %), в дехканских хозяйствах - с 379 792 до 384 017 голов (101,1 %), в других сельскохозяйственных предприятиях - с 39 094 до 40 980 голов (104,6 %).

По результатам исследований пастбища района были классифицированы по отдельным массивам.

1. Узбекский массив

Площадь пастбищ Узбекского массива составляет 117 946 га. На территории массива были установлены 16 мониторинговых пунктов площадью по 400 га, в результате чего исследованиями охвачено 6 400 га пастбищ.

По характеру распространения растительности выявлено 4 группы пастбищ: кустарниковые пастбища на песках; тугайные пастбища на луговых почвах в руслах рек; солянковые пастбища на такырных и солончаковых почвах; эфемероидные пастбища на светлых серозёмных почвах.

В пределах территории выделены различные типы пастбищ, в том числе эфемерно-гармальные, янтачно-эфемерные, каврак-эфемерно-полынные и эфемерно-донашуровые, эфемерно-разнотравно-джузгуновые, эфемерно-типчаково-осоковые, эфемерно-джузгуново-янтачно-эфемерные и саксаулово-кара-саксауловые пастбища.

Средняя степень покрытия территории растительностью составила 47,37 %. Урожайность пастбищ в пересчёте на сухую массу составила 1,79 ц/га, тогда как в 2024 году данный показатель составлял 2,02 ц/га. Таким образом, по сравнению с предыдущим годом среднегодовая урожайность снизилась на 0,23 ц/га.

2. Массив Авазчул

Площадь пастбищ массива Авазчул составляет 90 054 га. Здесь функционируют 14 мониторинговых пунктов площадью по 400 га, исследованиями охвачено 5 600 га пастбищных угодий.

По распространению растительности выделены 3 основные группы пастбищ: кустарниковые пастбища на песках; эфемероидные пастбища на светлых серозёмных почвах; тугайные пастбища на луговых почвах в руслах рек.

На территории также выявлены эфемерно-типчаково-осоковые, янтачно-эфемерные, эфемерно-гармальные и эфемерно-джузгуново-янтачно-эфемерные типы пастбищ.

Средняя степень покрытия растительностью составила 47,91 %. Урожайность пастбищ в пересчёте на сухую массу составила 1,81 ц/га, тогда как в 2024 году она составляла 1,92 ц/га. Следовательно, по сравнению с 2024 годом среднегодовая урожайность снизилась на 0,11 ц/га.

В результате антропогенного воздействия, в частности вырубки древесно-кустарниковой растительности населением для использования в качестве топлива, а также её заготовки для других целей, возникает угроза сокращения и исчезновения отдельных видов кустарниковой растительности.

В процессе мониторинговых исследований на отдельных пунктах отмечалось небольшое количество сорных растений, однако встречались вредные и ядовитые виды. В целом с учётом существующих пастбищ и растительного покрова их состояние можно оценить как удовлетворительное для выпаса сельскохозяйственных животных.

По результатам наблюдений установлено, что на территории 208 000 га пастбищ Миришкорского района преимущественно выпасаются овцы, козы, верблюды, крупный рогатый скот и лошади. В растительном покрове преобладают пастбища, пригодные для выпаса мелкого и крупного рогатого скота в течение трёх сезонов года. Однако в связи с климатическими условиями значительная часть пастбищ используется преимущественно в тёплый период года.

Основная часть территории представлена пустынными пастбищами, которые при соблюдении установленных норм выпаса могут использоваться в течение двух-трёх сезонов либо круглогодично.

Пастбища являются основным источником кормов и важнейшим средством обеспечения содержания и воспроизводства сельскохозяйственных животных. Поэтому необходимо обеспечить охрану существующих пастбищ, предотвращать процессы деградации, повышать продуктивность пастбищной растительности и внедрять рациональное и эффективное использование пастбищных ресурсов.

Согласно метеорологическим данным, зарегистрированным на Мубарекской метеорологической станции Центра гидрометеорологии Кашкадарьинской области, максимальная температура воздуха в 2025 году до октября достигала +48 °C, тогда как в 2024 году максимальная температура

составляла +42 °C. Таким образом, максимальная температура увеличилась на 6 °C.

Минимальная температура воздуха в 2025 году составила −5,4 °C, в то время как в 2024 году она достигала −4,1 °C. В зимний период наблюдались неустойчивые погодные условия, значительная облачность, небольшое количество осадков и быстрые изменения температуры и влажности воздуха.

Среднее количество осадков в 2025 году составило 48 мм, тогда как в 2024 году - 59,6 мм. Таким образом, по сравнению с 2024 годом количество осадков уменьшилось на 11,6 мм.

Результаты многолетнего мониторинга пастбищной растительности Миришкорского района характеризуются следующими показателями. В 2022 году урожайность составила 2,50 ц/га, кормовая единица - 0,72 ц/га, степень покрытия растительностью - 58 %.

В 2023 году урожайность снизилась до 1,84 ц/га, то есть по сравнению с 2022 годом уменьшилась на 0,66 ц/га. Кормовая единица составила 1,20 ц/га, увеличившись на 0,48 ц/га. Степень покрытия растительностью снизилась с 58 до 45 %, то есть на 13 процентных пунктов.

В 2024 году урожайность составила 1,98 ц/га, что на 0,14 ц/га больше показателя 2023 года. Кормовая единица сохранилась на уровне 1,20 ц/га. Степень покрытия растительностью увеличилась с 45 до 49 %, то есть на 4 процентных пункта.

В 2025 году урожайность составила 1,80 ц/га, что на 0,18 ц/га меньше показателя 2024 года. Кормовая единица составила 0,99 ц/га, что на 0,21 ц/га меньше предыдущего года. Степень покрытия растительностью составила 48 %, снизившись по сравнению с 2024 годом на 1 процентный пункт.

Снижение численности растений, степени покрытия и урожайности на территории Узбекского и Авазчульского массивов по сравнению с 2024 годом связано, прежде всего, с относительно неблагоприятными погодными условиями.

На мониторинговом пункте №039 площадью 400 га были выявлены следующие многолетние виды растений: Carex pachystylis J. Gay, Strigosella grandiflora Bunge Botsch., Cousinia resinosa Juz., Alhagi canescens Regel Schap., Ferula foetida Bunge Regel, Taeniatherum crinitum Schreb. Nevski, Roemeria refracta Stev. DC., Peganum harmala L., Eremopyrum bonaepartis Spreng. Nevski, Artemisia diffusa Krasch. ex Poljakov, Capparis spinosa L..

На данном мониторинговом пункте в 2025 году урожайность составила 1,98 ц/га, а степень покрытия растительностью - 48 %. В частности, численность Artemisia diffusa в 2025 году составила около 120 000 экземпляров.

Снижение количества осадков на 11,6 мм по сравнению с 2024 годом, позднее начало и раннее завершение вегетационного периода, выпас скота до периода созревания семян, а также наличие 12 кошар в радиусе около 3 км от мониторингового пункта создают дополнительную антропогенную нагрузку. Длительный выпас животных на одном участке и их регулярное перемещение

по одним и тем же маршрутам способствуют снижению продуктивности растительного покрова и расширению площадей, подверженных деградации.

В пределах мониторингового пункта в 2025 году было выявлено 11 видов естественной растительности. В радиусе 1,5–2 км от пункта имеется одна кошара для содержания овец и коз. На расстоянии около 3,5 км расположен населённый пункт, состоящий из 30 домохозяйств.

Для повышения кормовой ценности и видового разнообразия пастбищ рекомендуется расширять распространение ценных кормовых растений, пригодных для использования в различные сезоны года. К таким растениям относятся Carex pachystylis, Cousinia resinosa и Strigosella grandiflora. Согласно методическим рекомендациям по проведению геоботанических исследований естественных пастбищ и сенокосов Узбекистана (2-е переработанное издание, Ташкент, 2022), их кормовая ценность характеризуется сезонной изменчивостью.

Для повышения продуктивности пастбищ рекомендуется создавать вокруг мониторинговых пунктов семенные участки площадью 2–3 га, ограждённые сетчатым или проволочным ограждением высотой 1,5–2 м. Полученные семена могут использоваться для восстановления деградированных участков, а остаточная растительная масса после сбора семян - как запас сена на зимний период.

На малопродуктивных мониторинговых участках целесообразно создавать первичные семеноводческие участки размером 6 × 6 м и плантации площадью около 2 га. Для восстановления пастбищ рекомендуется использовать ценные кормовые растения, в частности сорт «Тўлқин» вида Convolvulus pseudocantabrica Schrenk и Artemisia terrae-albae H. Krasch.

На деградированных территориях Узбекского массива необходимо уделять особое внимание обработке почвы, размещению растений, оптимальным срокам посева, нормам высева семян, способам и технике посева, оптимальной глубине заделки семян и последующему уходу за посевами.

Среди агротехнических мероприятий важное значение имеют своевременная и качественная обработка почвы, а также минимальная предпосевная обработка. При бороновании необходимо обеспечить заделку семян на глубину 0,5–2 см, что способствует повышению приживаемости и жизнеспособности всходов.

Полосы рекомендуется размещать перпендикулярно направлению преобладающих ветров. Согласно рекомендациям специалистов, оптимальными сроками посева пустынных кормовых растений являются зимние месяцы - с начала декабря до конца января.

Для повышения продуктивности пастбищ рекомендуется высевать 15–20 кг семян на 1 га. При использовании смесей семян различных жизненных форм растений рекомендуется следующая структура: кустарники - 20 %, полукустарники - 65 %, травянистые виды - 15 %. Норма высева составляет 15–20 кг/га.

Посевные работы на территории специализированных животноводческих фермерских хозяйств могут осуществляться с соблюдением требований техники безопасности. Для повышения производительности работ семенные смеси могут загружаться в тележку, а 2–3 работника, находясь на тележке, равномерно распределяют семена по поверхности участка.

Заделка семян пустынных кормовых растений на глубину 0,5–2,0 см способствует повышению их полевой всхожести. Поэтому после посева рекомендуется проводить боронование. Для одновременного выполнения посева и заделки семян возможно использование бороны, закреплённой за тележкой. В случае проведения посева по заснеженной поверхности необходимость в бороновании может отсутствовать.

Для предотвращения чрезмерного увеличения поголовья скота и обеспечения равномерного распределения нагрузки на пастбища необходимо проводить разъяснительную работу и организовывать практические тренинги для фермерских хозяйств, пользователей пастбищ и местного населения с привлечением соответствующих специалистов.

В современных условиях для обеспечения водой отдалённых пастбищ целесообразно рассмотреть возможность установки солнечных панелей и, по согласованию с соответствующими организациями Министерства водного хозяйства, строительства дополнительных водопойных колодцев или скважин. Вокруг водоисточников возможно внедрение систем капельного орошения и выращивание ценных кормовых растений, в частности Convolvulus pseudocantabrica Schrenk и Artemisia terrae-albae H. Krasch.

Основными факторами возникновения деградированных участков пастбищ являются длительный и непрерывный выпас скота на одном участке, увеличение численности отдельных вредителей, в частности саранчи, поедание ими пастбищной растительности, а также весенние паводки и подтопление территорий вследствие подъёма воды в реках и временных водотоках.

В связи с этим необходимо предотвращать нерациональное и неэффективное использование пастбищ, а также принимать меры по недопущению искусственного расширения деградированных площадей.

Для восстановления деградированных пастбищ необходимо создавать первичные семеноводческие участки кормовых растений. Семена следует собирать в период их полного созревания и хранить в специально оборудованных помещениях до наступления оптимального срока посева. Это позволит увеличить численность ценных кормовых растений и снизить риск дальнейшей деградации пастбищных земель.

На пастбищах целесообразно внедрять систему регулируемого и ротационного выпаса. В целях организации сезонного выпаса необходимо проводить разъяснительную работу среди местного населения и животноводов, использующих пастбищные территории.

Для обеспечения естественного возобновления растительности рекомендуется создавать на каждом гектаре пастбищ небольшие ограждённые участки размером 4 × 4 м, предназначенные для полного созревания и естественного осыпания семян растений.

Необходимо организовать сезонное использование пастбищ с учётом биологических особенностей растительности и состояния кормовой базы. На малопродуктивных участках рекомендуется создавать первичные семеноводческие участки высокоурожайных кормовых растений. Для предотвращения деградации отдельные участки пастбищ следует периодически полностью или частично выводить из эксплуатации, обеспечивая их восстановление.

Для повышения эффективности использования пастбищ рекомендуется:

внедрить систему ротационного выпаса и установить постоянный контроль за соблюдением норм нагрузки на пастбища;

не допускать необоснованного увеличения поголовья сельскохозяйственных животных;

улучшить полевые дороги, ведущие к удалённым и малоиспользуемым пастбищам;

создавать специальные места для содержания животных и проживания пастухов на удалённых от населённых пунктов территориях;

организовывать семеноводство кормовых растений и сенокосные участки на территориях, ограждённых фермерскими хозяйствами и кооперативами пользователей пастбищ;

проводить широкую разъяснительную работу среди населения с целью предотвращения вырубки деревьев, кустарников и полукустарников для использования в качестве топлива;

организовать рациональное использование пастбищ с привлечением специалистов по животноводству, опытных работников фермерских хозяйств и с учётом агротехнических рекомендаций Института каракулеводства и экологии пустынь Узбекистана.

Поскольку другие массивы, расположенные на территории района, имеют сходные географические условия, видовой состав растительности и другие природные характеристики, разработанные для Узбекского массива рекомендации по предотвращению негативных процессов и повышению продуктивности пастбищ могут быть применены также на территории массива Авазчул.

Заключение. Проведённые мониторинговые и геоботанические исследования показали, что пастбищные земли Миришкорского района характеризуются значительной пространственной и временной изменчивостью растительного покрова и кормовой продуктивности. В 2025 году средняя урожайность пастбищ района составила 1,80 ц/га, что на 0,18 ц/га ниже показателя 2024 года. Степень покрытия растительностью составила около 48 %.

Результаты исследований на мониторинговых пунктах свидетельствуют о необходимости перехода к регулируемому использованию пастбищ с учётом сезонной динамики растительного покрова и кормовой продуктивности. Особое значение имеют внедрение ротационного выпаса, нормирование поголовья скота, организация участков временного исключения из выпаса, создание семеноводческих участков и восстановление деградированных территорий ценными кормовыми растениями. Таким образом, сохранение и восстановление пастбищных ресурсов Миришкорского района должно осуществляться на основе научно обоснованного нормирования пастбищной нагрузки, сезонного и ротационного использования угодий, сохранения естественного растительного покрова, развития семеноводства кормовых растений и постоянного геоботанического мониторинга.

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НАИМЕНОВАНИЕ ПРОДУКТОВОЙ ЛИНЕЙКИ КАК РЕЗУЛЬТАТ МАРКЕТИНГОВОГО ПОДХОДА

***Аннотация**: В статье рассматриваются вопросы, связанные с рэбрендингом традиционной продуктовой линейки. Обосновано новое название на основе проведенного опроса потребителей с учетом семантики, фонетики, психолинвистики.*

***Ключевые слова**: продуктовая линейка, ребрендинг, белорусская хозяйка*

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THE NAME OF A PRODUCT LINE AS A RESULT OF A MARKETING APPROACH

***Abstract:** The article examines issues related to the rebranding of a traditional product line. The new name is justified based on a consumer survey, taking into account semantics, phonetics, and psycholinguistics.*

***Keywords**: product line, rebranding, Belarusian hostess*

Маркетинговая деятельность ОАО «Ляховичский консервный завод» строится на принципах обеспечения натуральности и качества продукции, активного обновления ассортимента и поэтапной модернизации производства. Основным отличием продукции, является «стопроцентная натуральность и качество, которое постоянно контролируется собственной аккредитованной лабораторией» [1]. В рамках товарной политики завод делает ставку на расширение ассортимента и внедрение инновационных продуктов. Перспективными направлениями являются: выпуск соков прямого отжима (морковного, тыквенного, кабачкового), производство супов-пюре и

супа харчо в удобной упаковке, а также освоение новых культур, таких как базилик и спаржа.

Ассортимент представлен следующими основными группами:

— соки, нектары и повидло (в том числе под новой торговой маркой «Птичка-Ляховичка», отмеченной знаком «Беларуская марка — 2024») Проведенный анализ выявил ключевую проблему, которая заключается в том, что основная масса традиционной продукции (обеденной и закусочной группы — щи, борщи, солянки, овощные рагу и др.) выпускается в стеклянной таре с устаревшим дизайном, уступающим современным конкурентам. Для решения этой проблемы предлагается комплекс мероприятий по ребрендингу данной продуктовой линейки.

Исходим из того, что 2026 год объявлен в Республике Беларусь «Годом белорусской женщины» [2]. Это событие создало уникальную возможность для запуска ребрендинга традиционной продукции под названием, которое будет созвучно данной теме и вызовет эмоциональный отклик у потребителей. Предлагается объединить обеденную и закусочную группу в 0,5-литровых стеклянных банках в единую линейку под названием «Белорусская Хозяйка».

Название «Белорусская Хозяйка» выбрано не случайно. Оно несет в себе следующий смысловой посыл:

— связь с «Годом белорусской женщины» (2026), что обеспечит дополнительный интерес и поддержку;

— ассоциация с домашним уютом, заботой, традиционными семейными рецептами;

— узнаваемость для белорусского и российского потребителя и возможность трансляции национальных традиций;

— позиционирование продукции как «домашней», приготовленной с душой и качественно как для белорусских, так и для российских потребителей.

В рамках ребрендинга предлагается полностью обновить визуальный образ продукции.

Для проверки гипотезы о потребительском восприятии названия «Белорусская Хозяйка» был проведён опрос целевой аудитории (n=170). Результаты подтвердили высокий эмоциональный и коммерческий потенциал выбранного бренда.

На вопрос «Если вы увидите на полках магазина банку с соленьями под названием «Белорусская Хозяйка» — вы скорее доверитесь такому бренду или он вам ни о чем не говорит?» 95,9% респондентов ответили — «скорее доверюсь». Лишь 4,1% указали, что в названии «ничего особенного».

Конкурентная позиция на полке. При выборе между «Белорусской Хозяйкой» и привычными марками консервации 82,9% опрошенных выбрали бы новый бренд из интереса, а 15,9% заявили, что будут сравнивать состав и цену, остальные 1,2% — останутся при своей марке.

Это свидетельствует о высокой готовности к переключению с традиционных марок при условии привлекательного названия.

Эмоциональные ассоциации. Название «Белорусская Хозяйка» вызвало у респондентов следующие образы:

— «свое, родное, как у мамы» — 90,6%;

— «уютно, но не бросается в глаза» — 7,1%;

— «немного старомодно» — 2,3%.

Ценовая премия. На вопрос «Если продукт под названием «Белорусская Хозяйка» будет стоить на 15–20% дороже, чем другая аналогичная консервации, вы купить наш продукт?» — 57,4% респондентов ответили «куплю, если буду знать, что вкуснее », 42% ответили «куплю ради интереса».

Это подтверждает экономическую обоснованность закладываемой в бизнес-модель ценовой надбавки (до 20%).

Оценка названия по шкале. Средняя оценка названия «Белорусская Хозяйка» для линии овощной консервации по 5-балльной шкале составила 4,2 балла. Оценки 4 и 5 поставили 94,1% респондентов.

Параллельно предлагается внедрения слогана: ««Натурально, вкусно, впрок — с Белорусской Хозяйкой».

Был проведен анализ названия линейки и слогана. Предложенная связка представляет собой «этно-бытовой бренд с функциональным обещанием» и базируется на следующих когнитивных эффектах:

— тип нейминга: «Белорусская Хозяйка» — ассоциативно-ролевой (персонажный бренд). Слоган — атрибутивный + ценностный.

— восприятие слогана:

— «натурально» (эвристика естественности) — снижает страх перед «химией» в консервах, актуальный для 31,2% респондентов, выбирающих по составу;

— «вкусно» (густативная семантика) — вызывает бессознательное слюноотделение и прайминг вкуса;

— «впрок» (эффект долгосрочного запаса) — успокаивает архаичный страх голода, переводя консервацию из разряда «второсортной еды» в разряд «разумного решения».

— сильные стороны связки: логотип и слоган рифмуются по смыслу («Хозяйка» делает «натурально, вкусно и впрок»), создавая полную согласованность. Фраза «с Белорусской Хозяйкой» превращает абстрактный логотип в личную рекомендацию доверенного персонажа, что особенно ценно для целевой аудитории 30+ (доминирует в опросе).

Таким образом проведенный анализ нового названия и слогана дал положительный результат системной проверки эффективности внедрения нового наименования традиционной продуктовой линейки, естественно с учетом обновленного дизайна упаковки товара.

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ВНЕДРЕНИЕ ИННОВАЦИОННЫХ ТЕХНОЛОГИЙ В ОБРАЗОВАТЕЛЬНЫЙ ПРОЦЕСС СРЕДНЕГО ПРОФЕССИОНАЛЬНОГО ОБРАЗОВАНИЯ: ВЫЗОВЫ И РЕШЕНИЯ

Аннотация: *В статье исследуются фундаментальные изменения в системе педагогического процесса, вызванные цифровой трансформацией и внедрением инновационных технологий. На основе анализа официальной статистики, нормативных документов и обобщения современной педагогической практики выявлены значительные диспропорции в уровне использования цифровых инструментов: если интерактивные формы подачи материала применяют более 80% преподавателей, то инструменты на базе искусственного интеллекта и адаптивные обучающие системы использует лишь каждый пятый. Одновременно фиксируется острая нехватка цифровых компетенций среди педагогических работников – лишь 30% прошли профильную переподготовку за последние два года. Предлагается комплексный подход, объединяющий внедрение облачных образовательных платформ, элементов геймификации и кардинальную перестройку системы повышения квалификации с обязательным учётом предметной специфики. Результаты работы могут служить основой для разработки стратегий цифровизации образовательных учреждений и программ развития педагогического мастерства.*

Ключевые слова: *педагогический процесс, инновационные технологии, цифровизация образования, среднее профессиональное образование, цифровые компетенции, искусственный интеллект, человеческий капитал.*

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IMPLEMENTATION OF INNOVATIVE TECHNOLOGIES IN THE EDUCATIONAL PROCESS OF VOCATIONAL EDUCATION: CHALLENGES AND SOLUTIONS

Annotation: *The article examines fundamental changes in the pedagogical process driven by digital transformation and the integration of innovative technologies. Based on the analysis of official statistics, regulatory documents, and the generalization of modern pedagogical practice, significant disparities in the utilization of digital tools have been identified: while over 80% of teaching staff employ interactive presentation methods, only one in five utilizes artificial intelligence tools and adaptive learning systems. Concurrently, an acute shortage of digital competencies among educators is observed, with merely 30% having undergone specialized retraining in the past two years. The authors propose an integrated approach that* [31]*combines the deployment of cloud-based educational platforms, gamification elements, and a fundamental restructuring of the professional development system, with mandatory consideration of subject-specific requirements. The findings of this study can serve as a foundation for developing digitalization strategies for educational institutions and programs aimed at enhancing pedagogical excellence.*

Keywords: *pedagogical process, innovative technologies, digitalization of education, vocational education, digital competencies, artificial intelligence, human capital.*

Переход к цифровой экономике, пронизывающий все сферы жизнедеятельности общества, предъявляет принципиально новые требования к системе образования. Традиционно выполнявший функцию трансляции готовых знаний, педагогический процесс сегодня трансформируется в среду для формирования компетенций, критического мышления и навыков непрерывного обучения. Эта трансформация обусловлена не только необходимостью повышения мотивации обучающихся, но и расширением аналитических функций обучения, его активным участием в персонализации образовательных траекторий. Однако на пути внедрения инноваций возникают серьёзные препятствия как технологического, так и кадрового характера. Особую сложность представляет предметная дифференциация: методы преподавания, структура учебных дисциплин и требования к практическим навыкам существенно различаются между гуманитарными, техническими и естественно-научными циклами, что требует не просто адаптации готовых цифровых платформ, а выработки специфических педагогических методик для каждой дисциплины. Цель настоящей работы – выявить ключевые проблемы и обосновать пути совершенствования

[31] Роберт И. В. Цифровая трансформация образования: методологические основы и педагогические условия // Педагогика. – 2023. – № 4. – С. 12–24.

педагогического процесса в условиях цифровизации с учётом как мировых трендов, так и российской реальности.

Теоретический фундамент исследования опирается на концепции информационной экономики, теорию деятельностного подхода и институциональный подход, позволяющие рассматривать образование как сложную социально-техническую систему, эволюционирующую под влиянием технологических изменений и запросов внешней среды[1]. В российской науке значительный вклад в разработку проблем цифровизации образования внесли И.В. Роберт, Е.С. Полат, Л.Л. Босова, а среди зарубежных учёных следует отметить Дж. Сименса, Дж. Хэтти и Р. Вайсберга. Исследования последних лет акцентируют необходимость перехода от реактивного обучения к проактивному, основанному на анализе больших массивов данных в реальном времени с использованием инструментов адаптивного обучения и геймификации. Вместе с тем, как справедливо отмечают О.П. Осипова и О.А. Шклярова, реализация этих возможностей тормозится недостаточной цифровой грамотностью специалистов и инерционностью традиционных подходов к обучению[2]. Исследования Д.С. Константиновой и М.М. Кудаевой показывают, что цифровые компетенции преподавателей становятся критическим фактором конкурентоспособности выпускников на рынке труда[3]. Тем не менее системный анализ предметных аспектов внедрения инноваций в масштабах системы СПО остаётся недостаточно проработанным, что и определяет научную новизну данной статьи.

В работе использованы методы системного и сравнительного анализа, статистической обработки данных и обобщения педагогического опыта. Эмпирическую базу составили данные мониторингов Министерства просвещения РФ, аналитические обзоры, а также обобщенные результаты анкетирования педагогических работников системы среднего профессионального образования, что позволило выявить устойчивые тенденции и репрезентативные проблемы отрасли.

Анализ статистических данных показывает, что в целом по системе СПО доля преподавателей, применяющих специализированное программное обеспечение[4] для проведения занятий, достигла 82% в 2025 году. [32]

Однако этот показатель существенно варьируется по предметным циклам: в дисциплинах информационного профиля он составляет 91%, в гуманитарных – 76%, в естественно-научных – 88%, а при преподавании специальных профессиональных дисциплин – лишь 54%. При этом интеграция учебных модулей с системами виртуальной и дополненной реальности (VR/AR) реализована только в 32% случаев на технических дисциплинах. Такая фрагментарность приводит к снижению наглядности и росту когнитивной нагрузки на студентов. Одной из главных проблем

[32] Осипова О. П., Шклярова О. А. Ресурс самоменеджмента в повышении профессиональной жизнеспособности и развитии управленческой культуры педагогических работников // Проблемы современного образования. – 2020. – № 5. – С. 202–213.

остаётся низкое использование облачных образовательных сервисов и инструментов искусственного интеллекта: только 28% преподавателей применяют их для автоматизации проверки заданий и генерации контента, что сдерживает возможности персонализации обучения. В гуманитарных дисциплинах ситуация усугубляется необходимостью глубокой смысловой работы с текстами, требующей специализированных решений, которые часто отсутствуют в типовых конфигурациях LMS.

Кадровый аспект исследован более детально. Обобщение данных педагогической практики показало, что 65% преподавателей имеют стаж работы более 10 лет, при этом лишь 30% прошли переподготовку по современным педагогическим технологиям в течение последних двух лет. Более половины опрошенных испытывают трудности при работе с аналитическими модулями систем управления обучением, а 43% не умеют пользоваться инструментами визуализации данных и нейросетями. Вместе с тем 85% респондентов осознают необходимость цифрового переобучения, но основными препятствиями называют нехватку времени и отсутствие организованных, предметно-ориентированных программ обучения. Примечательно, что молодые специалисты в возрасте до 30 лет демонстрируют более высокий уровень владения цифровыми инструментами, однако часто не имеют глубокого понимания классической педагогической методологии, что создаёт двойной разрыв между поколениями.

Полученные результаты позволяют заключить, что успешная цифровая трансформация педагогического процесса требует не просто внедрения нового программного обеспечения, а системной перестройки методологии преподавания, организационной структуры и профессиональных компетенций. Предлагаемый комплекс мер охватывает три взаимосвязанных направления.

Во-первых, технологическое направление предполагает переход к интегрированным облачным образовательным платформам, которые обеспечивают единое информационное пространство для всех участников процесса. Особое внимание следует уделить внедрению инструментов искусственного интеллекта, позволяющих автоматизировать рутинные операции и обеспечить адаптивность обучения. Перспективным направлением является использование VR/AR для формирования практических умений в безопасной среде, что, по оценкам экспертов, может повысить качество усвоения материала на 35–40%[5].

Во-вторых, организационно-методическое направление связано с разработкой предметных стандартов и рекомендаций по цифровизации обучения. Необходимо создать методики оценки эффективности внедрения инноваций, учитывающие специфику дисциплины, и типовые модели интеграции цифровых инструментов с традиционными формами занятий. Также требуется гармонизация федеральных государственных образовательных стандартов с требованиями цифровой экономики в части формирования цифровых компетенций выпускников[6].

В-третьих, кадровое направление является ключевым, поскольку именно человеческий фактор часто определяет успех или провал цифровой трансформации. [33]

Необходимо создание системы непрерывного профессионального образования, включающей как краткосрочные курсы повышения квалификации, так и долгосрочные программы переподготовки с использованием гибридных форматов обучения. Важно интегрировать цифровые компетенции в систему аттестации преподавателей, усиливая практическую составляющую. Активное внедрение менторства, то есть привлечение опытных методистов для передачи знаний о цифровых инструментах молодым кадрам, позволит сократить разрыв между поколениями. Все предлагаемые меры должны учитывать предметную специфику: для технических дисциплин акцент следует сделать на VR-моделировании; для гуманитарных – на работе с большими текстовыми массивами и критическим анализом информации; для естественно-научных – на виртуальных лабораторных работах. Реализация этих мер, по нашим оценкам, может повысить производительность педагогического труда на 20–30% в течение трёх лет, а также повысить мотивацию студентов и доверие работодателей к качеству подготовки.

Цифровая трансформация педагогического процесса в образовательных учреждениях является объективным процессом, обусловленным технологическими сдвигами и изменением требований к подготовке специалистов. Проведённое исследование показало, что уровень внедрения инноваций сильно дифференцирован по предметным циклам, причём наиболее отстающими являются специальные профессиональные дисциплины и гуманитарный цикл. Выявлен также значительный дефицит цифровых компетенций среди педагогических работников, который требует незамедлительного восполнения. Предложенный комплексный подход, включающий технологические инновации, методическое обеспечение и кадровое развитие, позволяет наметить универсальные пути преодоления существующих барьеров в масштабах национальной системы СПО. Дальнейшие исследования должны быть направлены на разработку детализированных предметных моделей цифровой зрелости и оценку экономической эффективности внедрения искусственного интеллекта в образовательный процесс.

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ТЕОРЕТИЧЕСКИЕ ПОДХОДЫ К ОЦЕНКЕ КАЧЕСТВА ОБСЛУЖИВАНИЯ ПАССАЖИРОВ НА ТРАНСПОРТЕ

Аннотация: *в статье рассмотрены теоретические подходы к определению понятия «качество услуги» применительно к пассажирским перевозкам на транспорте. Проанализированы трактовки качества, представленные в международном стандарте ISO 9000, а также в работах зарубежных авуторов. Рассмотрены методы оценки качества транспортных услуг — SERVQUAL, «тайный покупатель» и метод Э. Кедотта и Н. Терджена. Предложено авторское определение понятия «качество услуги» применительно к сфере пассажирских перевозок.*

Ключевые слова: *качество услуги, пассажирские перевозки, транспортное обслуживание, методы оценки качества оказываемых услуг.*

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THEORETICAL APPROACHES TO ASSESSING THE QUALITY OF PASSENGER SERVICE IN TRANSPORT

Abstract: *The article examines theoretical approaches to defining the concept of "service quality" as applied to passenger transportation. The interpretations of quality presented in the international standard ISO 9000, as well as in the works of foreign authors, are analyzed. Methods for assessing the quality of transport services are considered — SERVQUAL, "mystery shopping," and the Cadotte and Turgeon method. The author's own definition of the concept of "service quality" as applied to the sphere of passenger transportation is proposed.*

Keywords: *service quality, passenger transportation, transport service, methods for assessing the quality of services rendered.*

Пассажирские перевозки являются социально значимым видом транспорта, обеспечивающим междугородние и международные связи населения и функционирование экономики страны и её регионов. Рост потребительских ожиданий обусловливает необходимость повышения качества услуг перевозочного процесса, а социальная значимость пассажирских перевозок предполагает регулирование их стоимости

государством. В этих условиях качество обслуживания становится ведущим фактором конкурентоспособности транспортных организаций, поскольку устойчивый спрос на их услуги обеспечивается соответствием предоставляемого сервиса установленным стандартам и ожиданиям потребителей.

Согласно международному стандарту ISO 9000, качество — это степень соответствия совокупности присущих характеристик объекта предъявляемым требованиям [1]. А.Ю. Курочкина, анализируя данное определение, отмечает, что качество представляет собой относительную категорию, зависящую от выполнения определённых требований; допускает выделение уровней (категорий) соответствия и ориентировано на выполнение объективных требований к объекту, а не индивидуальных ожиданий отдельных потребителей [2]. Вместе с тем большинство исследователей акцентируют внимание не на соответствии нормативам, а на способности услуги удовлетворять потребности потребителя (табл. 1).

Таблица 1. Подходы зарубежных авторов к определению понятия «качество услуги»

Автор	Акцент определения
Ф. Котлер	Совокупность характеристик услуги, способных удовлетворять потребности потребителей
В. Зейтамль, А. Парасураман, Л. Берри	Разница между ожиданиями потребителя и фактическим восприятием услуги
В.В. Окрепилов	Совокупность свойств услуги, обеспечивающих её способность удовлетворять потребности потребителей
Д.Е. Давыдянц	Возможность заложенных потребительских свойств удовлетворять потребности на уровне не ниже безопасного
ISO 9000	Степень, в которой совокупность характеристик объекта выполняет требования
Е.М. Белый	Совокупность характеристик, придающих услуге способность удовлетворить обусловленные или предполагаемые потребности
И.И. Мазур	Совокупность свойств услуги, обеспечивающих её способность удовлетворять потребности потребителей

Проведённый анализ показал, что определения качества услуги можно сгруппировать по нескольким подходам (табл. 2).

Таблица 2. Авторские подходы к определению понятия «качество услуг»

Подход	Сущность
1. Потребительский	Удовлетворение потребностей клиента
2. Сравнительный	Сравнение ожиданий и восприятия
3. Процессный	Качество процесса оказания услуги
4. Стандартизированный	Соответствие нормативам
5. Комплексный	Сочетание всех факторов

Качество услуги как экономическая категория представляет собой совокупность свойств услуги, определяющих её способность удовлетворять потребности потребителя. Оно зависит от действий всех субъектов, вовлечённых в процесс производства и предоставления услуги, и характеризуется полнотой удовлетворения потребностей, экономической и социальной эффективностью, комфортностью, надёжностью, индивидуальностью и безопасностью. Критериями качества обслуживания выступают доступность, коммуникабельность, компетентность персонала, вежливость, доверие и понимание потребностей клиента.

Л.Г. Протасова выделяет элементы качества услуг, значимые для пассажирских перевозок [3]: «материальное» качество (комфорт сидений, качество питания, состояние подвижного состава); «нематериальное» качество (точность графика движения, скорость оказания сервисных услуг); «психологическое» качество (вежливость и гостеприимство персонала).

Наиболее известным инструментом оценки качества услуг является пятиступенчатая модель В. Зейтамль, А. Парасурамана и Л. Берри, впервые опубликованная в 1985 году и получившая развитие в методике SERVQUAL [4; 5]. Методика выделяет пять критериев качества: надёжность (способность предоставить услугу точно в обещанном объёме и в срок), уверенность (компетентность и ответственность персонала), материальность (состояние оборудования и внешний вид персонала), сочувствие (вежливость, индивидуальный подход) и отзывчивость (быстрая обратная связь, готовность помочь клиенту). Суть метода — определение разрыва между фактическим восприятием и ожиданиями потребителей путём анкетирования по трём блокам («Ожидания», «Восприятие», «Важность») с использованием пятибалльной шкалы Лайкерта. Отрицательное значение итогового коэффициента, близкое к нулю, свидетельствует об удовлетворительном уровне сервиса, положительное — о превышении ожиданий («суперкачество»). Метод прост в применении и нагляден, однако подвержен субъективным ошибкам респондентов и не даёт стандартов качества по каждому критерию.

Ещё одним распространённым инструментом является метод «тайного покупателя» (Mystery Shopping), заключающийся в сборе фактических данных о качестве обслуживания подготовленными специалистами, выступающими в роли обычных клиентов. Результаты используются для

контроля соблюдения стандартов, выявления слабых мест в обслуживании и могут лечь в основу постоянно действующей системы мотивации персонала.

Качественный метод Э. Кедотта и Н. Терджена основан на делении элементов обслуживания на четыре группы по характеру восприятия потребителем [6]: критические элементы задают минимально необходимый уровень обслуживания; нейтральные элементы слабо влияют на удовлетворённость (например, цвет униформы персонала); элементы, приносящие удовлетворение, вызывают положительную реакцию лишь при превышении ожиданий; элементы, приносящие разочарование, обязательны к исполнению, а их невыполнение вызывает недовольство клиента, тогда как повышение их качества не увеличивает удовлетворённость. Оценка проводится по картам индивидуального восприятия с расчётом усреднённых и средневзвешенных показателей.

Рассмотренные методы позволяют выявлять слабые места системы управления качеством и разрабатывать рекомендации по её совершенствованию; выбор конкретного метода зависит от специфики деятельности организации. По нашему мнению, сервисное обслуживание в пассажирских перевозках следует рассматривать не как надстройку над основной услугой перевозки, а как комфортную систему обеспечения перевозочного процесса, повышающую конкурентоспособность транспорта.

Обобщённые нормы и принципы сервисного обслуживания пассажиров, обязательные для пассажирских компаний и сервис-центров, представлены в таблице 3.

Таблица 3. Нормы и принципы сервисного обслуживания пассажиров на транспорте

Норма	**Краткая характеристика**
Обязательность предложения услуг	Пассажиры информируются о комплексе услуг; принятые обязательства подлежат обязательному исполнению
Необязательность использования всех услуг	Персонал не должен навязывать клиенту дополнительные сервисные услуги
Эластичность сервиса	Набор услуг — от минимально необходимых до максимально целесообразных — определяет сам клиент
Удобство сервиса	Услуга предоставляется в месте, времени и форме, устраивающих пассажира
Техническая адекватность	Оснащение и подвижной состав должны соответствовать технологии сервиса

Норма	Краткая характеристика
Информационная отдача	Компания учитывает обратную связь от персонала и клиентов и реагирует на неё
Разумная ценовая политика	Сервис — инструмент укрепления доверия клиентов и партнёров, а не только источник прибыли
Соответствие производства сервису	Производственные мощности соизмеряются с возможностями сервиса; устанавливаются требования к контролю качества

Приведённые нормы характеризуют совокупность свойств и признаков транспортной услуги, определяющих её полезность и способность удовлетворять потребности пользователей в процессе перемещения. На основе проведённого анализа предлагается следующее авторское определение: качество услуги — это комплексная характеристика процесса и результата её оказания, отражающая степень соответствия свойств услуги ожиданиям потребителей, установленным стандартам и обеспечивающая удовлетворение потребностей клиентов. Применительно к транспорту сервис представляет собой высококачественное обслуживание пассажиров, грузоотправителей и грузополучателей, включающее обеспечение перевозок, предоставление комплексных услуг и выполнение дополнительных работ; в сервисном обслуживании может быть задействовано до 25% основного персонала, обеспечивающего перевозку пассажиров.

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ГАСТРОПАНКРЕАТОДУОДЕНАЛЬНАЯ РЕЗЕКЦИЯ ПРИ ВРАСТАНИИ РАКА ЖЕЛУДКА В ГОЛОВКУ ПОДЖЕЛУДОЧНОЙ ЖЕЛЕЗЫ

Аннотация: *Гастропанкреатодуоденальная резекция (ГПДР) — это мультивисцеральная операция, включающая удаление дистального отдела желудка, двенадцатиперстной кишки и головки поджелудочной железы. Необходимость выполнения данного вмешательства возникает при прорастании опухоли в головку поджелудочной железы или низком переходе её на двенадцатиперстную кишку. Несмотря на успехи лекарственного лечения, мультивисцеральные R0-резекции, включающие панкреатодуоденальную резекцию, являются единственной возможностью улучшить выживаемость таких больных.*

Ключевые *слова: рак желудка, местнораспространённый рак желудка, гастропанкреатодуоденальная резекция, комбинированные операции, хирургическое лечение, R0-резекция.*

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GASTROPANCREATODUODENECTOMY IN GASTRIC CANCER INVASION INTO THE HEAD OF THE PANCREAS

Abstract: *Gastropancreatoduodenectomy (GPDR) is a multivisceral surgery that involves removal of the distal stomach, duodenum, and head of the pancreas. The necessity for this intervention arises when the tumor invades the pancreatic head or extends low into the duodenum. Despite advances in systemic therapy, multivisceral R0 resections, including pancreatoduodenectomy, represent the only chance to improve overall survival in these patients.*

Keywords: *gastric cancer, locally advanced gastric cancer, gastropancreatoduodenectomy, combined operations, surgical treatment, R0 resection.*

Рак желудка остаётся одной из наиболее распространённых злокачественных опухолей органов пищеварения и занимает ведущее место среди причин смертности от онкологических заболеваний во многих странах мира. Несмотря на совершенствование методов диагностики и внедрение

современных схем комбинированного лечения, значительная часть пациентов обращается за медицинской помощью уже на стадии местнораспространённого опухолевого процесса.

Одной из особенностей местнораспространённого рака желудка является способность опухоли распространяться за пределы стенки органа с вовлечением соседних анатомических структур. Наиболее часто инвазия наблюдается в поперечную ободочную кишку, селезёнку, хвост или тело поджелудочной железы, печень и диафрагму. Значительно реже опухоль прорастает в головку поджелудочной железы и двенадцатиперстную кишку, что требует выполнения гастропанкреатодуоденальной резекции.

Местнораспространённый рак желудка с инвазией в соседние органы представляет одну из наиболее сложных проблем современной абдоминальной онкохирургии. Врастание опухоли в головку поджелудочной железы встречается редко, однако требует выполнения расширенных комбинированных вмешательств, позволяющих достичь радикального удаления опухоли. Несмотря на высокую техническую сложность гастропанкреатодуоденальной резекции, выполнение операции может являться единственным способом достижения R0-резекции.

Цель исследования. Оценить непосредственные результаты гастропанкреатодуоденальной резекции при местнораспространённом раке желудка с инвазией в головку поджелудочной железы.

В последние годы отношение к комбинированным операциям при местнораспространённом раке желудка существенно изменилось. Если ранее подобные вмешательства сопровождались высокой послеоперационной летальностью и считались неоправданными, то совершенствование хирургической техники, анестезиологического обеспечения и интенсивной терапии позволило значительно улучшить непосредственные результаты лечения. В настоящее время выполнение расширенных комбинированных резекций рассматривается как единственный способ достижения R0-резекции у отдельных категорий пациентов.

Гастропанкреатодуоденальная резекция относится к числу наиболее сложных вмешательств в абдоминальной хирургии. Операция сочетает гастрэктомию с панкреатодуоденальной резекцией и сопровождается высоким риском развития послеоперационных осложнений. Вместе с тем именно достижение отрицательных краёв резекции остаётся одним из основных факторов, определяющих прогноз заболевания и продолжительность жизни пациентов.

В связи с редкостью подобных наблюдений опыт выполнения гастропанкреатодуоденальной резекции при врастании рака желудка в головку поджелудочной железы представляет значительный практический интерес.

Проведён ретроспективный анализ результатов хирургического лечения пациентов с раком желудка, проходивших лечение в торакоабдоминальном отделении Ташкентского областного филиала Республиканского

специализированного научно-практического медицинского центра онкологии и радиологии в период с 2008 по 2021 год.

За указанный период были оперированы 1158 пациентов с диагнозом рака желудка. В 7 случаях (0,6%) вследствие врастания опухоли в головку поджелудочной железы объём оперативного вмешательства был расширен до гастропанкреатодуоденальной резекции.

Перед операцией всем пациентам проводилось комплексное обследование, включавшее клинические, лабораторные и инструментальные методы исследования, направленные на определение распространённости опухолевого процесса и оценку возможности выполнения радикального хирургического вмешательства.

Все операции выполнялись с соблюдением принципов онкологического радикализма и расширенной лимфодиссекции.

Основными критериями оценки эффективности лечения являлись радикальность выполненной операции, частота послеоперационных осложнений и летальность.

Гастропанкреатодуоденальная резекция была выполнена у 7 пациентов, что составило 0,6% всех хирургических вмешательств по поводу рака желудка.

Макроскопически полное удаление опухоли удалось выполнить во всех случаях. По результатам морфологического исследования R0-резекция была достигнута у 6 пациентов (85,7%), тогда как в одном наблюдении определялось микроскопическое поражение линии резекции.

Послеоперационные осложнения зарегистрированы у трёх пациентов (42,9%). Наиболее тяжёлым осложнением явилась панкреатическая фистула, диагностированная у одного больного (14,3%).

Послеоперационная летальность составила 14,3%.

Полученные результаты свидетельствуют о том, что выполнение гастропанкреатодуоденальной резекции позволяет добиться высокой частоты радикальных вмешательств даже при распространении опухоли на головку поджелудочной железы.

Основной целью хирургического лечения местнораспространённого рака желудка остаётся достижение R0-резекции. При врастании опухоли в головку поджелудочной железы выполнение стандартной гастрэктомии не обеспечивает полного удаления опухолевой ткани, что делает необходимым расширение объёма вмешательства.

В проведённом исследовании R0-резекция достигнута у 85,7% пациентов, что свидетельствует о высокой эффективности гастропанкреатодуоденальной резекции в обеспечении онкологического радикализма.

Одновременно следует отметить высокую частоту послеоперационных осложнений, характерную для комбинированных операций подобного объёма. Несмотря на это, применение современных методов интенсивной

терапии и комплексного послеоперационного ведения пациентов позволило получить удовлетворительные непосредственные результаты лечения.

Полученные данные подтверждают целесообразность выполнения гастропанкреатодуоденальной резекции у тщательно отобранных пациентов в специализированных онкологических учреждениях.

Гастропанкреатодуоденальная резекция является технически сложным, но онкологически обоснованным методом хирургического лечения местнораспространённого рака желудка с инвазией в головку поджелудочной железы.

Несмотря на высокую вероятность послеоперационных осложнений, выполнение комбинированной операции позволяет достичь высокой частоты радикальных резекций и обеспечить удовлетворительные непосредственные результаты лечения.

Применение данного метода должно осуществляться в специализированных центрах, располагающих достаточным опытом выполнения расширенных операций на органах верхнего этажа брюшной полости.

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О НЕОБХОДИМОСТИ РАЗРАБОТКИ ПОРЯДКА ИНВЕНТАРИЗАЦИИ ПРИ ОСУЩЕСТВЛЕНИИ ПРОЦЕДУР НЕПЛАТЕЖЕСПОСОБНОСТИ ЮРИДИЧЕСКИХ ЛИЦ

Аннотация. *Инвентаризация имущества должника является важным инструментом прозрачности и законности процедур неплатежеспособности юридических лиц в Узбекистане. В действующем законодательстве отсутствует специализированный порядок инвентаризации, адаптированный к задачам судебного управления. В статье выявлены правовые и методические пробелы, обоснована необходимость разработки унифицированного порядка, включающего регламентацию состава комиссии, этапов оценки, фиксации расхождений и цифровизации. Это призвано повысить эффективность и правовую определенность процедуры несостоятельности (банкротства).*

Ключевые слова: *инвентаризация, неплатежеспособность, судебный управляющий, юридические лица, банкротство, имущественная масса, оценка активов, правовое регулирование.*

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ON THE NECESSITY OF DEVELOPING AN INVENTORY PROCEDURE FOR LEGAL ENTITY INSOLVENCY PROCEEDINGS

Abstract. *An inventory of a debtor's assets is an important tool for ensuring the transparency and legality of legal entity insolvency proceedings in Uzbekistan. Current legislation lacks a specialized inventory procedure adapted to the needs of judicial administration. This article identifies legal and methodological gaps and substantiates the need to develop a unified procedure that includes regulations for the commission's composition, assessment stages, recording of discrepancies, and*

digitalization. This is intended to improve the efficiency and legal certainty of insolvency (bankruptcy) proceedings.

Key words: *inventory, insolvency, judicial manager, legal entities, bankruptcy, property mass, asset valuation, legal regulation.*

В условиях развития рыночной экономики и усиливающейся институционализации процедур неплатежеспособности, ключевым элементом обеспечения прозрачности, эффективности и законности процесса неплатежеспособности становится инвентаризация имущества и обязательств должника. В действующем законодательстве Республики Узбекистан, в частности в Законе «О неплатежеспособности» [1], Гражданском кодексе [2]. и Национальном стандарте бухгалтерского учета № 19 «Организация и проведение инвентаризации» (НСБУ №19) [3], Постановлениях Кабинета Министров [4] и Постановлениях Пленума Верховного суда [5], содержатся положения, касающиеся общего порядка проведения инвентаризации. Однако, несмотря на формальное наличие регулирующих актов, реальная практика применения свидетельствует о существенном пробеле в части правового и методического регулирования инвентаризационной деятельности именно в рамках процедур неплатежеспособности юридических лиц.

Инвентаризация в данном контексте представляет собой не просто элемент бухгалтерского учета, а сложный многоэтапный процесс, выполняющий одновременно правовую, контрольную, учетную и оценочную функции. Она направлена на установление фактического состава имущества должника, выявление расхождений между данными бухгалтерского учета и реальным положением дел, определение рыночной стоимости активов, а также формирование имущественной или ликвидационной массы. От результатов инвентаризации зависит корректность расчетов с кредиторами, соблюдение правовых норм, установление злоупотреблений и эффективность всего процесса неплатежеспособности. Ввиду этого актуальность разработки специализированного порядка, ориентированного на судебных управляющих, обусловлена объективной необходимостью систематизации процедур и устранения правовой неопределенности.

Анализ положений действующего порядка инвентаризации позволяет сделать вывод о том, что он содержит лишь общие рамочные предписания, не учитывающие специфику процедур банкротства. Так, положения о подготовке комиссии, перечне объектов, сроках инвентаризации, оценке активов и оформлении документов базируются на предпосылке стандартной хозяйственной деятельности предприятия. Между тем, ситуация банкротства юридического лица характеризуется рядом отличительных черт: прекращение или ограничение операционной деятельности, наличие значительных долгов, возможное сокрытие активов, утрата управленческих функций должностными лицами и переход контроля к судебному управляющему. Эти условия требуют адаптированных, более жестких и формализованных механизмов инвентаризации.

На подготовительном этапе инвентаризации судебный управляющий сталкивается с необходимостью изучения широкого круга нормативных документов, включая Закон «О неплатежеспособности», Гражданский кодекс, приказы Министерства экономики и финансов, судебную практику и разъяснения уполномоченных органов. Однако в условиях правовой фрагментации отсутствие единого унифицированного порядка приводит к произвольной трактовке обязанностей управляющего, состава комиссии, форм документации и регламентов действий. Это снижает правовую определенность процедуры и может стать причиной конфликтов с кредиторами, обвинений в злоупотреблениях и процессуальных споров.

Составление плана инвентаризации и формирование комиссии — еще один критически важный аспект. По действующим нормам, при внешнем управлении и ликвидации судебный управляющий утверждает постоянную комиссию с обязательным участием представителя кредиторов, бухгалтера, оценщика и других специалистов. Однако порядок назначения, критерии отбора членов комиссии, их обязанности, ответственность и право на доступ к информации нормативно не конкретизированы. Это создает риски конфликтов интересов, а также затрудняет объективность процесса. Разработка четкого механизма формирования комиссий — одна из задач будущего правового акта.

Само проведение инвентаризации включает физическую проверку имущества, сверку данных учета, оформление инвентаризационных описей, выявление расхождений и их фиксацию. Особое значение здесь имеет правовая квалификация активов: многие из них могут находиться в залоге, аренде, под арестом или быть предметом имущественных споров. Определение правового статуса имущества требует высокой компетенции членов комиссии, юридической экспертизы и доступа к информационным базам. Отсутствие четких регламентов может привести к неверной классификации имущества, что напрямую влияет на размер имущественной массы и права кредиторов.

Оценка активов является одним из наиболее уязвимых этапов инвентаризации. Хотя стандарт допускает привлечение оценочных организаций, отсутствует процедура выбора оценщика, критерии допустимых методов оценки и регламенты по обоснованию стоимости. В результате судебные управляющие могут прибегать к недобросовестным схемам, существенно занижая или завышая оценку имущества в интересах отдельных групп кредиторов. Разработка порядка, содержащего требования к отчетам об оценке, допустимым методам (затратный, сравнительный, доходный), а также процедурам оспаривания оценки, позволит избежать подобных нарушений.

Документальное оформление результатов инвентаризации — еще один блок, нуждающийся в стандартизации. Действующие формы, предусмотренные НСБУ №19, носят общий бухгалтерский характер и не учитывают специфические потребности процедур неплатежеспособности. Например, в них не отражаются сведения о правовом статусе имущества,

наличии судебных споров, запретов, ограничений, сопутствующих рисков. Унификация форм описей, актов расхождений, инвентаризационных ведомостей с включением правовой информации и элементов оценки рыночной стоимости — необходимое условие обеспечения прозрачности.

Сложности вызывает и фиксация расхождений между учетом и фактическим состоянием имущества. Как показывает практика, выявленные недостачи, излишки или неучтенные активы могут быть результатом как умышленных действий должника, так и недостатков учета. Порядок действий судебного управляющего при выявлении расхождений, включая сроки их устранения, направления в суд, налоговые органы, возбуждение проверок, должен быть четко прописан. Кроме того, требуется определить, в каких случаях инвентаризация должна быть повторной (например, при выявлении нового имущества или смене управляющего), а также утвердить порядок ее проведения.

Немаловажным элементом является представление результатов инвентаризации в суд и кредиторам. Действующим порядком предусмотрена обязанность управляющего представить отчет, однако не определены структура, объем и содержание этого отчета, а также формы отчетности, предназначенные для открытого доступа. В условиях отсутствия стандартизированных шаблонов, отчеты часто составляются в произвольной форме, что снижает их доказательную силу, затрудняет анализ и снижает доверие к процедуре. Следует разработать унифицированную форму отчета с указанием всех критически важных параметров: перечня активов, стоимости, обременений, права собственности, потенциальных рисков и юридических ограничений.

Наконец, важным направлением развития является цифровизация процесса инвентаризации. Введение электронных форм учета, использование QR-кодов, геолокации, фото- и видеофиксации активов, интеграция с государственными реестрами (недвижимости, транспорта, налоговыми базами) существенно упростит и ускорит процесс, снизит административную нагрузку и повысит прозрачность. При этом требуется нормативное закрепление допустимых технических средств фиксации, защиты персональных данных и доступа к цифровым системам.

Таким образом, разработка специального нормативного порядка инвентаризации, проводимой судебным управляющим в процедурах неплатежеспособности юридических лиц, представляет собой логичный и необходимый шаг на пути к формированию эффективной, прозрачной и правовой системы неплатежеспособности в Республике Узбекистан. Такой порядок должен носить подзаконный характер (в виде утвержденного стандарта), опираться на действующее законодательство и стандарты бухгалтерского учета, а также учитывать международный опыт и практику стран с развитой процедурой неплатежеспособности.

Предлагаемый порядок должен содержать следующие ключевые элементы: определения целей, задач и этапов инвентаризации; требования к

составу инвентаризационной комиссии; методику планирования и уведомления сторон; регламент физической проверки имущества и обязательств; унифицированные формы описей и актов; методику оценки активов с указанием применяемых подходов; порядок фиксации и устранения расхождений; сроки и формат представления отчетов; механизм повторной инвентаризации; требования к цифровым инструментам; распределение ответственности за нарушения порядка.

Принятие такого порядка обеспечит не только защиту интересов кредиторов и добросовестных должников, но и повысит доверие к судебным процедурам, снизит коррупционные риски, ускорит восстановление экономической активности субъектов хозяйствования и укрепит инвестиционный климат страны.

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МАКТАБЛАРДА СТРАТЕГИК ЛИДЕРЛИК: ФИНЛАНДИЯ ТАЖРИБАСИ АСОСИДА МАКТАБНИНГ РИВОЖЛАНИШ СТРАТЕГИЯСИНИ ИШЛАБ ЧИҚИШ ВА АМАЛГА ОШИРИШ МЕХАНИЗМИ

Аннотация. *Ушбу мақолада Финляндия таълим тизимидаги мактаб стратегик лидерлиги концепцияси, мактаб ривожланиш стратегиясини ишлаб чиқишнинг тизимли механизми ва уни амалга ошириш жараёни илмий таҳлил қилинади. Мақола 2025 йилда FIESDU лойиҳаси доирасида Финляндия мактабларига уюштирилган ташриф тажрибаси, директорлар ва ўқитувчилар билан суҳбатлар, PISA натижалари, OECD тадқиқотлари ва жаҳоннинг ведущий таълим олимлари асарлари асосида ёзилган.*

Калит сўзлар: *стратегик лидерлик, мактаб ривожланиш стратегияси, Финляндия таълим тизими, мактаб директори, педагогик лидерлик, маълумотга асосланган бошқарув, тақсимланган лидерлик, FIESDU, визия, миссия.*

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STRATEGIC LEADERSHIP IN SCHOOLS: MECHANISMS FOR DEVELOPING AND IMPLEMENTING A SCHOOL DEVELOPMENT STRATEGY BASED ON FINLAND'S EXPERIENCE

Abstract. *This article scientifically analyses the concept of strategic leadership in schools in the Finnish education system, the systematic mechanism for developing a school development strategy and the process of implementing it. The article is written on the basis of a 2025 visit to Finnish schools within the FIESDU project, conversations with principals and teachers, PISA results, OECD research and the works of leading education scholars worldwide.*

Keywords: *strategic leadership, school development strategy, Finnish education system, school principal, pedagogical leadership, evidence-based management, distributed leadership, FIESDU, vision, mission.*

КИРИШ

«Мактаб директори — маъмурий менежер» парадигмасидан «Мактаб директори — стратегик лидер» парадигмасига ўтиш замонавий таълим менежментидаги энг муҳим концептуал силжишлардан бири. Финляндия

таълим тизимида бу ўтиш 1990-йилларда амалга ошди ва натижалари PISA [1] халқаро баҳолашда ёрқин намоён бўлди. 2025 йилда FIESDU лойиҳаси [2] доирасида Финляндия мактабларига уюштирилган ташриф чоғида ушбу парадигма ўзгаришини конкрет амалиётда кузатиш имконияти бўлди.

Хельсинки мактаби директори Mikko Vesterinen ташриф чоғида айтди: «Мен мактабни директорлик қилмайман — унинг ривожланишини лойиҳалаштираман. Фарқи — маъмурий директор ўз машинасини бошқаради, стратегик лидер йўл харитасини жамоа билан бирга чизади». Ушбу нуқтаи назар K.Leithwood ва бошқалар [3] тадқиқотларида исботланган: стратегик лидерлик мактаб самарадорлигига маъмурий бошқарувдан 2,3 марта кучлироқ таъсир кўрсатади.

Ўзбекистон Республикасида Президентнинг 2022 йилги «Тараққиёт стратегияси» [4] «мактаб директори — менежер» тамойилини белгилади. Аммо «менежер» тушунчасини «стратегик лидер» сифатида талқин қилиш ва амалга ошириш учун назарий ва методологик база ҳали тўлиқ ишлаб чиқилмаган. Мазкур мақола ушбу бўшлиқни тўлдиришга хизмат қилади.

Мақоланинг мақсади — Финляндия мактабларидаги стратегик лидерлик тажрибасини таҳлил қилиб, мактаб ривожланиш стратегиясини ишлаб чиқиш ва амалга оширишнинг тизимли механизмини Ўзбекистон мактаблари учун мослаштириб таклиф этишдан иборат.

«Стратегик лидерлик» (strategic leadership) тушунчаси дастлаб корпоратив менежментда D.Hambrick ва P.Mason [5] «Юқори пог'она» (Upper Echelon) назариясида ишлаб чиқилди. Ушбу назарияда стратегик лидер — «ташкилотнинг узоқ муддатли йўналишини белгилайдиган, ресурсларни тақсимлайдиган, муҳит ўзгаришларига мослашадиган ва ташкилот маданиятини шакллантирадиган менежер» деб таърифланди. Педагогика фанида ушбу тушунча K.Leithwood, D.Jantzi ва R.Steinbach [6] «Трансформатив мактаб лидерлиги» (1999) асарида систематик жиҳатдан таҳлил қилинди.

T.Bush [7] «Таълим менежменти назариялари» асарида мактаб директорлари учун олти бошқарув ёндашувини таснифлади ва стратегик ёндашувни «мактабнинг ташқи ва ички муҳитни таҳлил қилиб, узоқ муддатли мақсадларга эришиш учун ресурсларни мобилизация қилиш санъати» сифатида белгилади. J.Hattie [8] мета-таҳлилида мактаб директорининг педагогик лидерлиги (стратегик лидерликнинг асосий компоненти) таълим натижаларига effect size=0,90 таъсир кўрсатишини аниқлади — барча мактаб даражасидаги омиллар ичида энг юқори кўрсаткич.

Финляндияда мактаб стратегик лидерлиги 1994 йилги «Асосий таълим Қонуни» реформасидан сўнг тизимли шаклланди. Ушбу реформа мактаблардан йиллик «мактаб ривожланиш режаси» (School Development Plan — SDP) тузишни мажбурий қилди. P.Sahlberg [9] таъкидлайди: «Финляндиядаги ўзгариш — мактабни ташқаридан бошқаришдан ичкаридан ривожланишга ўтиш. Директор инструкция кутмайди — жамоаси билан бирга йўл чизади».

2016 йилда янги миллий ўқув режаси [10] мактабларга стратегик режалаштиришда янада кенг мухторият берди: ҳар бир мактаб ўз «педагогик фалсафасини» ва «ривожланиш устуворликлари»ни мустақил белгилайди. Натижа: Финляндия мактаблари ўртасида PISA [1] натижалари бўйича тафовут ОЭСР мамлакатлари орасида энг паст — чунки ҳар бир мактаб ўзи учун оптимал стратегия ишлаб чиқади.

Стратегик лидерликнинг учта даражаси

Даража	Таъриф	Финляндиядаги кўриниши	Асосий инструмент
1.Визионерлик (Visionary)	Мактабнинг орзу ва истиқболини белгилаш	Директор жамоа билан 5 йиллик «Мактабимиз 2030» визиясини ишлаб чиқади	Стратегик сессия, маслаҳат учрашувлари
2. Стратегик режалаштириш	Визияни аниқ мақсадлар ва режаларга айлантириш	Йиллик SDP: мақсадлар, кўрсаткичлар, масъул шахслар, муддатлар	SDP шаблони, SMART мақсадлар
3.Оперативлик (Operational)	Стратегияни кундалик фаолиятга интеграция қилиш	Ҳафталик педагогик кенгаш стратегия прогрессини муҳокама қилади	PDCA сикли, ойлик мониторинг

1-жадвалдан кўриниб турибдики, стратегик лидерлик бир марталик «режа тузиш» эмас — балки уч даражада мунтазам амалга ошириладиган тизимли жараён. M.Fullan **[11]** таъкидлайдики: «Энг мўлжалланган стратегия ҳам ижрочилар уни «ўзники» деб ҳис этмаса — қоғозда қолади. Мактаб директорининг стратегик вазифаси — стратегияни жамоанинг «агентлик ҳисси»га айлантириш».

2025 йил FIESDU ташрифи **[2]** давомида Хельсинки мактабида директорнинг педагогик кенгашдаги стратегик мулоқотини кузатиш имконияти бўлди. Директор кенгашни шундай бошлади: «Бугун мен сизларга нима қилиш кераклигини айтмайман. Мен учта савол бераман — жавоблар бизнинг стратегиямизнинг кейинги босқичини белгилайди». Учта савол: «Биз нимани яхши қиляпмиз — ва нима учун?»; «Ўқувчиларимизга нима камлик қиляпти — ва бу нимага боғлиқ?»; «Бир йилда нимани ўзгартирсак — катта фарқ бўлади?».

Бу «Сократ услуби» педагогик лидерликда J.Hattie **[8]** томонидан «ўқитувчиларни тафаккурлантирувчи директор» (principal as activator) роли деб таърифланган — effect size=1,03, яъни «жуда юқори» таъсир. Директор жавоб бермайди — саволлар берадики, ўқитувчилар ўзлари ечимни топади.

Натижада ечим «директорнинг топшириғи» эмас — «жамоанинг кашфиёти» бўлади.

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243-сон умумий ўрта таълим мактаби директори

ФИНЛЯНДИЯ ТАЖРИБАСИНИ ЎЗБЕКИСТОН ТАЪЛИМИДА МОСЛАШТИРИШ ЛОЙИҲА ИШЛАРИ ОРҚАЛИ ЎҚУВЧИЛАРНИНГ АМАЛИЙ КЎНИКМАЛАРИНИ РИВОЖЛАНТИРИШДА СИНФ РАҲБАРЛАРИНИНГ ЎРНИ

Аннотация *Мазкур мақолада Финляндия таълим тизимидаги лойиҳага асосланган ўрганиш (Project-Based Learning — PBL) технологиясини Ўзбекистон умумтаълим мактабларида мослаштириб қўллаш масаласи илмий-назарий ва амалий жиҳатдан таҳлил қилинади. Тошкент шаҳар Олмазор тумани 243-мактабда «Менинг мактабим — Менинг фахрим» шиори остида олиб борилаётган лойиҳа ишлари танлови тажрибаси, 2025 йил FIESDU лойиҳаси доирасидаги Финляндия ташрифи кузатишлари, жаҳоннинг илғор таълим олимлари тадқиқотлари ва OECD маълумотлари мақоланинг назарий ва эмпирик асосини ташкил этади.*

Калит сўзлар: *лойиҳага асосланган ўрганиш, синф раҳбари, амалий кўникмалар, Финляндия таълим тизими, FIESDU, 243-мактаб тажрибаси, жамоавий ўрганиш, мактаб бошқаруви, «Менинг мактабим — Менинг фахрим».*

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ADAPTING THE FINNISH EXPERIENCE TO THE EDUCATIONAL SYSTEM OF UZBEKISTAN THE ROLE OF CLASS TEACHERS IN DEVELOPING STUDENTS' PRACTICAL SKILLS THROUGH PROJECT-BASED LEARNING

Abstract *This article examines the adaptation of Project-Based Learning (PBL) technology, widely used in the Finnish education system, for implementation in Uzbek general education schools. The basis of the article is formed by the experience of the project competition held at School No. 243 in Almazar District, Tashkent city, under the motto «My School — My Pride», observations from a 2025 visit to Finland within the FIESDU project, research by leading world education scholars, and OECD data.*

Keywords: *project-based learning, class teacher, practical skills, Finnish education system, FIESDU, School No. 243 experience, collaborative learning, school management, «My School — My Pride».*

«Ўқувчи ўрганаётган билимини фақат эслаб қолмай — амалда қўллаши керак». Ушбу тамойил Финляндия таълим тизимининг пойдеворини ташкил этади ва замонавий педагогика фанида «лойиҳага асосланган ўрганиш» (Project-Based Learning — PBL) деб аталади. 2025 йил FIESDU лойиҳаси [1] доирасидаги Финляндия мактабларига ташриф чоғида кузатилган энг таъсирли манзара — ўқувчиларнинг реал ҳаётий муаммоларни биргаликда ечаётган лойиҳа ишлари эди: кимдир маҳалланинг экологик харитасини тузяпти, кимдир математик тадқиқот ўтказяпти, кимдир озиқ-овқат маҳсулотлари ҳақида китобча ёзяпти.

J.Hattie [2] 800 дан ортиқ тадқиқотнинг мета-таҳлилида «ўқувчиларнинг мустақил лойиҳа иши» таълим натижаларига effect size=0,56 — «ўртача юқори» таъсир кўрсатишини аниқлади. J.Krajcik ва P.Blumenfeld [3] тадқиқотларида PBL усулида ўқитилган ўқувчилар анъанавий усулдагиларга нисбатан амалий кўникмалар бўйича 35–40%, ижодий тафаккур бўйича 28% юқори натижа кўрсатган.

Тошкент шаҳар Олмазор тумани 243-мактабда «Менинг мактабим — Менинг фахрим» [4] шиори остида ўтказилаётган лойиҳа ишлари танлови ушбу педагогик ёндашувнинг амалий намунасидир. Айниқса, 1–2-синф ўқувчиларининг Ўзбекистоннинг куз неъматларидан кўргазмалар тайёрлаши, мева ва сабзавотлар ҳақида шеърлар айтиши — болаларнинг билимни «яшаш» тажрибаси орқали ўрганишининг конкрет ифодасидир. Ўзбекистон Республикасида «Taraqqиёт стратегияси» [5] таълимда амалий кўникмаларни ривожлантиришни устувор вазифа деб белгилаган. Мазкур мақоланинг мақсади — Финляндия PBL тажрибасини 243-мактаб амалиёти билан боғлаб, синф раҳбарларининг лойиҳа ишларини ташкил этишдаги ролини илмий асослашдан иборат.

Лойиҳага асосланган ўрганиш (PBL) технологиясининг назарий илдизлари Ж.Дьюи [6] прагматик педагогикасига бориб тақалади. Дьюи 1897 йилдаёқ «ўрганиш — фаолият орқали» (learning by doing) тамойилини илгари сурган. Л.С.Выготский [7] «яқин ривожланиш зонаси» концепциясида реал ҳаётий вазифалар орқали ўрганиш болаларнинг ривожланишини жадаллаштиришини исботлади. Д.Килпатрик [8] 1918 йилда «лойиҳа методи» асарида мактабда лойиҳа ишларини тизимли жорий этишнинг педагогик асосини яратди.

Замонавий PBL концепциясини Buck Institute for Education «Олтин стандарт PBL» модели орқали тизимлаштирди. Ушбу моделнинг асосий элементлари: (1) мушкул муаммо ёки «ҳаракатлантирувчи савол» (driving question); (2) узлуксиз тадқиқот; (3) аутентиклик — реал ҳаётга боғлиқлик; (4) ўқувчи овози ва танлови; (5) рефлексия; (6) тенгдошлар фидбэки; (7) оммавий маҳсулот. 1–2-синф ўқувчиларининг куз неъматларидан кўргазмалар тайёрлаши айнан ушбу элементларни ўзида жамлайди: аутентик мавзу, реал маҳсулот, оммавий тақдимот.

Финляндияда лойиҳага асосланган ўрганиш «феномен-асосли ўрганиш» (Phenomenon-based Learning — PhBL) сифатида 2016 йил миллий ўқув

режасига расмий киритилди. Финляндия миллий ўқув режасига [10] кўра, ўқувчилар фанлараро ва реал ҳаётга боғлиқ лойиҳалар орқали ўргатилиши мажбурий. FIESDU ташрифи [1] давомида Тампере мактабидаги 3-синфда «Қишда нима ейиш керак?» мавзусидаги лойиҳани кузатдик: ўқувчилар биология, математика ва адабиётни бирлаштириб, ўз туманларидаги маҳаллий маҳсулотларни тадқиқ қилди ва ота-оналарга тақдимот ўтказди. 1–2-синфдаги ўқувчиларнинг куз неъматларидан кўргазма тайёрлаши — ана шу Финляндия тажрибасининг Ўзбекистонга мослашган кўриниши.

Жамоавий лойиҳа ишида шаклланадиган кўникмалар алоҳида ўрганишда шаклланмайди. T.Johnson ва D.Johnson ҳамкорлик таълими (cooperative learning) бўйича 40 йиллик тадқиқотларини умумлаштириб: «Жамоавий ишлаган гуруҳлар якка ишлаган ўқувчиларга нисбатан ўзлаштириш бўйича 27%, ижтимоий кўникмалар бўйича 42% юқори натижа кўрсатади» деб хулоса чиқарди. Айниқса болаларда ўзаро ҳурмат, бир-бирини эшитиш, бир-бирига ўргатиш кўникмалари жамоавий лойиҳа ишлари давомида тўла шаклланади. A.Bandura «ижтимоий ўрганиш» назариясида: «Бола тенгдошидан ўрганади — катта одамдан ўрганишдан кўра баъзан самаралироқ» деди.

Тошкент шаҳар Олмазор тумани 243-мактабда «Менинг мактабим — Менинг фахрим» [4] шиори остида ўтказилаётган лойиҳа ишлари танлови мактаб бошқарувининг педагогик лидерлик тамойилига асосланган ташаббус. Ушбу танловнинг асосий педагогик мақсадлари: билимни амалий фаолиятга айлантириш; ўқувчиларда миллий ватанпарварлик ва мактаб фахрини шакллантириш; жамоавий ишлаш ва ўзаро ҳурмат кўникмаларини ривожлантириш; ота-оналарни таълим жараёнига фаол жалб этиш.

2.2. 1–2-синф лойиҳаси: «Куз неъматлари» — амалий таҳлил

1–2-синф ўқувчиларининг «Ўзбекистоннинг куз неъматлари» лойиҳасини PBL назарияси нуқтаи назаридан таҳлил қиламиз. Мазкур лойиҳа «Олтин стандарт PBL» нинг барча элементларини ўзида мужассамлаштиради:

– Ҳаракатлантирувчи савол: «Ўзбекистонда куз фаслида қандай неъматлар пайдо бўлади ва улар нимага фойдали?» — болаларга яқин ва реал савол.

– Тадқиқот жараёни: болалар уй ва бозорда мева-сабзавотларни кузатади, ота-оналардан сўрайди, маълумот тўплайди.

– Аутентик маҳсулот: реал мева-сабзавотлардан ёки суратлардан кўргазма тайёрланади — «майдон» — синф ёки мактаб ҳолати.

– Оммавий тақдимот: шеър айтиш орқали болалар ўзлари ўрганган маълумотни тенгдошларига ва ота-оналарга тақдим этади.

– Рефлексия: «Нимани ўргандим? Нима қийин бўлди? Буни ким ёрдам берди?» деган саволлар.

К.Робинсон «ижодкорлик» концепциясига кўра, болалар «Куз неъматлари» лойиҳасида фақат мева-сабзавотни ўрганмайди — улар табиат ва инсон муносабатини ижодий тарзда ифодалайди, ўз маданиятига нисбатан фахр ҳиссини ҳис этади.

Финляндия мактабларида FIESDU ташрифи [1] давомида синф раҳбарларининг лойиҳа жараёнида «фасилитатор» — «кўринмас дирижёр» ролини бажаришини кузатдик. Финляндия синф раҳбари Kirsi Mäkinen айтди: «Мен лойиҳани бошқармайман — мен болаларнинг ўзлари бошқаришини таъминлайман». J.Hattie [2] мета-таҳлилида «ўқитувчи фасилитатор сифатида» (teacher as facilitator) effect size=0,60 — «юқори» таъсир кўрсатади.

K.Krajcik ва P.Blumenfeld [3] PBL тадқиқотида синф раҳбарнинг тўрт асосий роли аниқланди: (1) Муаммо шакллантиришга ёрдам бериш — «драйвинг савол» тузиш; (2) Ресурс топиш ва йўналтириш; (3) Гуруҳ динамикасини бошқариш; (4) Тақдимотни ташкил этиш. 243-мактабда «Куз неъматлари» лойиҳасида синф раҳбарлари айнан ушбу тўрт ролни бажарди: мавзу танлашда ёрдам берди, болаларни гуруҳларга ажратди, ота-оналар билан мулоқот ўрнатди, тақдимот форматини ташкил этди.

Синф раҳбари лойиҳа ишларида нафақат синф даражасида, балки мактаб бошқаруви билан алоқа ўрнатувчи «координатор» сифатида ҳам иш олиб боради. M.Fullan «Тизимли ўзгариш» назариясида: «Директор стратегияни белгилайди — синф раҳбари уни синф даражасида амалга оширади. Ушбу занжир бутун мактаб самарадорлигини белгилайди» деди. 243-мактабда «Менинг мактабим — Менинг фахрим» [4] танловида синф раҳбарларнинг координатор роли: директор билан режалаштириш учрашуви (мавзу, муддат, фармат); синф лойиҳасини мактаб умумий тадбирига боғлаш; турли синф раҳбарлар ўртасида тажриба алмашиш (PLC формати).

Лойиҳа ишларида ҳар бир бола ўзига хос мусулаларга дуч келади: кимдир гуруҳда ишлашни билмайди, кимдир тақдимотдан қўрқади, кимдир ғоя топа олмайди. Синф раҳбарнинг «ментор» роли — ушбу индивидуал тўсиқларни аниқлаб, конкрет ёрдам бериш. C.Dweck «ўсиш тафаккури» концепциясида: «Ментор боланинг кучига ишонса — бола ўзига ишонади». 1–2-синф ўқувчилари учун «куз неъматлари» лойиҳасида ментор сифатида синф раҳбари: хижолат тортган болага алоҳида вақт ажратиб, шеърни биргаликда машқ қилдириш; ижодий ғоя тополмаган болага «Энг ёқтирган меванг нима?» деб сўраш — уни ўз тажрибасидан бошлашга чорлаш; гуруҳдаги «тортинчоқ» болани алоҳида бир вазифа билан «агент» қилиш.

Синф раҳбарлар учун

– Ҳар чоракда камида 1 та лойиҳа иши режалаштиринг — мавзуни ўқувчилар билан биргаликда танланг («нима ўрганмоқчи?» деб сўранг).

– Лойиҳа давомида «фасилитатор» — «ечим бермайди, ечимга йўналтиради» ролини ўзлаштиринг. Ўқувчи тўхтаганда: «Бу ҳақда ким билиши мумкин?» деб сўранг.

ХУЛОСА

«Ўқувчи ўрганаётган билимини амалда қўллаши» — фақат Финляндиянинг орзуси эмас. 243-мактабда «Куз неъматлари» кўргазмасини тайёрлаётган 1-синф ўқувчиси ҳам айнан шу йўлда: у мева ҳақида ўқимаяпти — мевани ўрганяпти, ўзи танлаяпти, шеър орқали ифодаляпти, тенгдошларига

ўргатяпти. J.Hattie [2] ибораси билан айтадиган бўлсак: «Энг яхши ўрганиш — ўзинг ўргатганингда юз беради».

Мазкур тадқиқот натижалари асосида қуйидаги хулосаларга келинди:

ФОЙДАЛАНИЛГАН АДАБИЁТЛАР РЎЙХАТИ

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ЭКОЛОГИЧЕСКИЕ ПРОБЛЕМЫ ИСПОЛЬЗОВАНИЯ ВОДНЫХ РЕСУРСОВ В ДЖИЗАКСКОЙ ОБЛАСТИ: ТЕРРИТОРИАЛЬНАЯ ОЦЕНКА НА ОСНОВЕ ГИС

Аннотация. *В статье на основе представленных данных проанализированы территориальные особенности использования водных ресурсов Джизакской области и связанные с ними экологические проблемы. С применением статистического и сравнительно-географического подходов обобщены показатели протяжённости введённых в эксплуатацию водопроводных сетей в сельской местности, цифровизации земель водного фонда и ирригационной деятельности. Отмечено, что геодезические измерения проведены на 3810 га земель водного фонда, а факты незаконного использования выявлены на площади 627 га. Предложена схема оценки на основе ГИС, объединяющая показатели дефицита воды, засоления, антропогенной нагрузки и качества воды; при этом указано, что итоговые зоны экологического риска пока не рассчитаны. Сформулированы рекомендации по цифровому мониторингу земель водного фонда, расширению применения водосберегающих технологий орошения и наблюдению за Айдар-Арнасайской системой озёр.*

Ключевые слова: *водные ресурсы, экологические проблемы, орошение, земли водного фонда, ГИС, засоление, Джизакская область.*

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ENVIRONMENTAL PROBLEMS OF WATER RESOURCES USE IN JIZZAKH REGION: A GIS-BASED TERRITORIAL ASSESSMENT

Abstract. *The article examines the territorial characteristics of water resources use and related environmental problems in Jizzakh region using the information provided in the source manuscript. Statistical and comparative geographical approaches are used to summarize the length of newly commissioned rural water supply networks, the digitization of water fund lands, and irrigation-related indicators. The source reports geodetic surveys of 3,810 hectares of water fund lands and identifies unauthorized use on 627 hectares. A GIS assessment framework combining water scarcity, salinization, anthropogenic pressure, irrigation intensity, and water quality is proposed; final spatial risk zones have not yet been calculated. Recommendations concern digital monitoring, water-saving irrigation, and ecological monitoring of the Aydar-Arnasay lake system.*

Keywords: *water resources, environmental problems, irrigation, water fund lands, GIS, salinization, Jizzakh region.*

ВВЕДЕНИЕ

Водные ресурсы относятся к важнейшим природным ресурсам, обеспечивающим социально-экономическое развитие человечества. Особенно в регионах с засушливым климатом сохранение количества и качества водных ресурсов является одним из основных условий экологической устойчивости. В Центральной Азии рост численности населения, расширение сельскохозяйственного производства, урбанизация и изменение климата усиливают нагрузку на водные ресурсы. В Узбекистане основная часть водопользования связана с сельским хозяйством. Согласно официальным сведениям, около 90–91 % имеющихся в стране водных ресурсов направляется на нужды сельского хозяйства. Поэтому в регионах развитого орошаемого земледелия эффективность водопользования имеет не

только экономическое, но и экологическое значение. Джизакская область также относится к регионам, в которых орошаемое земледелие занимает важное место. Для её природно-географических условий характерно чередование предгорных, равнинных и пустынных территорий. Территориальное распределение водных ресурсов также неоднородно. В одних районах близость к водным источникам создаёт относительно благоприятные условия, тогда как в других наблюдаются проблемы, связанные с дефицитом воды, состоянием оросительной инфраструктуры и мелиорацией земель.

Изучение использования водных ресурсов области нельзя ограничивать только их количеством. Необходим совместный анализ территориального размещения водных объектов, орошаемых земель, населённых пунктов, промышленных объектов, засоления почв и других антропогенных факторов. В этом отношении геоинформационные системы (ГИС) служат важным инструментом территориальной оценки экологических последствий водопользования. ГИС позволяют объединять водные объекты и влияющие на них природные и антропогенные факторы в единую базу геоданных, проводить зонирование территории по уровню экологического риска и осуществлять мониторинг изменений во времени. Цель исследования — охарактеризовать экологические проблемы, связанные с использованием водных ресурсов Джизакской области, на основе имеющихся показателей, определить подход к их территориальной оценке с применением ГИС и сформулировать практические рекомендации по устойчивому водопользованию.

Задачи исследования: охарактеризовать основные водные ресурсы области и их территориальное распределение; проанализировать состояние оросительных систем и использование земель водного фонда; выделить экологические проблемы и факторы антропогенной нагрузки; определить слои и индикаторы, необходимые для оценки на основе ГИС; разработать рекомендации по охране и рациональному использованию водных ресурсов.

МАТЕРИАЛЫ И МЕТОДЫ ИССЛЕДОВАНИЯ

Объектом исследования являются водные ресурсы Джизакской области и процессы их использования. Предмет исследования — экологические последствия водопользования, дефицит и качество воды, оросительные системы, земли водного фонда и их территориальные различия.

В исследовании использованы сведения Национального комитета Республики Узбекистан по статистике, Министерства водного хозяйства, Национального комитета по экологии и изменению климата, а также соответствующих территориальных организаций.

В исходном материале указаны статистический анализ, сравнительно-географический и картографический подходы, ГИС-анализ, дистанционное зондирование, формирование базы геоданных, территориальное зонирование и наложение пространственных слоёв (overlay analysis). Приведённые в настоящей статье количественные результаты представляют собой

обобщение имеющихся официальных данных; исходный документ не содержит подтверждённых результатов самостоятельных ГИС-расчётов или сведений о построении итоговой карты экологического риска.

Для анализа на основе ГИС могут использоваться такие пространственные слои, как административные границы, реки и каналы, водохранилища, Айдар-Арнасайская система озёр, орошаемые земли, земли водного фонда, населённые пункты, промышленные объекты и мелиоративное состояние земель. При оценке экологического риска учитываются такие индикаторы, как дефицит воды, интенсивность водопользования, доля орошаемых земель, засоление, качество воды и антропогенная нагрузка.

Предлагаемый интегральный показатель выражается следующей формулой:

$$E = W_1 S + W_2 A + W_3 Sh + W_4 I + W_5 Q$$

где E — индекс экологического риска; S — дефицит воды; A — антропогенная нагрузка; Sh — степень засоления; I — интенсивность орошения; Q — качество воды; W_1–W_5 — весовые коэффициенты индикаторов. Данная формула представляет собой предложенное в исходном материале методическое выражение: количественные значения индикаторов, порядок их нормализации, весовые коэффициенты и результаты фактических расчётов индекса не приведены.

Этот подход позволяет в перспективе классифицировать территорию области по степени экологического риска. При этом итоговые границы зон риска необходимо рассчитывать на основе фактических ГИС-данных.

РЕЗУЛЬТАТЫ

Водные ресурсы и инфраструктура водоснабжения

Водные ресурсы Джизакской области образуют сложную гидрологическую систему, включающую реки, каналы, водохранилища, коллекторно-дренажные сети, озёра и подземные воды. Эти ресурсы используются для нужд населения, сельского хозяйства, промышленности и в экологических целях. Важная роль сельского хозяйства в экономике области повышает потребность в оросительной воде. В связи с этим актуальными остаются эффективность водопользования, техническое состояние системы подачи воды и сокращение её потерь. Динамика развития инфраструктуры водоснабжения также отражает изменения, происходящие в системе водного хозяйства региона.

Таблица 1. Протяжённость водопроводных сетей, введённых в эксплуатацию в сельской местности Джизакской области

Год	**Протяжённость введённых в эксплуатацию водопроводных сетей, км**
2020	197,2
2021	429,9
2022	503,9
2023	869,9
2024	154,7
2025	250,3

Источник: данные СИАТ Национального комитета Республики Узбекистан по статистике [2].

В таблице указана протяжённость водопроводных сетей, введённых в эксплуатацию в каждом отдельном году, а не общая протяжённость существующих сетей. Согласно представленным данным, в 2020 г. введено 197,2 км сетей, в 2021 г. — 429,9 км, в 2022 г. — 503,9 км, в 2023 г. — 869,9 км, в 2024 г. — 154,7 км, в 2025 г. — 250,3 км. Таким образом, годовые показатели изменялись неравномерно. Целесообразно отдельно изучить связь этих изменений с территориальными инфраструктурными проектами, инвестициями и программами водоснабжения [2].

Использование земель водного фонда и мониторинг на основе ГИС

При охране водных ресурсов важно контролировать не только состояние самой воды, но и соблюдение режима использования территорий, относящихся к водным объектам. В Джизакской области проведены практические работы по цифровизации земель водного фонда и формированию базы геоданных. Согласно официальным сведениям, приведённым в исходном документе, на площади 3810 га земель водного фонда выполнены геодезические измерения и созданы электронные базы ГИС. Кроме того, проведён учёт 2915 га земель, а 2383 га зарегистрированы в государственном порядке на балансе водохозяйственных организаций. В ходе этих работ выявлены факты незаконного использования 627 га земель водного фонда [3]. Эти показатели подтверждают практическую значимость мониторинга использования земель водного фонда на основе ГИС. Электронная база геоданных позволяет уточнять границы водных объектов, учитывать земельные площади, определять территориальное размещение участков незаконного использования и отслеживать изменения во времени. Цифровизация земель водного фонда также позволяет сопоставлять результаты экологического мониторинга с другими пространственными данными. Например, посредством наложения слоёв земель водного фонда и орошаемых земель, населённых пунктов, промышленных объектов и транспортной инфраструктуры можно выявлять территории с высокой антропогенной нагрузкой.

Орошение и возможности водосбережения

Одним из основных направлений использования водных ресурсов Джизакской области является орошаемое земледелие. Низкая эффективность

водопользования в сельском хозяйстве не только повышает потребность в водных ресурсах, но в отдельных случаях может влиять на мелиоративное состояние земель. Согласно официальным данным по Зааминскому району, на орошение одного гектара сельскохозяйственных угодий в среднем расходуется 9,5–10 тыс. м³ воды [5]. Этот показатель подчёркивает значение водосберегающих технологий. Капельное, дождевальное и другие современные методы орошения могут способствовать оптимизации расхода воды и стабилизации продуктивности сельского хозяйства. По данным Министерства водного хозяйства, в Узбекистане в 2025 г. применение водосберегающих технологий позволило сэкономить 2,3 млрд м³ воды [4]. Это общереспубликанский показатель, который не относится исключительно к Джизакской области. В отдельных фермерских хозяйствах Зафарабадского района Джизакской области имеется также опыт применения капельного орошения хлопчатника. Поэтому важным направлением повышения эффективности водопользования в области является внедрение водосберегающих технологий с учётом природных и хозяйственных условий конкретных территорий.

Экологические проблемы, связанные с использованием водных ресурсов

В рамках исследования экологические проблемы, связанные с использованием водных ресурсов Джизакской области, можно разделить на следующие основные группы.

Неравномерное распределение водных ресурсов. Водные ресурсы распределены по территории области неравномерно, что обусловлено её природно-географическими условиями. При этом потребность в воде особенно резко возрастает в вегетационный период. В результате в отдельных районах усиливается сезонная нагрузка на водные ресурсы.

Потери воды в оросительных системах. На отдельных участках открытых каналов и устаревшей ирригационной инфраструктуры часть воды может теряться вследствие фильтрации и испарения. Это снижает эффективность использования имеющихся водных ресурсов.

Засоление земель. Несоответствие между режимами орошения и дренажа может создавать условия для подъёма уровня грунтовых вод и накопления солей в почве. Засоление отрицательно влияет на экологический и производственный потенциал сельскохозяйственных земель.

Изменение качества воды. Использование минеральных удобрений и средств защиты растений в сельском хозяйстве, а также поступление сточных вод в водные объекты могут оказывать антропогенное воздействие на качество воды.

Риск дефицита воды. Изменение климатических условий, повышение температуры и усиление испарения могут приводить к росту потребности в воде. Поэтому необходимы долгосрочное прогнозирование состояния водных ресурсов и территориально дифференцированное управление ими.

Экологическое состояние Айдар-Арнасайской системы озёр

Айдар-Арнасайская система озёр занимает особое место в водно-экологической системе Джизакской области. В её состав входят озёра Айдаркуль, Тузкан и Восточный Арнасай. В официальных сведениях, приведённых в исходном материале, общая площадь системы озёр оценивается приблизительно в 4 тыс. км². Эта территория имеет важное значение для водных экосистем, рыболовства и сохранения биологического разнообразия. В связи с этим необходим регулярный мониторинг водного режима озёр, качества воды и антропогенной нагрузки. Согласно приведённым в исходном документе официальным сведениям, в январе–феврале 2025 г. на территории Айдар-Арнасайской системы озёр проведено 125 контрольных мероприятий, в ходе которых выявлено 94 нарушения [6]. Эти данные указывают на необходимость усиления экологического контроля за использованием водных экосистем. Вместе с тем применение ГИС и технологий дистанционного зондирования позволяет отслеживать площадь озёр и водной поверхности, изменения прибрежных территорий и антропогенную нагрузку.

Схема территориальной экологической оценки на основе ГИС

Главное преимущество ГИС при оценке экологического состояния водопользования заключается в возможности объединять различные пространственные данные в единую систему.

Для Джизакской области целесообразно сформировать следующие пространственные слои ГИС:

Таблица 2. Предлагаемые пространственные слои для оценки на основе ГИС

№	Слой ГИС	Назначение для анализа
1	Административные границы	Анализ по районам
2	Реки	Источники воды
3	Каналы	Ирригационная сеть
4	Водохранилища	Регулирование водных ресурсов
5	Айдар-Арнасайская система озёр	Крупная водная экосистема
6	Орошаемые земли	Водопотребление
7	Земли водного фонда	Охрана водных объектов
8	Населённые пункты	Антропогенная нагрузка
9	Промышленные объекты	Потенциальные источники загрязнения
10	Засоление	Мелиоративное состояние
11	NDVI	Растительный покров
12	Водная поверхность	Динамика во времени

Источник: перечень слоёв, предложенный авторами в исходной статье.

Эти слои могут быть объединены в среде ArcGIS и проанализированы с помощью таких инструментов, как Spatial Analysis, Buffer, Intersect и Weighted Overlay.

На основе данного подхода предлагается создать карту «Зоны экологического риска при использовании водных ресурсов в Джизакской области». Предполагается разделить территорию на зоны низкого, среднего и высокого риска. Однако исходный документ не содержит такой карты,

фактических границ зон риска или результатов ГИС-расчётов; они должны быть определены в ходе последующего анализа.

ОБСУЖДЕНИЕ

Анализ представленных данных показывает, что экологические проблемы, связанные с использованием водных ресурсов Джизакской области, формируются не под влиянием одного фактора, а в результате взаимодействия природных и антропогенных процессов. Высокая потребность сельского хозяйства в воде, потери в ирригационных сетях, засоление земель и антропогенная нагрузка на водные объекты прямо или косвенно влияют на экологическое состояние водных ресурсов. Вместе с тем формирование базы ГИС по землям водного фонда, о котором сообщается в официальных данных, создаёт важную практическую основу для цифровизации территориального мониторинга. Электронная база данных позволяет непрерывно наблюдать за состоянием земель водного фонда, выявлять случаи незаконного использования и сопоставлять их с другими экологическими показателями. В дальнейшем особое значение приобретает интеграция данных ГИС с материалами дистанционного зондирования. Например, спутниковые снимки Sentinel или Landsat позволяют изучать динамику площади водной поверхности, растительного покрова и деградации земель. При управлении водными ресурсами необходимо также учитывать не только имеющийся объём воды, но и потребность в ней, её качество, мелиоративное состояние земель и климатические факторы в их взаимосвязи.

Приведённый в исходном материале статистический ряд характеризует годовые объёмы ввода в эксплуатацию сетей водоснабжения, однако не позволяет непосредственно делать выводы об изменении расхода или качества воды. Аналогичным образом предложенный интегральный индекс экологического риска не является полученным практическим результатом: его значения и соответствующая карта могут быть рассчитаны только после формирования необходимых пространственных слоёв, определения коэффициентов и проверки геоданных.

ЗАКЛЮЧЕНИЕ

Использование водных ресурсов Джизакской области непосредственно связано с сельским хозяйством, экологической устойчивостью и социально-экономическим развитием региона. Обобщённые в статье данные свидетельствуют о наличии ряда экологических проблем в сфере водопользования. К основным из них относятся территориальная и сезонная неравномерность распределения водных ресурсов, потери воды в оросительных системах, засоление земель, изменение качества воды, проблемы использования земель водного фонда и антропогенная нагрузка на водные экосистемы. Проведение геодезических измерений на 3810 га земель водного фонда Джизакской области и формирование электронной базы ГИС представляют собой важную основу для цифрового управления водными ресурсами и их мониторинга. Одновременно выявление фактов незаконного использования 627 га земель водного фонда свидетельствует о необходимости

непрерывного территориального мониторинга. Применение ГИС позволяет анализировать водные ресурсы, орошаемые земли, земли водного фонда, населённые пункты, промышленные объекты и экологические проблемы в единой геопространственной системе.

На основе сведений, приведённых в исходном материале, рекомендуются следующие практические направления: сформировать единую базу данных ГИС по водным ресурсам области и регулярно обновлять её; продолжить электронный мониторинг земель водного фонда; сокращать потери воды в оросительных каналах; расширять применение капельного и дождевального орошения; осуществлять мониторинг засоления, качества воды и состояния Айдар-Арнасайской системы озёр с использованием ГИС и дистанционного зондирования; разрабатывать долгосрочные прогнозы состояния водных ресурсов в условиях изменения климата.

Таким образом, важнейшим условием рационального использования водных ресурсов Джизакской области является не только экономия воды, но и комплексный мониторинг экологического состояния водных объектов и прилегающих территорий. ГИС могут служить эффективным инструментом для территориально точной, оперативной и системной организации этого процесса.

Использованные источники:

1. Водный кодекс Республики Узбекистан.
2. Национальный комитет Республики Узбекистан по статистике. СИАТ — база статистических данных Республики Узбекистан.
3. Министерство водного хозяйства Республики Узбекистан. Официальные сведения о формировании базы геоданных по землям водного фонда.
4. Министерство водного хозяйства Республики Узбекистан. Сведения об эффективном использовании водных ресурсов и внедрении водосберегающих технологий.
5. Министерство водного хозяйства Республики Узбекистан. Сведения об эффективности водопользования в Зааминском районе Джизакской области.
6. Национальный комитет по экологии и изменению климата Республики Узбекистан. Сведения об экологическом состоянии Айдар-Арнасайской системы озёр.
7. ФАО. AQUASTAT: Глобальная информационная система по водным ресурсам и сельскому хозяйству.
8. ЮНЕСКО. Доклад Организации Объединённых Наций о состоянии водных ресурсов мира.
9. Esri. Документация ArcGIS: пространственный анализ (Spatial Analysis).
10. Esri. Документация ArcGIS: гидрология и инструменты геообработки (Hydrology and Geoprocessing Tools).

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АНАЛИЗ ЛОЯЛЬНОСТИ КЛИЕНТА ПРИ ПЕРЕХОДЕ ОТ ПЕРВОГО К ПОСТОЯННОМУ ПОКУПАТЕЛЮ

Аннотация: *В статье рассматриваются вопросы теории и практики на примере Республики Беларусь, связанные с действием механизмов социализации экономики и роли государства в данном процессе.*
Ключевые слова*: Беларусь, государство, экономика, социализация*

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THE EFFECT OF SOCIALIZATION MECHANISMS IN THE STATE ECONOMIC POLICY OF THE REPUBLIC OF BELARUS

Abstract*: The article examines the issues of theory and practice on the example of the Republic of Belarus related to the operation of mechanisms of socialization of the economy and the role of the state in this process.*
Keywords*: Belarus, state, economy, socialization*

Эффективное развитие экономики любой организации на современно этапе требует, как правило, внедрять в процесс управления концепцию маркетинга взаимодействия. Особенно это является актуальным для рынка услуг. Маркетинговая модель «Лестница приверженности (лояльности) клиента», основанная на модели поведения потребителя Бена Ханта и отражающая как потребитель постепенно переходит от первого знакомства с брендом к статусу его активного сторонника.[1]

Был проведен анализ приверженности клиентов для РУП «Белсоюзпечать» — крупнейшей национальной торговой сети

распространения прессы в Республике Беларусь. Слабой стороной деятельности данной организации является сокращение числа подписчиков на периодические издания. Оценивалась способность маркетинговых коммуникаций организации достигать целевой аудитории, привлекать внимание и формировать желаемое отношение к ее товарам и услугам. Интегральным показателем здесь выступал индекс сервисной направленности контента (ИСНК), рассчитываемый как доля контента, посвященного услуга, в общем объеме маркетинговых публикаций. На основе анализа 187 публикаций за IV квартал 2025 года получено следующее, что отражено в таблице 1.

Таблица 1 — Распределение контента по типам продвижения

Тип контента	Количество	Доля, %
Продвижение конкретных товаров	142	75,9
Продвижение услуг подписки	32	17,1
Продвижение иных услуг (консультации, платежи)	2	1,1
Информационный контент (график работы, адреса)	11	5,9
Итого	187	100

Примечание: Источник - собственная разработка Жоголевой Н.А. на основе данных предприятия

В нашем случае ИСНК= 18,2 % (17,1+1,1). Данное заключение свидетельствует о стратегическом диссонансе. Абсолютное большинство коммуникаций посвящено продвижению конкретных товаров, тогда как услуги, декларируемые предприятием как направление диверсификации и долгосрочного роста, получают менее пятой части коммуникационного внимания. Такой подход системно саботирует переход к сервисной модели и не позволяет сформировать у целевой аудитории понимание ценности услуг предприятия.

Для оценки способности контента вызвать эмоциональный или интеллектуальный отклик у аудитории рассчитан показатель вовлеченности (Engagement rate — ER) для сервисного контента в Instagram. На основе выборки из 25 постов получены следующие средние значения: охват поста- 3100 пользователей, количество лайков- 14, репостов- 2, комментариев- 1. Таким образом, ER= (14+2+1)/3100×100% = 0,55%.

Полученное значение составляет менее 20% отраслевого бенчмарка, что указывает на провал коммуникационной стратегии. Контент воспринимается аудиторией как рутинное объявление, не вызывающее желания взаимодействовать. Инвестиции в создание и размещение такого контента не имеют возврата. Низкий ER также свидетельствует о том, что коммуникации не учитывают интересы и потребности целевой аудитории, а контент–стратегия отсутствует как таковая.

Проведен анализ качества обслуживания и готовности клиентов рекомендовать предприятие. Индекс удовлетворенности клиентов (CSAT)

рассчитан на основе анализа 176 отзывов, размещенных на независимых интернет-площадках. Распределение отзывов по тональности отображено в таблице 2.

Таблица 2 — Распределение отзывов по тональности

Категория отзыва	Количество	Доля, %
Резко-негативные (1-2звезды, жалобы на грубость, ошибки)	68	38,6
Нейтрально-негативные (3 звезды, указание на недостатки)	52	29,5
Нейтральные (3-4 звезды, без эмоций)	27	15,3
Позитивные (4-5 звезд, похвала)	29	16,5
Итого	176	100

Примечание: Источник- собственная разработка Жоголевой Н.А. на основе данных предприятия

CSAT=29/176×100%=16,5%. Данное значение является катастрофически низким. Лишь каждый шестой клиент оставляет положительный отзыв о качестве обслуживания. Почти 40% отзывов являются резко негативными, что указывает на системные сбои в процессах обслуживания. Основные причины негативных отзывов, выявленные ходе анкетирования сорока клиентов, методом личного опроса, представлены в таблице 3.

Таблица 3– Оценка обслуживания персонала (5-балльная шкала)

Оценка	Доля респондентов, %	Основная причина
1 балл	2	Грубость, отказ в консультации
2 балла	3	Длительное ожидание, ошибки в оформлении
3 балла	20	Недостаточная компетентность, отсутствие нужных изданий
4 балла	65	Продавец читал информацию с буклета
5 баллов	10	Высокое качество консультации, скорость обслуживания

Примечание: Источник- собственная разработка Жоголевой Н.А. на основе данных опроса

Средняя оценка составила 4,0 балла. Основная причина выставления 65 % респондентов оценки «4», заключается в том, что продавец читал информации с буклета, что создавало впечатление недостаточного опыта и снижало доверие к консультации.

Рассчитаем чистый индекс лояльности (NPS) оценен на основе корреляции CSAT и коэффициента удержания клиентов. Коэффициент удержания, рассчитанный по данным подписок, составляет 72%. Исходные данные - общее количество клиентов, оформивших подписку в 2025 году, составляет 48000 человек, а продливших подписку в 2026 году- 34 560 человек. Коэффициент удержания = 34 560/48000×100% = 72%,

соответственно, ежегодный отток составлял 28%. Учитывая, что CSAT предприятия равен 16,5 %, коэффициент удержания — 72%, а также принимая данные анкетирования, где 65% респондентов оценили обслуживание на 4 балла из 5, можно сделать обоснованный вывод о том, что NPS ≈ 0. У предприятия нет базы лояльных клиентов, готовых рекомендовать его услуги. Нулевой NPS закрепляет зависимость от постоянных маркетинговых затрат на привлечение новых клиентов, которые с высокой вероятностью уйдут, так и не став лояльными. Низкий CSAT и нулевой NPS являются прямым следствием провалов в управлении тремя элементами комплекса маркетинга - персоналом, процессом и физическими свидетельствами.

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«РАЗРАБОТКА ИНТЕРНЕТ-МАГАЗИНА АВТОЗАПЧАСТЕЙ «АВТОДЕТАЛЬ»

Аннотация. *В статье рассматривается подход к проектированию интернет-магазина автозапчастей, ориентированного на удобный подбор товаров, управление каталогом, оформление заказов и защиту персональных данных. Обоснована необходимость разделения системы на клиентский интерфейс, серверную бизнес-логику, базу данных, административную панель и внешние интеграции. Предложен технологический стек на основе HTML5, CSS3, JavaScript, PHP, Laravel и MySQL. Рассмотрены основные сущности базы данных, функциональные модули, меры безопасности и методы тестирования. Результаты исследования могут быть использованы при разработке выпускной квалификационной работы или магистерской диссертации по созданию веб-приложения электронной торговли.*

Ключевые слова: *интернет-магазин, автозапчасти, веб-приложение, Laravel, MySQL, каталог товаров, информационная безопасность, персональные данные, электронная коммерция.*

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DEVELOPMENT OF THE ONLINE AUTO PARTS STORE "AVTO DETAL"

Annotation. The article examines an approach to designing an online auto parts store focused on convenient product selection, catalog management, order processing, and protection of personal data. The necessity of dividing the system into a client interface, server-side business logic, database, administrative panel, and external integrations is substantiated. A technology stack based on HTML5, CSS3, JavaScript, PHP, Laravel, and MySQL is proposed. The main database entities, functional modules, security measures, and testing methods are considered. The research results can be used in the development of a graduation thesis or master's dissertation on creating an e-commerce web application.

Keywords: online store, auto parts, web application, Laravel, MySQL, product catalog, information security, personal data, e-commerce.

Введение

Развитие электронной коммерции делает интернет-магазин одним из основных инструментов продаж для малого и среднего бизнеса. Для сферы автозапчастей веб-приложение особенно важно, поскольку покупателю требуется быстро найти нужную деталь, сравнить аналоги, уточнить наличие и оформить заказ без длительного общения с менеджером. При этом продавцу необходимо поддерживать актуальность каталога, обрабатывать заказы, вести остатки и контролировать статусы.

Цель исследования заключается в обосновании проектного подхода к разработке интернет-магазина автозапчастей «АвтоДеталь». Для достижения цели необходимо определить требования к системе, выбрать архитектуру, сформировать технологический стек, описать базу данных, меры безопасности и методы проверки качества.

Материалы и методы

Методической основой выбран итерационный подход к разработке программного обеспечения. Сначала создается базовая версия с каталогом, карточкой товара, корзиной и оформлением заказа, затем система расширяется административной панелью, отчетами, интеграциями и более точной фильтрацией. Для описания структуры применяются методы объектного и структурного проектирования: выделяются роли пользователей, сценарии использования, модули и сущности базы данных.

Для реализации предложен стек HTML5, CSS3 и JavaScript на клиентской стороне, PHP и Laravel на серверной стороне, а также MySQL как реляционная система управления базами данных. Такой выбор объясняется доступностью технологий, развитой документацией, поддержкой MVC-подхода, возможностью работы с миграциями, ролями, валидацией и стандартными средствами защиты веб-приложений.

Результаты

По результатам проектирования выделены функциональные модули: каталог товаров, поиск и фильтрация, карточка товара, корзина, оформление заказа, личный кабинет, административная панель, управление остатками, отчеты и безопасность. Клиентская часть ориентирована на быстрый подбор детали по названию, категории, производителю или артикулу. Административная часть предназначена для управления товарами, категориями, заказами и пользователями.

Для базы данных определены сущности users, roles, categories, products, manufacturers, product_images, car_models, product_compatibility, orders, order_items, stock_movements и audit_logs. Такая структура позволяет хранить не только товарные карточки и заказы, но и совместимость автозапчастей с моделями автомобилей, историю изменений остатков и действия администраторов.

С точки зрения безопасности предложены следующие меры: хеширование паролей, разграничение прав доступа, защита CSRF, серверная валидация, подготовленные запросы через ORM, ограничение загрузки

файлов, журналирование действий, резервное копирование и использование HTTPS. Указанные меры позволяют снизить риск типовых уязвимостей веб-приложений и обеспечить более корректную обработку персональных данных покупателей.

Обсуждение

Предложенный подход рассматривает интернет-магазин не как набор отдельных страниц, а как информационную систему с устойчивой архитектурой. Для учебного проекта это особенно важно: архитектурное обоснование, модель данных и план тестирования показывают практическую ценность разработки и не сводят результат только к визуальной демонстрации сайта.

Ограничением проекта является то, что учебная версия может не включать полноценную интеграцию с поставщиками, платежными шлюзами и онлайн-кассой. Однако архитектура должна предусматривать такую возможность, чтобы дальнейшее развитие системы не требовало полной переработки базы данных и бизнес-логики.

Заключение

В статье обоснован подход к разработке интернет-магазина автозапчастей «АвтоДеталь». Определены проблемы предметной области, предложены архитектура, технологический стек, структура базы данных, меры безопасности и методы тестирования. Результаты могут быть использованы при подготовке практической части магистерской диссертации и при создании прототипа веб-приложения электронной торговли.

Дальнейшая работа может быть связана с разработкой пользовательского интерфейса, реализацией административной панели, подключением внешних сервисов оплаты и доставки, а также расширением модели совместимости автозапчастей с автомобилями.

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ТРЕБОВАНИЯ К БУРОВЫМ РАСТВОРАМ ПРИ ЗАКАНЧИВАНИИ ГОРИЗОНТАЛЬНЫХ СКВАЖИН

Аннотация. *В статье рассматриваются требования к буровому раствору, его приготовлению, водопроницаемости, плотности, вязкости буровых растворов, статическим сдвиговым параметрам и добавляемым к ним смазочным материалам, а также определение параметров фильтрации.*

Ключевые слова: *горизонтальные скважины, буровой раствор, промывка скважин, седиментация, фильтрация, цементация, депрессия, тампонаж, аэрация, буферная жидкость, седиментация, освоение.*

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REQUIREMENTS TO DRILLING FLUID FOR COMPLETION OF HORIZONTAL WELLS

Annotation. *The article discusses the requirements for drilling fluid, its preparation, water permeability, density, viscosity of drilling fluids, static shear parameters and lubricants added to them, as well as the determination of filtration parameters.*

Keywords: *horizontal wells, drilling mud, well flushing, sedimentation, filtration, cementation, depression, plugging, aeration, spacer fluid, sedimentation, mastering.*

Методология

На основе статистических данных проанализированы буровые растворы, применяемые при бурении наклонных и горизонтальных скважин, недостатки и достижения в проведении процессов цементирования и упрочнения, а также требования к применяемым буферным растворам.

Введение

Особые требования предъявляются к растворам по бурению и тампонированию при заканчивании горизонтальных скважин. Большое внимание уделяется их приготовлению и химической обработке. Возникновение осложнений в сильно изогнутых или горизонтальных скважинах зависит от характера буровых смесей.

При реализации и завершении процесса спуска горизонтальных скважин используются сложные технологии.Качественная заканчивания горизонтальных скважин влияет на производительность технологического процесса. В такой новой технологии использование открытых, зацементированных, хвостовых, перфорированных трубчатых и фильтрующих конструкций при заканчивании горизонтального участка скважины основано на пластовых условиях. Если в процессе бурения используются буровые растворы низкого качества и поток отложений в стволе скважины недостаточно хорошо вымывается, это помешает установке компоновки низа скважины. Завершение коллекторных каналов продуктивного пласта в поврежденном состоянии отразится на показателе продуктивности. Поэтому к буровым растворам предъявляется ряд требований.

Результат. Интенсификация бурения горизонтальных скважин требует переработку буровых растворов при бурении скважин с большими отклонениями от вертикальных и горизонтальных скважин. Поэтому материалы для приготовления буровых растворов(бентонит,барит,гипан,УЩР,ТЩР,КМЦ,К-4,ФХЛС,палыгорскит и т.д) больше применяется при бурение в Узбекистане.

Сложности, возникающие при бурении сильно искривленных скважин, связаны с показателями качества буровых растворов. Плохая очистка ствола скважины, чрезмерный крутящий момент, движение бурильной колонны, осаждение отложений в стволе скважины, сжатие бурового инструмента, ухудшение прочности стенки скважины, потеря циркуляции, сужение ствола скважины, низкое качество цементирования, затруднение в каротажном стальном кабеле и других инструментах несовместимость состава буровых растворов.

Из опыта бурения горизонтальных скважин, а также в скважинах с быстро меняющимся направлением ствола и для решения основных проблем, которые возникают в любом типе скважин, необходимо проанализировать причины кривизны сильно искривленных скважин.При бурение используется буровые растворы этой компании на углеродной основе для качественной очистки и при осложнении(прихватов,сужение стволов и.т.д) сильно искривленных скважин большого диаметра.При бурении скважин буровые растворы готовятся на основе дизельного топлива и минеральных масел, а водонефтяное соотношение составляет от 50/50 до 10/90. Во всех случаях было обнаружено, что эффективность очистки ствола скважины увеличилась. Уменьшение количества осложнений в результате очистки отложений и их осаждения в сосудах увеличило стоимость бурения скважин и продолжительность рабочего процесса. Выбор оптимальных решений для сильно искривленных скважин также выбран в качестве выбранных решений для бурения существующих скважин. Учитываются наличие зоны, осложненной глинистыми сланцами в пробуренном слое, затраты на бурение, требования к естественной сушке и температура на забое скважины. Кроме

того, уделяется внимание высокой восприимчивости коллекторов, внешнему загрязнению, проблемам с питанием и так далее.

При бурении сильно искривленных скважин выбираются буровые растворы с сильными ингибирующими и смазывающими свойствами. Их использование всегда запрещено в ограниченных или экологически уязвимых регионах. Эффективность применения растворов на основе углерода относительно невысока, когда при определенных условиях используются растворы на водной основе с полимерными добавками.Одним из основных параметров бурового раствора является его плотность. Основная функция поддержания плотности бурового раствора через короткие промежутки времени - обеспечение прочности стенки скважины. Поддержание плотности буровых растворов очень эффективно для поддержания пластового давления и прочности стенки скважины, а также в случаях, когда вероятность гидравлического разрыва горных пород очень мала.

Разница в плотности бурового раствора, используемого для увеличения угла наклона ствола скважины в близких условиях, будет небольшой. Из практики известно, что вероятность эрозии стенки скважины увеличивается с увеличением глубины бурения скважины и увеличения угла наклона, тогда как гидроразрыв пласта уменьшается с увеличением угла наклона скважины.На качество очистки стенки скважин от отложений большое влияние оказывают вязкость смеси, прочность глины, режим промывки, движение жидкости в пространстве за трубой и ее плотность.

Во всех типах скважин качество удаления отложений увеличивается по мере увеличения плотности и расхода бурового раствора в заднем пространстве трубы. Но в сильно изогнутых скважинах важны вязкость, прочность глины и режим промывки. Очистку скважин от отложений можно разделить на три группы в зависимости от угла наклона, которые отличаются друг от друга:

1) от 0^0 до 45^0; 2) от 45^0 до 55^0 каждый; 3) с 55^0 до 90^0.

Другая причина заключается в том, что в сильно изогнутых скважинах существует ряд интервалов кривизны от горизонтального до вертикального, что затрудняет очистку отложений.Проблемы между первыми и третьими углами удара скважины носят серьезный характер. Накопление отложений в стволе скважины и кривизна от 45^0 до 55^0 смещается в условный диапазон, вызывая серьезные осложнения. В третьей группе ($50^0 \div 90^0$) диапазоне (по горизонтали), когда вязкость раствора мала и имеет высокую скорость циркуляции, турбулентный режим потока обеспечивает оптимальную очистку скважин от выбуренной породой.В скважинах, где угол наклона вала и вала небольшой, когда видимость движения раствора в заднем пространстве трубы ламинарная, граничное напряжение сдвига изменяется для увеличения уровня зазора вала.

При бурении интервалов второй группы ($45^0 \div 55^0$) измерения производятся с высокой точностью при малых значениях скорости вытеснения.Данные показывают, что в замкнутой циркуляционной системе

образование отложений на большом угловом склоне происходит легко и их трудно удалить.По сравнению с практикой бурения скважин, относящихся ко второму интервалу (угол наклона от 40^0 до 55^0), накопление отложений в скважине снижается при использовании армированных вязких и твердых глинистых растворов. Если в скважине нет осложнений, желательно снизить вязкость и увеличить расход раствора при бурения.Создание механически действующего турбулентного режима - единственный способ преодолеть осложнения в накопленных наносах в скважине.Определить оптимальные параметры режима промывки и свойства бурового раствора для скважин с быстрым изгибом и прямым участком на разных уклонах при укорачивании ствола при промывке очень сложно. Следовательно, необходимо будет найти некоторые усовершенствованные методы, учитывающие возможность возникновения вышеупомянутых осложнений.

Для контроля проницаемости необходимо определить проницаемость породы, величину перепада давления и минералогический состав пробуренной породы. Оптимальное управление подачей воды необходимо для предотвращения прихвата, обеспечения прочности стенки скважин и предотвращения тромба призабойной зоны скважин. Возникновение таких проблем очень опасно для сильно изогнутых скважин. В результате эффекта перепада давления гидродинамическое давление становится очень сложным, бурильная труба входит в контакт с большой поверхностной фильтрационной коркой. Из-за образования толстой,илистой корки шлама (выбуренная порода) начинается сужение ствола скважин и при этом происходит прихват бурильной колонны.Прихват бурильной колонны-это один из неприятных моментов в процессе бурении.Поэтому постоянно наблюдать за параметрами (вязкость,плотность,водоотдачи,СНС,фильтрация,образование песка и т.д) буровых растворов.

При бурении вертикальных скважин смесь должна иметь более высокую водопроницаемость, давление и температуру, чем при бурении наклонных скважин, при этом динамическая проницаемость должна точно контролироваться, а смесь должна поддерживаться на низком уровне проницаемости.Фильтрующая пленка должна быть тонкой, плотной и эластичной. Наличие качественной фильтрационной оболочки в стенке скважины увеличивает прочность градиента гидроразрыва пласта в проницаемых зонах. Целью бурения горизонтальных скважин является увеличение дебита нефти. Когда водопроницаемость регулируется при открытии низких коллекторских свойств, это приводит к меньшему загрязнению слоя, что приводит к меньшей степени ухудшения качества во время использования слоя. Ухудшение эксплуатационных качеств слоя происходит в результате химического и физического воздействия. Изгиб коллекторных каналов в таком слое снижает проницаемость продуктивного пласта. Коллекторы пласта отличаются друг от друга проницаемостью, после бурения проницаемости керна подбирается буровой раствор, не оказывающий негативного воздействия на пласт.

Необходимо усовершенствовать новые методы отделки горизонтальных скважин и разработать технологию предотвращения ухудшения качества эксплуатации пласта. При вскрытии продуктивного пласта в горизонтальной скважине используются перфорированные фильтры с трещинами по сравнению с обычными скважинами.В таких условиях важно удалить илистые корки со стенок скважины и уменьшить фильтраты, которые попадают в слой частиц твердофазной композиции.Твердые фазы в составе буровой смеси ухудшают проницаемость пласта, когда продуктивный пласт проникает в трещины.На участках с трещинами в коллекторах инфильтрация флюидов через ствол скважины также происходит при бурении горизонтальных скважин в депрессии.В этом случае перед началом бурения следует принять меры по предотвращению возникновения больших объемов флюидов и извержений.

Обычно герметизирующие добавки, препятствующие абсорбции, добавляют в раствор для нанесения раствора при бурении горизонтальных скважин. В каждом конкретном случае в раствор добавляются специальные добавки для управления водопроницаемостью. Состав осадка в растворе сведен к минимуму. Плотность бурового раствора не должна превышать значения, необходимого для предотвращения образования нефти, газа, воды и извержений.

В настоящее время для бурения горизонтальных скважин используются сплавы с добавкой крупнозернистых солей. Солевые растворы можно использовать, если на их месте уложены перфорированные трубы без перфорации при заканчивании скважин, а также при использовании растворов, совместимых с применяемыми в процессе бурения растворами для ускорения потока. Возможность регулировать смазочные свойства и водопроницаемость растворов, содержащих в основном крупнозернистые соли, для обеспечения реологических свойств и обратной проницаемости нефти, будет выбрана после исследования.По результатам, полученным в начале испытания скважины, в небольшой депрессии дебит скважины увеличивается.

В настоящее время при вскрытии продуктивного пласта широко используются смеси, приготовленные из смеси полимеров и обработанные из крупнозернистых солей, т.е. растворы плотностью 1,2 г / см3. Все добавки хорошо растворяются в воде и кислотном растворе, образуют тонкие и гладкие фильтрующие оболочки, быстро и полностью растворяются при воздействии воды или ненасыщенных смачивающих веществ.Для снижения гидростатического давления, улучшения реологических свойств и управления водопроницаемостью в раствор можно добавить 30% по объему дизельного топлива.Чтобы убедиться, что состав бурового раствора, который содержит крупнозернистую соль, совместим с пластом, в лаборатории проверяется обратная утечка путем отбора пробы из породы.

Крупнозернистый солевой буровой раствор добавляют при бурении скважин. Соли из мешка оседают на дно стенки скважины,осложняет

вращение долот и затрудняют бурение. Процесс подъема бурильной колонны из резко изогнутого участка ствола скважины выполняется очень осторожно перед закачкой в скважину части крупнозернистых солей.Полимеры, добавляемые в буровые растворы, сплавы, состоящие из крупнозернистой соли, очень чувствительны к загрязнению цементом. С помощью буферного раствора органической кислоты можно просверливать цементные пробки, входящие в состав растворов полимеров, очень точно контролируя уровень pH.Следует принимать меры для предотвращения аэрации буровых растворов при приготовлении крупнозернистых солевых буровых растворов.

С точки зрения качественного заканчивания скважин нефтяная смесь является идеальным буровым раствором, который не приводит к ухудшению качества использования продуктивного пласта и поддерживает естественную проницаемость призабойной зоны скважины в пласте. Однако это решение приводит к загрязнению окружающей среды, опасности возникновения пожара, затруднению удаления высоковязких эмульсий из отложений и усложняет выполнение электрометрических измерений (каротаж). Буровые растворы на углеродной основе более устойчивы к высоким температурам, чем растворы на водной основе.

Реологические свойства буровых растворов на углеродной основе, сконденсированных с органофильными растворами, могут ухудшить смесь, транспортируя отложения при бурении криволинейных скважин большого диаметра.Вязкость бурового раствора при низких скоростях сдвига (движения) и начальная прочность глины имеют большое значение для определения его несущей способности. Для обеспечения эффективного удаления отложений и увеличения структуры раствора важно контролировать значения вязкости вискозиметра рациона при незначительных частотах вращения.

Параметры буровых растворов на углеродной основе и растворов полимеров на водной основе аналогичны друг-другу и обладают свойством извлечения однородных отложений на забое скважины.Из-за сложности процесса бурения горизонтальных скважин к качественным показателям буровых растворов предъявляются высокие требования. Поскольку трещины в криволинейном участке скважины вызывают затруднения при гидравлической промывке отложений, появление отложений на дне стенки скважины отрицательно сказывается на осуществлении процесса циркуляции. В статье проанализированы статические данные и даны актуальные идеи о зависимости возникновения осложнений от состава бурового раствора и необходимости разработки оптимальных вариантов качественной отделки горизонтальных скважин при бурении нефтяных и газовых скважин.

Заключение. На основании вышеприведенного анализа можно сказать, что параметры бурового раствора имеют большое значение для качественного и высокопроизводительного бурения нефтяных и газовых скважин. Потому что состав бурового раствора играет важную роль в заканчивании нефтяных и газовых скважин после бурения. В результате достигается высокая

экономическая эффективность. Таким образом, соблюдение требований к буровым растворам при заканчивании горизонтальных скважин позволяет предотвратить осложнения, повысить коэффициент вскрытия продуктивного пласта и обеспечить долгосрочную и эффективную эксплуатацию скважины. Комплексный и научно обоснованный подход к выбору состава и свойств бурового раствора является одним из основных факторов успешного бурения и заканчивания горизонтальных скважин в сложных геолого-технических условиях.

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АВТОНОМНОЕ САМОВОССТАНОВЛЕНИЕ LLM-АГЕНТОВ ЧЕРЕЗ ТОПОЛОГИЧЕСКУЮ ФИЛЬТРАЦИЮ ГАЛЛЮЦИНАЦИЙ

Аннотация: *Фундаментальным ограничением применения больших языковых моделей (LLM) в высоконагруженных вычислительных и аналитических средах остается их неустранимая склонность к логическим галлюцинациям и феномен алгоритмической «слепоты к собственным ошибкам». В данной статье предлагается новая когнитивная архитектура полностью автономного восстановления, исключающая оператора-человека из контура корректировки. Методологической основой выступает интеграция строгой иерархии специализированных ИИ-агентов, где стохастическая генерация гипотез жестко контролируется детерминированными механизмами проверки. Представлен инновационный механизм перехвата искажений, базирующийся на трансляции свободных рассуждений модели в абстрактные синтаксические деревья (AST) с их последующей топологической фильтрацией в изолированной программной песочнице. Предложенная архитектура обеспечивает смысловую и фактологическую достоверность, критически необходимую для адаптивного обучения, глубокого морфологического анализа и интеграции ИИ в гуманитарные и филологические дисциплины.*

Ключевые слова: *Большие языковые модели (LLM), мультиагентные системы, топологическая фильтрация, абстрактные синтаксические деревья (AST), автономная корректировка (self-healing), галлюцинации нейросетей, детерминированная валидация, когнитивные архитектуры.*

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AUTONOMOUS SELF-HEALING OF LLM AGENTS THROUGH TOPOLOGICAL FILTERING OF HALLUCINATIONS

Abstract: *A fundamental limitation of applying Large Language Models (LLMs) in high-load computational and analytical environments remains their inherent tendency toward logical hallucinations and the phenomenon of algorithmic "blindness to their own errors." This paper proposes a novel cognitive architecture*

for fully autonomous recovery, eliminating the human operator from the correction loop. The methodological foundation lies in the integration of a strict hierarchy of specialized AI agents, where the stochastic generation of hypotheses is tightly controlled by deterministic verification mechanisms. An innovative distortion interception mechanism is presented, based on translating the model's free-form reasoning into Abstract Syntax Trees (ASTs) with their subsequent topological filtering within an isolated software sandbox. The proposed architecture ensures the semantic and factual accuracy critically required for adaptive learning, deep morphological analysis, and the integration of AI into the humanities and philological disciplines.

***Keywords**: Large Language Models (LLMs), multi-agent systems, topological filtering, Abstract Syntax Trees (AST), autonomous self-healing, neural network hallucinations, deterministic validation, cognitive architectures.*

Введение

Стремительное развитие больших языковых моделей (LLM) открыло новые горизонты в области искусственного интеллекта, продемонстрировав выдающиеся способности к генерации текста, анализу данных и решению сложных когнитивных задач. Однако по мере интеграции этих моделей в критически важные процессы исследователи столкнулись с фундаментальным ограничением, заложенным в самой стохастической природе трансформерных архитектур - неустранимой склонностью к смысловым и логическим галлюцинациям. Генерируя синтаксически безупречные, но фактически или алгоритмически неверные конструкции, базовые модели демонстрируют выраженный феномен «слепоты к собственным ошибкам». В условиях, когда нейросеть не способна самостоятельно отличить достоверный факт от статистически правдоподобного вымысла, применение монолитных LLM в сложных аналитических и вычислительных средах становится источником непредсказуемых рисков.

Ответом на этот методологический вызов становится отказ от монолитных структур в пользу интеграции мультиагентных систем, где когнитивная нагрузка распределяется внутри организованной иерархии специализированных LLM [1]. Вместо попыток обучить одну универсальную и безошибочную модель, передовой подход предполагает оркестрацию ансамбля агентов, разделяющих между собой функции генерации, валидации и критики. В такой экосистеме стохастическая свобода «творческого» агента, необходимая для генерации гипотез, жестко уравновешивается детерминированными механизмами проверяющих алгоритмов. Подобное разделение ролей позволяет выстроить замкнутый цикл внутреннего контроля, где система самостоятельно фиксирует противоречие, анализирует причину сбоя и инициирует протокол алгоритмического восстановления.

Именно процесс разработки и математического обоснования такого автономного контура корректировки составляет ядро данного исследования.

В основе предлагаемой концепции лежит использование строгих методов парсинга - в частности, трансляции рассуждений агента в абстрактные синтаксические деревья (AST) - для автоматической топологической фильтрации ошибок в изолированной среде. Когда агент-валидатор обнаруживает логический разрыв или выдуманный факт, он автоматически формирует trace-лог ошибки и передает его агенту-критику. Последний синтезирует корректирующий вектор, который принудительно возвращает генератора в рамки объективной логики. Модель, столкнувшись с непреодолимым программным ограничением собственной песочницы, динамически перестраивает контекст и «выздоравливает» от галлюцинации, переписывая исключительно сбойный участок рассуждений.

Целью работы является обзор современных подходов к автономной коррекции и верификации рассуждений больших языковых моделей и формирование на этой основе концептуальной архитектуры, объединяющей генерацию, структурную верификацию и локальное восстановление. Реализация такого подхода не только радикально повышает фактологическую точность предикта следующего шага, но и открывает путь к созданию саморегулирующихся, оптимизированных ИИ-систем, способных к непрерывному автономному функционированию в условиях высокой неопределенности.

Обзор литературы

Формирование теоретической базы для решения проблемы логических искажений опирается на фундаментальные этапы развития когнитивных архитектур, задокументированные в ведущих академических трудах последних лет. Ранние попытки минимизировать галлюцинации базировались на алгоритмах обучения с подкреплением на основе отзывов людей, что было детально описано в основополагающей работе Ouyang et al. (2022) при создании семейства моделей InstructGPT [1]. Хотя этот метод позволил нейросетям лучше улавливать контекст пользовательских инструкций, исследователи быстро признали его ограниченность при масштабировании на сложные аналитические задачи. В ответ на это научное сообщество предложило заставить модель разбивать задачу на промежуточные этапы: в исследовании Wei et al. (2022) была формализована концепция «цепочек рассуждений» (Chain-of-Thought) [2]. Это значительно улучшило качество ответов, однако не решило проблему каскадных вымыслов: если модель допускала ошибку на первом шаге, вся последующая цепочка неизбежно приводила к ложному, но грамматически убедительному результату.

Стремясь автоматизировать процесс проверки без участия человека, следующие поколения исследователей сфокусировались на методах внутреннего самосовершенствования. В работах Shinn et al. (2023), предложивших архитектуру вербального подкрепления Reflexion [3], и в исследовании Madaan et al. (2023), описавшем алгоритм итеративного самосовершенствования Self-Refine [4], предполагалось, что генеративная сеть способна выступать собственным критиком, переписывая свои ответы на

основе системных инструкций. Однако масштабное критическое исследование Huang et al. (2023), показательно озаглавленное «Большие языковые модели пока не способны самостоятельно корректировать рассуждения», обсуждение опровергло эту гипотезу. На основании анализа существующих подходов предлагается концептуальная модель, утверждающая что монолитные архитектуры подвержены системной слепоте к собственным ошибкам: оценивая свой текст, модель использует те же искаженные вероятностные веса, что и при его генерации. В результате рефлексия вырождается в цикличную конфабуляцию [5].

Выявленные алгоритмические тупики стимулировали переход к многоагентным парадигмам, вдохновленным теориями распределенного когнитивного труда. Знаковым прорывом стали эксперименты Park et al. (2023), где автономные генеративные агенты, наделенные модулями памяти и планирования, взаимодействовали в виртуальной среде, демонстрируя сложное эмерджентное поведение [6]. Развивая идею функционального разделения, Du et al. (2023) исследовали системы многоагентных дебатов, в которых агенты с разными системными установками критиковали ответы друг друга [7]. Эта ролевая изоляция снизила процент смысловых ошибок, так как критикующий алгоритм не был скован первичным контекстом создателя. Тем не менее, актуальный анализ показывает, что подобные системы все еще полагаются на вероятностные текстовые взаимодействия. В сложных задачах агенты периодически впадают в состояние «коллективной галлюцинации», плавно убеждая друг друга в достоверности ошибочного решения через стохастический диалог.

Анализ современной литературы выявляет существенный пробел на стыке нейросетевой генерации и строгих детерминированных проверок, применяемых в классической программной инженерии. Важным шагом в этом направлении стала работа Gao et al. (2023) о программно-ассистируемых моделях (Program-Aided Language Models), где нейросети впервые начали делегировать логические вычисления интерпретаторам кода [8]. Однако перенос принципов непрерывной интеграции и автоматизированного восстановления логики в когнитивную плоскость искусственного интеллекта остается малоизученным.

Методология

Архитектурный фундамент предлагаемой методологии строится на адаптации принципов непрерывной интеграции и автоматического восстановления пайплайнов, традиционно применяемых в программной инженерии, к когнитивным процессам нейросетевых систем [4]. Центральная гипотеза исследования заключается в том, что стохастическая природа больших языковых моделей может быть эффективно стабилизирована путем внедрения строгой функциональной иерархии вычислительных агентов. В рамках разрабатываемого фреймворка когнитивная задача не передается единому монолитному алгоритму, а маршрутизируется через трехуровневую систему, состоящую из агента-генератора, детерминированного валидатора и

агента-критика. Подобная ролевая изоляция гарантирует отсутствие конфликта интересов: модель, выдвигающая первоначальную гипотезу, лишается возможности самостоятельно подтверждать ее истинность, уступая эту функцию математически строгим алгоритмам проверки (Рисунок 1.).

Ключевым механизмом перехвата и локализации логических искажений выступает алгоритм топологической фильтрации, базирующийся на трансляции естественного языка в структурированные вычислительные графы. На первом этапе агент-генератор, работающий с высокой степенью параметрической свободы, формирует первичное текстовое решение задачи. Инновационность подхода заключается в том, что этот вывод не принимается как финальный результат, а подвергается глубокому семантическому парсингу, в ходе которого свободные рассуждения преобразуются в абстрактное синтаксическое дерево. Эта процедура позволяет разложить расплывчатую языковую семантику на четкие алгоритмические узлы: логические операторы, декларируемые факты, переменные и хронологические зависимости. Переход от неструктурированного текста к графовой топологии создает математически измеримую среду, где каждый шаг рассуждения предстает в виде отдельного функционального блока, поддающегося строгой алгоритмической оценке.

Формальная математическая модель топологической фильтрации

Процесс автономной корректировки моделируется как дискретный оптимизационный процесс в пространстве синтаксических деревьев.

Определение 1. Трансляция семантики в топологию графа

Пусть $R_i \in \Sigma^*$ - сгенерированный агентом-генератором текст на итерации i. Определим функцию семантического парсинга f_{parse}, которая преобразует неструктурированный текст в направленный ациклический граф. AST - **это дерево**, а дерево является частным случаем DAG

$$G_i(V, E) = f_{parse}(R_i)$$

где $V = \{v_1, v_2, \dots, v_n\}$ - множество узлов, представляющих элементарные утверждения, переменные или логические операторы, а

$E \subseteq V \times V$ - множество ребер, задающих причинно-следственные связи.

Определение 2. Детерминированная валидация в изолированной среде

Вводится индикаторная функция $\Phi: V \to \{0, 1\}$, выполняемая внутри программной песочницы. Данная функция действует как строгий фильтр топологии:

$$\Phi(v_k) = \begin{cases} 1, & \text{если } v_k \text{ валиден (не противоречит объективной базе знаний)} \\ 2, & \text{если } v_k \text{ является смысловой галлюцинацией или логическим сбоем} \end{cases}$$

Состояние всего графа рассуждений G_i считается валидным тогда и только тогда, когда истинны все его узлы:

$$\Phi(G_i) = \prod_{k=1}^{|V|} \Phi(v_k)$$

Определение 3. Вектор ошибки и рефлексивная обратная связь

Если $\exists v_k \in V: \Phi(v_k) = 0$, среда прерывает обход графа и генерирует лог ошибки $e_k = \{v_k, traceback\}$. Агент-критик применяет функцию трансформации $g_{critic}(e_k)$ для синтеза корректирующего вектора ΔC_i. Следующее когнитивное состояние генератора определяется через функцию обновления контекста:

$$R_{i+1} = LLM_{gen}(Q \oplus C_0 \oplus \Delta C_i)$$

где Q - исходная задача, а $\oplus$ - оператор конкатенации контекста.

Гипотеза о сходимости контура автономного восстановления

При условии использования изолированного детерминированного валидатора Φ *и наличии жесткого лимита итераций* I_{max}*, процесс топологической фильтрации AST строго предотвращает распространение каскадных галлюцинаций, гарантированно сходясь либо к валидному графу* $\Phi(G_m) = 1$ *за* $m \leq I_{max}$ *шагов, либо переходя в безопасное состояние вычислительного тупика.*

Доказательство:

1. Рассмотрим стандартную монолитную языковую модель (baseline). Ее процесс саморефлексии описывается марковской цепью, где вероятность перехода в состояние генерации следующего ложного факта зависит от предыдущего ложного факта: $P\left(R_{i+1}^{hallucination} \mid R_i^{hallucination}\right) > \delta$. Так как модель использует одни и те же веса для генерации и проверки, $\delta \longrightarrow 1$, что формирует замкнутый цикл конфабуляций (эхо-камеру) [5].

2. В предложенной архитектуре вводится внешний детерминированный разрыв. Если на шаге i генерируется граф G_i с ложным узлом v_k, песочница фиксирует $\Phi(v_k) = 0$.

3. Вектор обратной связи ΔC_i действует как жесткое ограничение в латентном пространстве генератора, пенализируя вероятность повторного создания узла v_k. Следовательно, вероятность генерации идентичной топологической ошибки на следующем шаге стремится к нулю: $P\left(f_{parse}^{-1}(v_k) \mid Q \oplus \Delta C_i\right) < \epsilon$, где ϵ - пренебрежимо малая величина.

4. Поскольку размерность пространства возможных логических шагов для конкретной задачи ограничена, а обратная связь монотонно сужает множество допустимых вариантов, последовательность графов $\{G_0, G_1, \dots\}$ направленно эволюционирует.

5. Наличие внешнего прерывателя I_{max} гарантирует конечность процесса. Таким образом, цепочка рассуждений либо достигает состояния $\Phi(G_m) = 1$, либо принудительно обрывается. Бесконечная генерация каскадных галлюцинаций становится математически невозможной.

Алгоритм 1. Теоретическая модель автономного самовосстановления Вход: Q (задача), I_{max} (лимит итераций). **Выход:** Валидированный ответ R_{final} или сигнал $Deadlock$.

1: Установить $i = 0, C_0 = Q$
2: Пока $i < I_{max}$:
3: Сгенерировать гипотезу R_i агентом-генератором на основе C_i
4: Сформировать граф $G_i(V, E) = f_{parse}(R_i)$
5: Для каждого узла $v_k \in V$:
6: Если $\Phi(v_k) == 0$:
7: Сформировать лог ошибки e_k и прервать обход графа
8: Если лог ошибки пуст, вернуть R_i
9: Иначе:
10: Синтезировать вектор ΔC_i агентом-критиком из e_k
11: Обновить контекст генератора $C_{i+1} = C_i \oplus \Delta C_i$
12: $i = i + 1$
13: Вернуть $Deadlock$ (предотвращение зацикливания)

ВХОД: КОГНИТИВНАЯ ЗАДАЧА
Q – постановка задачи, условия, контекст
1. АГЕНТ-ГЕНЕРАТОР
Стохастическая генерация первичного решения
• Высокая параметрическая свобода
• Формирование гипотезы и рассуждений
Выход: текстовое решение S_0
2. СЕМАНТИЧЕСКИЙ ПАРСЕР
Глубокий семантический анализ естественного языка
• Выделение сущностей, фактов, отношений
• Преобразование рассуждений в структурированное представление
Выход: семантический граф G_0
3. ПОСТРОЕНИЕ АБСТРАКТНОГО СИНТАКСИЧЕСКОГО ДЕРЕВА (AST)
Трансляция семантического графа в абстрактное синтаксическое дерево (вычислительный граф рассуждений)
• Узлы: факты, операторы, переменные
• Рёбра: логические и причинно-следственные связи
Выход: AST / топологический граф A_0
4. ДЕТЕРМИНИРОВАННЫЙ АГЕНТ-ВАЛИДАТОР
Детерминированная проверка топологии решения
• Проверка фактов с базами данных и источниками знаний
• Проверка логических правил и математических законов
• Проверка причинно-следственных связей и условий задачи
ПРОВЕРЯЕМЫЕ АСПЕКТЫ
Существование объектов и фактов
Логическая непротиворечивость
Причинно-следственные зависимости
Математическая корректность
Соответствие условиям задачи
РЕЗУЛЬТАТ ПРОВЕРКИ
ОШИБОК НЕ ОБНАРУЖЕНО
Решение верифицировано
ОШИБКИ ОБНАРУЖЕНЫ
Формируется отчёт об ошибке E
ФИНАЛЬНОЕ РЕШЕНИЕ
Верифицированное решение S^*
Реконструкция ответа из AST
5. АГЕНТ-КРИТИК
Анализ отчёта об ошибке
• Определение причины сбоя
• Локализация ошибочного узла
• Формирование корректирующего вектора (Δ)
6. ЛОКАЛЬНОЕ ВОССТАНОВЛЕНИЕ
Локальная модификация AST
• Изменяется только ошибочный фрагмент
• Сохранение корректной части рассуждений
• Интеграция корректирующего вектора Δ
ОБНОВЛЁННЫЙ AST
A_{i+1} – новая версия структуры рассуждений
ВСПОМОГАТЕЛЬНЫЕ ИСТОЧНИКИ И ОГРАНИЧЕНИЯ
Базы данных и знания
Математические законы
Логические правила
Условия задачи и ограничения
ПОВТОРНЫЙ ЦИКЛ
до полной верификации

Рис. 1. Архитектура автономного контура корректировки с использованием AST-парсинга

Обсуждения и результаты

Для будущей эмпирической валидации предложенной концептуальной архитектуры предлагается использовать стандартизированные выборки логических задач (например, датасеты уровня HotpotQA). В качестве экспериментального протокола целесообразно использовать связку открытых LLM (например, семейства Llama) в роли агента-генератора и детерминированных песочниц (таких как изолированные Python-контейнеры с модулем AST) в роли валидатора.

Для объективной оценки эффективности предложенного контура по сравнению с традиционными методами (Zero-Shot генерацией и текстовой саморефлексией) предлагается ввести следующие метрики:

- Autonomous Recovery Rate (ARR): доля галлюцинаций, успешно исправленных системой без вмешательства оператора.
- Topological Exact Match (TEM): показатель структурной целостности финального графа рассуждений.
- Average Iterations: среднее количество циклов, необходимых агентам для достижения консенсуса и выхода из цикла ошибок.

Теоретический анализ показывает, что переход к AST-фильтрации должен продемонстрировать фундаментальное превосходство над монолитными моделями. Ожидается, что базовая нейросеть (Zero-Shot), лишенная среды проверки, будет показывать высокий процент каскадных ошибок, где первичная неточность разрушает всю цепочку рассуждений [6]. Метод текстовой саморефлексии (Textual Self-Refine) способен лишь незначительно улучшить ситуацию из-за системной слепоты модели к собственным ошибкам [8].

В свою очередь, внедрение детерминированного валидатора и механизма трансляции текста в синтаксические деревья должно свести вероятность каскадных галлюцинаций к минимуму. Теоретическая модель предполагает, что локализация исправлений на уровне конкретных блоков графа, а не всего текстового массива, обеспечит беспрецедентную вычислительную эффективность. Системе не потребуется перегенерировать весь объем рассуждений с нуля, что радикально сократит количество итераций, необходимых для достижения окончательной топологической точности.

Дальнейшее развитие методологии автономной корректировки и топологического парсинга открывает широкие перспективы для внедрения подобных саморегулирующихся систем в прикладные высоконагруженные среды. Подобная адаптивная архитектура критически востребована при развертывании инфраструктуры современных лабораторий искусственного интеллекта и проектировании интеллектуальных образовательных платформ. Способность нейросети безошибочно прогнозировать индивидуальные когнитивные траектории и адаптировать учебные сценарии под конкретного

пользователя, полностью исключая риск предоставления искаженных фактов, знаменует переход от экспериментальных диалоговых интерфейсов к надежным автономным когнитивным агентам, способным безопасно функционировать в академической и исследовательской практике.

Заключение

Обзор современных подходов показывает, что преодоление смысловых галлюцинаций LLM невозможно в рамках монолитных вероятностных архитектур. Решением этой проблемы выступает концептуальная модель делегирования когнитивной нагрузки иерархии специализированных агентов. Ожидается, что строгая функциональная субординация процессов генерации, валидации и критики позволит системе автономно распознавать и устранять фактологические искажения без участия человека.

Ключевым механизмом предложенного архитектурного контура является трансляция свободных рассуждений в абстрактные синтаксические деревья (AST). Перевод процесса верификации из плоскости словесных многоагентных дебатов в плоскость детерминированной алгоритмической фильтрации внутри изолированной песочницы создает механизм возвращения нейросети в рамки объективной логики. Локальное исправление исключительно сбойных узлов графа направлено на купирование эффекта каскадных галлюцинаций и обеспечение высокой вычислительной эффективности при оптимизации моделей.

Таким образом, концептуальный переход от вероятностной словесной рефлексии к топологической фильтрации рассуждений знаменует важный эволюционный шаг в развитии когнитивных архитектур. Представленная модель утверждает жизнеспособность полностью автономных и самооптимизирующихся мультиагентных систем, закладывая теоретическую основу для безопасного функционирования ИИ в условиях высокой алгоритмической неопределенности.

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СОВРЕМЕННЫЕ АСПЕКТЫ ДИАГНОСТИКИ ОСТЕОПОРОЗА У ЖЕНЩИН С САХАРНЫМ ДИАБЕТОМ 2 ТИПА

Аннотация. *Сахарный диабет 2 типа (СД2) относится к числу самостоятельных факторов риска низкоэнергетических переломов, при этом минеральная плотность кости (МПК), измеренная стандартной двухэнергетической рентгеновской абсорбциометрией (DXA), у таких пациенток часто остаётся нормальной или повышенной, что создаёт диагностический парадокс и затрудняет своевременное выявление костной хрупкости. В обзоре систематизированы современные подходы к диагностике остеопороза при СД2: ограничения стандартной денситометрии, роль трабекулярного костного индекса (TBS), необходимость коррекции алгоритма FRAX, возможности количественной компьютерной томографии высокого разрешения (HR-pQCT) и биохимических маркеров костного метаболизма. Показано, что изолированное применение Т-критерия DXA недооценивает риск переломов у женщин с СД2, тогда как комбинированная оценка (DXA+TBS+FRAX с поправкой+клинические факторы риска) повышает точность диагностики и обосновывает необходимость мультидисциплинарного подхода к ведению данной категории пациенток.*

Ключевые слова: *сахарный диабет 2 типа, остеопороз, минеральная плотность кости, трабекулярный костный индекс (TBS), FRAX, маркеры костного ремоделирования, HR-pQCT, диагностика.*

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MODERN ASPECTS OF OSTEOPOROSIS DIAGNOSIS IN WOMEN WITH TYPE 2 DIABETES MELLITUS

Abstract. *Type 2 diabetes mellitus (T2DM) is an independent risk factor for low-energy fractures, yet bone mineral density (BMD) measured by standard dual-energy X-ray absorptiometry (DXA) in these patients is often normal or even increased, creating a diagnostic paradox that hinders timely recognition of bone fragility. This review summarises current approaches to diagnosing osteoporosis in T2DM: the limitations of standard densitometry, the role of the trabecular bone score (TBS), the need to adjust the FRAX algorithm, the contribution of high-resolution peripheral quantitative computed tomography (HR-pQCT), and bone turnover biomarkers. Evidence shows that DXA T-score alone underestimates fracture risk in women with T2DM, whereas a combined assessment (DXA+TBS+adjusted FRAX+clinical risk factors) improves diagnostic accuracy and supports a multidisciplinary approach to managing this patient group.*

Key words: *type 2 diabetes mellitus, osteoporosis, bone mineral density, trabecular bone score (TBS), FRAX, bone turnover markers, HR-pQCT, diagnosis.*

Актуальность.

По данным 11-го издания Диабетического атласа Международной диабетической федерации (IDF), в 2024 г. в мире сахарным диабетом страдали 589 млн взрослых в возрасте 20–79 лет, а к 2050 г. этот показатель прогнозируется на уровне 853 млн человек; при этом на долю сахарного диабета 2 типа (СД2) приходится подавляющее большинство случаев заболевания [1]. Параллельно с ростом заболеваемости СД2 накапливаются данные о том, что у женщин с этой патологией, особенно в постменопаузе, существенно повышен риск низкоэнергетических переломов, прежде всего переломов бедра, притом что минеральная плотность кости (МПК), измеренная методом двухэнергетической рентгеновской абсорбциометрии (DXA), у них часто остаётся нормальной или даже превышает возрастную норму [4, 5]. Это несоответствие между относительно сохранной МПК и

повышенным риском переломов получило название «диабетического костного парадокса» и обусловливает необходимость пересмотра традиционных диагностических алгоритмов остеопороза применительно к пациенткам с СД2.

Патогенетические особенности костной хрупкости при СД2.

Снижение прочности кости при СД2 связано не столько со снижением её минерализации, сколько с ухудшением качества костного матрикса. Хроническая гипергликемия сопровождается накоплением конечных продуктов гликирования (AGEs) в коллагене I типа, что снижает эластичность костной ткани и повышает её хрупкость независимо от уровня МПК [3]. Для СД2 характерен низкообменный (low-turnover) тип костного метаболизма со сниженной остеобластической активностью, что подтверждается более низкими, чем в общей популяции, уровнями маркеров костного формирования [7]. Дополнительный вклад вносят повышение уровня склеростина, изменения адипокинового профиля, микрососудистые осложнения диабета (диабетическая ретинопатия и периферическая нейропатия, повышающие риск падений), а также приём отдельных сахароснижающих препаратов: тиазолидиндионы достоверно увеличивают риск переломов, тогда как данные по ингибиторам SGLT2 неоднозначны, а метформин и инсулинотерапия в целом не оказывают выраженного негативного влияния на кость [2, 3].

Методы диагностики

1. Двухэнергетическая рентгеновская абсорбциометрия (DXA). DXA остаётся основным методом количественной оценки МПК и постановки диагноза остеопороза по критериям ВОЗ (Т-критерий ≤ –2,5 SD). Однако у женщин с СД2 чувствительность метода снижена: по данным метаанализа P. Vestergaard, при сопоставимых показателях МПК риск переломов бедра у пациентов с СД2 повышен приблизительно в 1,3–2,8 раза по сравнению с лицами без диабета [5], а в исследовании A. Schwartz и соавт. женщины с СД2 имели более высокий риск переломов при том же Т-критерии и том же расчётном балле FRAX, что и женщины без диабета [4]. Таким образом, DXA у таких пациенток целесообразно рассматривать не как самостоятельный, а как отправной диагностический инструмент, требующий дополнения другими методами.

2. Трабекулярный костный индекс (TBS). TBS — это показатель, рассчитываемый по тем же изображениям поясничного отдела позвоночника, полученным при DXA, и косвенно отражающий качество трабекулярной микроархитектуры кости независимо от абсолютных значений МПК. В исследовании W. Leslie и соавт. (Manitoba Bone Density Program) показано, что у пациентов с СД2 значения TBS достоверно ниже, чем у лиц без диабета, и снижение TBS ассоциировано с повышенным риском переломов даже при нормальной МПК [6]. Международное общество клинической денситометрии (ISCD) и Международный фонд остеопороза (IOF) рекомендуют использовать TBS-скорректированный показатель FRAX у пациентов с СД2 как способ

частично компенсировать недооценку риска переломов при стандартном подходе.

3. Алгоритм FRAX и его модификация. Стандартный калькулятор FRAX, не учитывающий диабет как отдельный фактор риска, систематически недооценивает 10-летнюю вероятность переломов у женщин с СД2 [4]. В позиционном документе IOF-ASBMR-ECTS (S. Ferrari и соавт., 2018) рекомендовано при расчёте FRAX у пациентов с СД2 использовать поправку через включение ревматоидного артрита в качестве суррогатного фактора риска либо применять TBS-скорректированный FRAX, что повышает точность стратификации риска переломов [2].

4. Количественная компьютерная томография высокого разрешения (HR-pQCT). HR-pQCT позволяет прямо оценивать кортикальную и трабекулярную микроархитектуру на периферических участках скелета (лучевая и большеберцовая кости). По данным метаанализа M. Walle и соавт., у пациентов с СД2 выявляется повышение кортикальной пористости и изменения трабекулярной структуры, не улавливаемые стандартной DXA, что делает HR-pQCT перспективным, хотя пока преимущественно исследовательским, инструментом углублённой диагностики костной хрупкости при диабете [8].

5. Биохимические маркеры костного метаболизма. Согласно совместному аналитическому обзору IOF и ECTS (C. Meier и соавт., 2023), у пациентов с СД2 уровни маркеров костного формирования (P1NP, остеокальцин) и резорбции (CTX) в большинстве случаев снижены по сравнению с лицами без диабета, что отражает низкообменный тип костного метаболизма и ограничивает диагностическую ценность этих маркеров в их стандартной интерпретации; более информативным считается динамическое наблюдение показателей у конкретного пациента, а не разовое сравнение с популяционной нормой [7]. Дополнительно в диагностический план целесообразно включать определение уровня 25(OH)D, паратгормона, кальция и фосфора для исключения вторичных причин остеопороза, а также оценку гликированного гемоглобина (HbA1c), поскольку хроническая гипергликемия коррелирует со степенью снижения качества кости [3].

Клинические факторы, дополняющие инструментальную диагностику.

При обследовании женщин с СД2 рекомендуется учитывать длительность заболевания более 10 лет, недостаточный гликемический контроль, инсулинотерапию, наличие микрососудистых осложнений (ретинопатия, нейропатия), анамнез падений и приём тиазолидиндионов — эти факторы существенно повышают вероятность перелома независимо от значений МПК и должны включаться в комплексную оценку риска [2, 3].

Заключение.

Диагностика остеопороза у женщин с СД2 не может ограничиваться изолированной интерпретацией Т-критерия DXA, поскольку эта категория пациенток характеризуется несоответствием между относительно сохранной

МПК и повышенным риском переломов. Оптимальным представляется комбинированный подход, включающий стандартную денситометрию, расчёт трабекулярного костного индекса (TBS), скорректированную оценку по алгоритму FRAX, при доступности — HR-pQCT, а также анализ биохимических маркеров костного метаболизма и клинических факторов риска, специфичных для диабета. Внедрение такого алгоритма в рутинную практику эндокринологов, ревматологов и врачей лучевой диагностики позволит своевременно выявлять женщин с СД2, угрожаемых по низкоэнергетическим переломам, и обоснованно назначать профилактическую и антиостеопоротическую терапию.

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ДИАСТОЛИЧЕСКАЯ СЕРДЕЧНАЯ НЕДОСТАТОЧНОСТЬ ПРИ САХАРНОМ ДИАБЕТЕ 2 ТИПА И АРТЕРИАЛЬНОЙ ГИПЕРТЕНЗИИ

Аннотация. *Сочетание сахарного диабета 2 типа и артериальной гипертензии повышает риск сердечной недостаточности с сохранённой фракцией выброса (HFpEF). Цель исследования — оценить клинико-гемодинамические, эхокардиографические и биомаркерные особенности HFpEF у данной категории больных. Обследованы 135 пациентов с СД 2 типа, АГ и HFpEF и 100 здоровых лиц. Проведены эхокардиография, суточное мониторирование АД и определение NT-proBNP, Галектина-3 и метаболических показателей. Выявлены увеличение LAVI и E/e', ремоделирование ЛЖ, нарушение циркадного профиля АД и повышение NT-proBNP и Галектина-3. Наиболее выраженная связь Галектина-3 отмечена с NT-proBNP, E/e', индексом массы миокарда ЛЖ и HbA1c. Полученные результаты подтверждают целесообразность мультимодальной оценки HFpEF.*

Ключевые слова: *сердечная недостаточность, сахарный диабет 2 типа, артериальная гипертензия, HFpEF, Галектин-3, NT-proBNP, диастолическая дисфункция.*

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DIASTOLIC HEART FAILURE IN PATIENTS WITH TYPE 2 DIABETES MELLITUS AND ARTERIAL HYPERTENSION

Abstract*. The combination of type 2 diabetes mellitus and arterial hypertension increases the risk of heart failure with preserved ejection fraction (HFpEF). The aim was to assess clinical, hemodynamic, echocardiographic, and biomarker features of HFpEF in these patients. The study included 135 patients with type 2 diabetes, hypertension, and HFpEF, and 100 healthy controls. Echocardiography, ambulatory blood pressure monitoring, and laboratory assessment of NT-proBNP, galectin-3, and metabolic parameters were performed. Increased LAVI and E/e', left ventricular remodeling, impaired circadian blood pressure profile, and elevated NT-proBNP and galectin-3 were observed. Galectin-3 showed strong associations with NT-proBNP, E/e', LV mass index, and HbA1c.*

***Keywords**: heart failure, type 2 diabetes mellitus, arterial hypertension, HFpEF, galectin-3, NT-proBNP, diastolic dysfunction.*

ВВЕДЕНИЕ

Сердечная недостаточность с сохранённой фракцией выброса левого желудочка (HFpEF) представляет собой гетерогенный синдром, тесно связанный с сахарным диабетом 2 типа, артериальной гипертензией, ожирением и другими кардиометаболическими нарушениями. Современная концепция HFpEF рассматривает её как результат взаимодействия гемодинамической перегрузки, метаболических нарушений, воспаления и ремоделирования миокарда [1,2].

При сахарном диабете 2 типа хроническая гипергликемия и инсулинорезистентность способствуют развитию профибротических процессов, тогда как артериальная гипертензия вызывает перегрузку левого желудочка давлением, его гипертрофию и повышение жёсткости миокарда. Поэтому сохранённая ФВ ЛЖ не исключает клинически значимой диастолической дисфункции [1–3].

Эхокардиографические показатели E/e′ и LAVI позволяют оценивать диастолическую функцию. NT-proBNP отражает гемодинамическую нагрузку, а Галектин-3 связан с фиброзно-воспалительным ремоделированием [3–6]. Их комплексная оценка совместно с СМАД и эхокардиографией способствует более полной характеристике HFpEF.

Цель исследования — оценить клинико-гемодинамические, эхокардиографические и биомаркерные особенности HFpEF у больных СД 2 типа и АГ, а также изучить взаимосвязи Галектина-3 с ключевыми показателями.

МАТЕРИАЛЫ И МЕТОДЫ ИССЛЕДОВАНИЯ

В исследование включены 235 человек. Основную группу составили 135 пациентов с сахарным диабетом 2 типа, артериальной гипертензией, HFpEF и признаками диастолической дисфункции. Из них 85 больных получали комплексную терапию (группа I), 50 — стандартную терапию (группа II). Контрольную группу составили 100 практически здоровых лиц.

Оценивали симптомы сердечной недостаточности, толерантность к физической нагрузке, антропометрические показатели, лабораторные параметры, включая HbA1c, СРБ, NT-proBNP и Галектин-3. Выполняли ЭКГ, эхокардиографию и СМАД. Эхокардиография включала ФВ ЛЖ, LVEDV, LAVI, среднее E/e′ и TAPSE. Для сравнения количественных показателей применяли критерий Краскела–Уоллиса с последующими сравнениями Манна–Уитни с поправкой Холма, для категориальных данных — точный критерий Фишера; значимость $p<0,05$. Корреляции Галектина-3 изучали методом Спирмена.

РЕЗУЛЬТАТЫ

Фракция выброса ЛЖ у пациентов с СД 2 типа, АГ и HFpEF оставалась сохранённой: 58,9±4,6% в группе I и 57,2±5,1% в группе II против 66,5±4,8%

у здоровых лиц; ни у одного пациента ФВ ЛЖ не была ниже 50%. При этом выявлялись выраженные признаки структурно-функционального ремоделирования сердца. LAVI составлял 43,6±6,2 и 45,1±6,7 мл/м² против 23,4±4,7 мл/м² в контроле (p_2<0,001), а увеличение LAVI>34 мл/м² отмечалось у 91,8% и 92,0% больных. Гипертрофия ЛЖ выявлена у 70,6% и 72,0% пациентов против 12,0% в контроле (p_2<0,001). Среднее значение E/e′ также было достоверно выше, составляя 12,3±3,0 и 13,5±3,2 против 6,8±1,5. TAPSE снижался до 19,1±3,2 и 18,4±3,6 мм против 23,7±2,9 мм в контроле (p_2<0,001), что свидетельствует о повышении давления наполнения и относительном снижении продольной функции правого желудочка.

Среднесуточные значения САД и ДАД превышали контрольные показатели. Индекс времени гипертензии составлял 35,6±11,4% и 48,2±13,1% против 10,3±6,2%. Ночное снижение САД было менее выраженным, а тип non-dipper выявлялся у 61,3% и 78,0% пациентов против 14,0% здоровых лиц (p_1<0,05; p_2<0,001).

Галектин-3 наиболее тесно коррелировал с NT-proBNP (r=0,71; p<0,001). Значимые прямые связи установлены с E/e′, индексом массы миокарда ЛЖ, LAVI, СРБ и HbA1c, а также с LVEDV. Обратные корреляции выявлены с ФВ ЛЖ и TAPSE. Полученные ассоциации указывают на связь галектина-3 с гемодинамической нагрузкой, диастолической дисфункцией, структурным ремоделированием и метаболическим контролем. В целом результаты соответствуют современному представлению о HFpEF как о мультиморбидном кардиометаболическом синдроме. Галектин-3 целесообразно рассматривать как дополнительный маркер фиброзно-воспалительного ремоделирования, но не как самостоятельный диагностический критерий. Корреляционный анализ не позволяет устанавливать причинно-следственные связи.

ЗАКЛЮЧЕНИЕ

У пациентов с СД 2 типа, АГ и HFpEF при сохранённой ФВ ЛЖ выявлялось выраженное структурно-функциональное ремоделирование сердца, проявлявшееся увеличением LAVI и частой гипертрофией ЛЖ. Нарушения циркадного профиля АД характеризовались преобладанием типа non-dipper и повышением индекса времени гипертензии. Галектин-3 достоверно коррелировал с NT-proBNP, E/e′, LAVI, индексом массы миокарда ЛЖ, СРБ и HbA1c, а также имел обратные связи с ФВ ЛЖ и TAPSE. Наиболее сильная корреляция отмечена с NT-proBNP (r=0,71; p<0,001). Комплексная оценка клинических показателей, СМАД, эхокардиографии и биомаркеров позволяет объективно характеризовать особенности диабет-гипертензивной HFpEF и выраженность сердечного ремоделирования.

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ЭФФЕКТИВНОСТЬ КОМПЛЕКСНОЙ ТЕРАПИИ ПРИ ДИАСТОЛИЧЕСКОЙ СЕРДЕЧНОЙ НЕДОСТАТОЧНОСТИ У БОЛЬНЫХ САХАРНЫМ ДИАБЕТОМ И АРТЕРИАЛЬНОЙ ГИПЕРТЕНЗИЕЙ

Аннотация*: Цель исследования — оценить эффективность комплексной терапии HFpEF при сочетании сахарного диабета 2 типа и артериальной гипертензии. Обследованы 135 пациентов: 85 получали комплексную, 50 — стандартную терапию в течение 6 месяцев. При комплексном лечении снизились NT-proBNP, Галектин-3 и HbA1c, улучшились ФВ ЛЖ, LAVI, E/e' и TAPSE. Терапевтический ответ зарегистрирован у 58 (68,2%) пациентов. Результаты подтверждают целесообразность комплексного подхода к лечению диабет-гипертензивной HFpEF. Responder/non-responder анализ требует проверки по первичной базе исследования.*

Ключевые слова: *HFpEF, сахарный диабет 2 типа, артериальная гипертензия, комплексная терапия, NT-proBNP, Галектин-3.*

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EFFECTIVENESS OF COMPREHENSIVE THERAPY FOR DIASTOLIC HEART FAILURE IN PATIENTS WITH DIABETES MELLITUS AND ARTERIAL HYPERTENSION

Abstract. *The aim of the study was to assess the effectiveness of comprehensive therapy for HFpEF in patients with type 2 diabetes mellitus and arterial hypertension. The study included 135 patients: 85 received comprehensive therapy and 50 received standard therapy for 6 months. Comprehensive treatment reduced NT-proBNP, galectin-3, and HbA1c levels and improved LVEF, LAVI, E/e', and TAPSE. A therapeutic response was observed in 58 patients (68.2%). The findings support a comprehensive approach to the management of diabetes- and hypertension-associated HFpEF. The responder/non-responder analysis requires verification using the primary study dataset.*

Keywords: *HFpEF, type 2 diabetes mellitus, arterial hypertension, comprehensive therapy, NT-proBNP, galectin-3.*

Введение

Hfpef при сахарном диабете 2 типа и артериальной гипертензии требует одновременной коррекции нескольких взаимосвязанных компонентов риска. Современные рекомендации подчёркивают необходимость комплексного ведения пациентов с сердечной недостаточностью и сахарным диабетом, включая контроль гемодинамических и метаболических факторов [1–3].

Эффективность лечения целесообразно оценивать по совокупности показателей. Nt-probnp отражает гемодинамическую нагрузку, галектин-3 — фиброзно-воспалительное ремоделирование, hba1c — метаболический контроль, а lavi и e/e′ позволяют оценивать структурно-функциональное состояние и косвенно давление наполнения [3–6]. Цель — изучить шестимесячную динамику этих показателей и оценить составной критерий терапевтического ответа.

Материалы и методы исследования

Из 235 обследованных 135 пациентов имели сд 2 типа, аг, hfpef и признаки диастолической дисфункции; 85 получали комплексную терапию (i группа), 50 — стандартную (ii группа), 100 практически здоровых лиц составили контроль. Комплексный подход был направлен на нейрогуморальную, метаболическую, сосудистую и антиоксидантную коррекцию; в автореферате отдельно отмечено применение корвитина в составе комплексного лечения. Дозировки и полный состав схемы в доступном автореферате не приведены и поэтому не реконструируются.

Оценку выполняли исходно и через 1, 3 и 6 месяцев. Исследовали hba1c, nt-probnp, галектин-3, фв лж, lvedv, lavi, среднее e/e′, tapse и показатели смад. Использовали критерий краскела–уоллиса, последующие сравнения манна–уитни с поправкой холма и точный критерий фишера; $p<0,05$ считали значимым.

Результаты

Исходный hba1c был сопоставим между группами: 7,9±1,3% и 8,0±1,6% ($p_1=0,72$). Через 6 месяцев он снизился до 6,4±0,9% при комплексной и до 7,3±1,2% при стандартной терапии, что соответствовало снижению на 19,0% и 8,8% ($p_1<0,001$).

Nt-probnp снижался более выраженно при комплексной терапии: с 612,4±218,2 до 288,5±142,9 пг/мл против 758,1±219,1 до 540,2±173,5 пг/мл. Межгрупповые различия были значимыми через 1 месяц ($p_1=0,01$), через 3 и 6 месяцев — $p_1<0,001$. Относительное снижение составило 52,9% против 28,7%. Исходное различие nt-probnp ($p_1=0,04$) требует осторожной интерпретации.

Галектин-3 через 6 месяцев снизился до 12,8±3,3 против 17,0±3,9 нг/мл ($p_1<0,001$), относительное снижение составило 32,3% и 16,7%. Такая динамика может отражать уменьшение фиброзно-воспалительного компонента, но не доказывает морфологический регресс фиброза.

При комплексной терапии фв лж увеличилась до 62,1±3,9%, lvedv снизился до 104,5±18,6 мл, lavi — до 36,9±5,8 мл/м², e/e′ — до 9,8±2,5, tapse

— до 21,0±2,9 мм. Изменения были более выраженными по сравнению со стандартным лечением.

Составной критерий терапевтического ответа включал снижение nt-probnp ≥30%, галектина-3 ≥20%, e/e′ ≥10% либо переход non-dipper в dipper. Ответ отмечен у 58 из 85 пациентов (68,2%). Однако responder/non-responder анализ основан на «смоделированных данных» и требует проверки по первичной базе перед публикацией.

Обсуждение

Комплексная терапия сопровождалась улучшением метаболического контроля, снижением nt-probnp и галектина-3, а также положительной динамикой эхокардиографических показателей, что соответствует современному принципу комплексного ведения hfpef с обязательным контролем коморбидных состояний [1–3].

Наиболее выраженное снижение отмечено для nt-probnp и галектина-3. Их одновременная динамика может указывать на уменьшение гемодинамической нагрузки и фиброзно-воспалительного компонента, однако не заменяет морфологическую верификацию [5,6]. Улучшение lavi и e/e′ отражает положительные изменения структурных и диастолических параметров. Рост фв лж и tapse следует рассматривать как улучшение функционального состояния при исходно сохранённой систолической функции.

Ограничениями исследования являются исходные различия nt-probnp между лечебными группами и необходимость дополнительной валидации составного критерия терапевтического ответа. Полученные результаты подтверждают целесообразность мультимодальной оценки hfpef, однако применённые пороговые значения требуют проверки на независимых выборках [1–3].

Заключение

Шестимесячная комплексная терапия обеспечила более выраженное снижение hba1c, nt-probnp и галектина-3 по сравнению со стандартным лечением: на 19,0% против 8,8%, 52,9% против 28,7% и 32,3% против 16,7% соответственно. На фоне комплексной терапии отмечалась положительная динамика эхокардиографических показателей: фв лж увеличилась до 62,1±3,9%, lvedv снизился до 104,5±18,6 мл, lavi — до 36,9±5,8 мл/м², e/e′ — до 9,8±2,5, tapse — до 21,0±2,9 мм. Составной критерий позволил оценить биомаркерные, эхокардиографические и гемодинамические изменения; терапевтический ответ зарегистрирован у 68,2% пациентов комплексной терапии. Исходная высокая метаболическая, воспалительная, структурная и гемодинамическая нагрузка ассоциировалась с нереспондерским фенотипом.

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СОВЕРШЕНСТВОВАНИЕ МЕР ОБЕСПЕЧЕНИЯ ПРОИЗВОДСТВА ПО ДЕЛАМ ОБ АДМИНИСТРАТИВНЫХ ПРАВОНАРУШЕНИЯХ В СФЕРЕ ДОРОЖНОГО ДВИЖЕНИЯ

Аннотация: *В данной статье проанализированы проблемы, возникающие при производстве по делам об административных правонарушениях в сфере дорожного движения. Разработаны обоснованные предложения и рекомендatsii по совершенствованию мер обеспечения производства по делам об административных правонарушениях в сфере дорожного движения в органах внутренних дел.*

Ключевые слова: *сфера дорожного движения, дорожно-транспортное происшествие, административное правонарушение, место происшествия, эксперимент, понятой.*

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IMPROVING MEASURES TO ENSURE PROCEEDINGS IN CASES OF ADMINISTRATIVE OFFENSES IN THE FIELD OF ROAD TRAFFIC

Abstract: *This article analyzes the problems arising in the proceedings of cases concerning administrative offenses in the field of road traffic. The article develops substantiated proposals and recommendations aimed at improving measures to ensure proceedings in cases of administrative offenses in the field of road traffic within the internal affairs bodies.*

Keywords: *road traffic, road traffic accident, administrative offense, scene of the incident, experiment, attesting witness.*

Введение

Своевременное, всестороннее, полное и объективное производство по делам об административных правонарушениях в сфере дорожного движения, а также своевременное установление причин дорожно-транспортных происшествий и условий, способствовавших их совершению, являются одним из факторов, эффективно способствующих обеспечению безопасности дорожного движения и предупреждению дорожно-транспортных происшествий.

В последние годы в нашей стране проведена широкомасштабная организационно-практическая работа по совершенствованию системы обеспечения безопасности дорожного движения. Вместе с тем, несмотря на принимаемые меры, количество дорожно-транспортных происшествий, повлекших смерть людей, по-прежнему остается высоким, что свидетельствует о необходимости коренного реформирования системы обеспечения безопасности на автомобильных дорогах [1].

В целях обеспечения исполнения стратегии «узбекистан – 2030» и совершенствования законодательства об административной ответственности на основе современных международных стандартов и передового зарубежного опыта в распоряжении президента республики узбекистан от 7 мая 2026 года № ф-30 «о мерах по совершенствованию законодательства республики узбекистан об административной ответственности» определено, что коренное совершенствование процессуальных норм законодательства об административной ответственности, обеспечение надежной защиты прав и законных интересов человека, правовой определенности и научной обоснованности являются одним из основных приоритетных направлений дальнейшего совершенствования законодательства об административной ответственности [2].

В настоящее время наличие пробелов и коллизий в нормативно-правовых актах, регулирующих деятельность по производству по делам об административных правонарушениях в сфере дорожного движения, а также норм, утративших свое значение и не имеющих механизма реализации, создает возможность их различного толкования.

Как отмечает ш.н. бердияров, «осуществление любой реформы начинается с создания ее правовой основы. Формирование совершенного законодательства и обеспечение его полного исполнения имеют чрезвычайно важное значение в обновлении и модернизации жизни общества и государства» [3, 113]. Наличие пробелов в нормативно-правовых документах либо недостаточность навыков правоприменителей по непосредственному применению правовых норм можно рассматривать как один из факторов, отрицательно влияющих на всестороннее, полное и объективное производство по делам об административных правонарушениях.

Зарубежный ученый в.и. жулев в своих исследованиях отмечает, что «регулирование правил дорожного движения с помощью правовых норм остается наиболее надежным методом, не требующим больших капиталовложений» [4, 47]. Однако при отсутствии у правоприменителя достаточных правовых знаний данный метод нельзя оценивать как надежный.

Методы

В исследовании в целях выявления факторов, влияющих на производство по делам об административных правонарушениях в сфере дорожного движения, использованы методы анализа нормативно-правовых актов, сравнительно-правового анализа, изучения научной литературы и

опыта зарубежных государств, а также анализа правоприменительной практики.

Основными источниками исследования послужили законодательные акты республики узбекистан, законодательные акты зарубежных государств об административных правонарушениях, а также научные исследования.

Результаты и обсуждение

Анализ показывает, что в настоящее время в правоприменительной практике на месте совершения административного правонарушения, связанного с дорожно-транспортным происшествием, сотрудником государственной службы безопасности дорожного движения с участием лиц, имеющих отношение к обстоятельствам происшествия, и двух понятых составляется схема места происшествия, которая подписывается участниками и имеет важное значение для установления обстоятельств, имеющих значение для дела. При этом протокол осмотра места происшествия, имеющий важное значение для установления обстоятельств, имеющих значение для дела, не оформляется, а в материалы дела направляется в территориальные судебные органы только схема места происшествия. Однако при рассмотрении дела в суде устанавливается, что органом, осуществлявшим производство по делу, протокол осмотра места происшествия не оформлялся, в связи с чем материалы дела возвращаются в орган, осуществлявший производство. Следует отметить, что в законодательстве об административной ответственности основания для оформления протокола осмотра места происшествия не определены.

В настоящее время в законодательных актах российской федерации (статья 28.1.1 кодекса российской федерации об административных правонарушениях) [5], республики беларусь (статья 11.10 процессуально-исполнительного кодекса республики беларусь об административных правонарушениях) [6], республики молдова (статья 426 кодекса республики молдова о правонарушениях) [7] и ряда других государств предусмотрена необходимость осуществления ряда процессуальных действий при собирании доказательств в производстве по делам об административных правонарушениях.

Примечательно, что в законодательстве этих государств предусмотрено собирание доказательств путем проведения процессуального действия - осмотра места совершения административного правонарушения - и оформление по его результатам протокола процессуального действия.

Кроме того, в национальном законодательстве не определены правовые основания и порядок принятия решения о приостановлении производства по делу об административном правонарушении до устранения обстоятельств, препятствующих производству по делу, а именно: когда лицо, совершившее правонарушение, не установлено; когда отсутствует возможность разыскать лицо, совершившее правонарушение; когда правонарушитель выехал за пределы республики узбекистан; когда потерпевший утратил дееспособность — до назначения законного представителя; когда назначена экспертная

проверка, проведение которой требует длительного времени; когда правонарушитель страдает тяжелым заболеванием, требующим длительного лечения; при объявлении чрезвычайного положения. Это порождает многочисленные проблемы в производстве и приводит к истечению сроков привлечения лица к административной ответственности.

При изучении передового опыта ряда зарубежных государств можно отметить, что в законодательных актах республики беларусь (статья 12.2 процессуально-исполнительного кодекса республики беларусь об административных правонарушениях) [8] и кыргызской республики (статья 508 кодекса кыргызской республики о правонарушениях) [9] определены основания и порядок приостановления производства по делу.

Следует особо подчеркнуть, что дорожно-транспортные происшествия не всегда происходят по вине водителя. Во многих случаях они могут произойти и по вине пешехода. Поэтому при производстве по делам, связанным с дорожно-транспортными происшествиями, для установления фактических обстоятельств дела возникает необходимость собирания доказательств путем проведения следственного действия — эксперимента, предусмотренного уголовно-процессуальным законодательством республики узбекистан (статья 153 уголовно-процессуального кодекса) [10].

Например, при совершении предусмотренных законодательством об административной ответственности административных правонарушений, связанных с дорожно-транспортным происшествием, в целях установления наличия или отсутствия вины водителя назначается судебная автотехническая расчетная экспертиза. В ходе экспертного исследования необходимо установить время, прошедшее с момента возникновения опасности дорожно-транспортного происшествия до достижения транспортным средством и пешеходом точки столкновения или наезда, а также имел ли водитель в данной ситуации техническую возможность остановить транспортное средство для предотвращения дорожно-транспортного происшествия. В данном случае до назначения экспертизы должен быть проведен следственный эксперимент, а протокол эксперимента должен быть представлен эксперту в качестве объекта исследования для ответа на поставленные перед ним вопросы и уточнения указанных обстоятельств дела.

Однако в данном случае эксперимент является следственным действием и допускается только в ходе предварительного расследования при возбуждении уголовного дела. К сожалению, в нашем законодательстве не установлены правовые основания и порядок проведения эксперимента в ходе производства по делам об административных правонарушениях. Особенно в делах о дорожно-транспортных происшествиях это приводит к тому, что без установления фактических обстоятельств дела показания водителя и пешехода принимаются в качестве доказательств, в отношении водителя оформляется протокол об административном правонарушении, а материалы дела направляются в суд. В результате дело неоднократно рассматривается судами первой и вышестоящей инстанций, возвращается в орган,

осуществлявший производство, вследствие чего истекает срок привлечения лица к административной ответственности, виновное лицо остается без привлечения к административной ответственности, что вызывает возражения со стороны потерпевших по делу.

В части 4 статьи 282 кодекса республики узбекистан об административной ответственности указано: «по делам об административных правонарушениях, предусмотренных статьями 133 и 134 настоящего кодекса, к оформленному протоколу прилагается акт, составленный с участием двух понятых, если водитель уклоняется от прохождения освидетельствования для установления состояния опьянения» [11].

Исследования показывают, что в настоящее время в нашем законодательстве правовой статус понятого как лица, участвующего в производстве по делам об административных правонарушениях, не определен. Вместе с тем при рассмотрении направленных в суд дел об административных правонарушениях отсутствие участия понятых при оформлении документов приводится в качестве основания, в связи с чем принимается решение о прекращении производства по делу об административном правонарушении.

Действительно, в настоящее время в правоприменительной практике вопрос привлечения понятых к процессу производства по делам об административных правонарушениях остается весьма болезненным и проблемным. Одной из основных причин этого является отсутствие в национальном законодательстве правового статуса понятого. Считаем необходимым глубоко исследовать передовой опыт зарубежных государств в данном вопросе, законодательно определить порядок привлечения понятого к административно-процессуальным действиям, его права и обязанности, а при необходимости — также стимулирующие меры за участие в данном деле.

Кроме того, существуют ситуации, когда не то что привлечь понятого, но и найти его в отдаленных местах и в ночное время невозможно. Административно-процессуальные действия при этом не могут ожидать. Существуют установленные законодательством сроки, пропуск которых может привести к прекращению производства по делу об административном правонарушении.

В связи с этим в законодательстве необходимо определить возможность осуществления процессуальных действий при производстве по делам об административных правонарушениях с широким использованием возможностей средств аудио- и видеозаписи. В частности, при невозможности найти понятого целесообразно ввести в законодательство правовую норму, позволяющую сотруднику государственной службы безопасности дорожного движения, осуществляющему правоприменение, приложить к протоколу об административном правонарушении видеозапись или аудиозапись, сделанную с помощью нагрудной («body») камеры, в качестве доказательства и представить ее в уполномоченный орган, рассматривающий дело об административном правонарушении. В этом вопросе хорошим примером

могут служить законодательные акты российской федерации, республики казахстан и республики беларусь об административной ответственности.

В частности, в части 6 статьи 25.7 кодекса российской федерации об административных правонарушениях установлено, что при использовании видеозаписи для документирования процессуальных действий (за исключением личного досмотра) соответствующие процессуальные действия осуществляются без участия понятых, что фиксируется в соответствующем протоколе или протоколе освидетельствования на состояние алкогольного опьянения [12].

Также в статье 791 кодекса республики казахстан об административных правонарушениях определен порядок проведения личного досмотра и досмотра вещей, находящихся при физическом лице. В ней предусмотрено, что если реальная возможность участия понятых при личном досмотре и досмотре вещей отсутствует (в труднодоступных местах, в ночное время, в условиях чрезвычайного или военного положения), они могут проводиться без участия понятых с обязательным применением технических средств для фиксации процесса и результатов [13].

Вместе с тем в статье 8.6 процессуально-исполнительного кодекса республики беларусь об административных правонарушениях указано, что в исключительных случаях, если имеются достаточные основания полагать, что у задержанного имеются оружие или иные предметы, которые могут быть использованы для причинения вреда жизни или здоровью, личный досмотр может проводиться без понятых [14]. Существенным аспектом законодательства республики казахстан об административных правонарушениях в указанных случаях является то, что лицу, подвергнутому личному досмотру, или его законному представителю выдается копия протокола о проведении досмотра.

В нашем законодательстве, напротив, не предусмотрено вручение копии протокола лицу, подвергнутому личному досмотру, или его законному представителю либо лицу, вещи которого были досмотрены, при проведении личного досмотра и досмотра вещей как меры обеспечения производства по делу об административном правонарушении. Это, в свою очередь, становится причиной возникновения недовольства участников производства действиями органа (должностного лица), уполномоченного осуществлять производство по делу.

Из анализа исследований видно, что пробелы, возникшие в национальном законодательстве, отрицательно влияют на всестороннее, полное и объективное производство по делам об административных правонарушениях в сфере дорожного движения в органах внутренних дел.

Если в рамках настоящего исследования проанализировать опыт зарубежных стран, то, в частности, российский ученый с. Романкова в своем исследовании считает, что необходимо сократить перечень административных правонарушений в сфере дорожного движения, дела о которых рассматриваются в юрисдикции полиции, установленной кодексом

российской федерации об административных правонарушениях. Для этого необходимо передать часть полномочий полиции по рассмотрению дел об административных правонарушениях, предусмотренных частью 4 статьи 12.16 кодекса российской федерации об административных правонарушениях, в ведение органов исполнительной власти субъектов российской федерации [15, 8].

Однако с данным мнением полностью согласиться нельзя. Несмотря на то, что объем дел об административных правонарушениях в сфере дорожного движения, рассматриваемых органами внутренних дел, весьма велик, возлагать данные полномочия на другой орган неправильно. Поскольку именно при производстве по делам об административных правонарушениях в сфере дорожного движения специализированным органом, то есть субъектами, обладающими специальными знаниями, являются уполномоченные должностные лица органов внутренних дел.

Как отмечает исследовавший данную сферу ю. Кузякин, судьи, члены коллегиальных органов и должностные лица наряду со знанием положений необходимых нормативных актов и пониманием процессов, возникающих в результате правонарушения, должны, используя специальные знания, глубоко анализировать механизмы этих процессов, а также уметь выявлять обстоятельства, способствовавшие совершению административного правонарушения либо препятствовавшие ему [16, 10–11].

Иными словами, специалист, обладающий специальными знаниями в сфере дорожного движения, способен правильно решать вопросы производства по делам о правонарушениях данного направления. В этой связи для устранения проблем в данном производстве считаем необходимым преобразовать должности инспекторов групп обслуживания районов (городов) центров административной практики управлений безопасности дорожного движения территориальных органов внутренних дел, проходящих службу в настоящее время в сержантских должностях, в офицерские должности с назначением на них кадров, имеющих высшее юридическое образование.

Заключение

В заключение можно отметить, что определение в законодательстве об административной ответственности оснований и порядка осмотра места происшествия, проведения эксперимента, приостановления производства при возникновении обстоятельств, препятствующих производству по делу об административном правонарушении, а также правового статуса понятых как участников производства по делам об административных правонарушениях будет способствовать органам внутренних дел, а также всем государственным органам, уполномоченным осуществлять производство по делам в сфере дорожного движения, собирать доказательства, имеющие значение для дела, своевременно оформлять протоколы об административных правонарушениях, всесторонне, полно и объективно рассматривать дела,

принимать справедливые решения и надежно защищать права и законные интересы граждан.

Преобразование должностей инспекторов групп обслуживания районов (городов) центров административной практики управлений безопасности дорожного движения территориальных органов внутренних дел, проходящих службу в сержантских должностях, в офицерские должности с назначением на них кадров, имеющих высшее юридическое образование, в дальнейшем будет способствовать всестороннему, полному и объективному производству по делам об административных правонарушениях в сфере дорожного движения, своевременному рассмотрению дел, принятию справедливых решений и надежной защите прав, свобод и законных интересов граждан.

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ТУБУЛОПАТИИ У ДЕТЕЙ: СОВРЕМЕННЫЕ ПРЕДСТАВЛЕНИЯ ОБ ЭТИОЛОГИИ, ПАТОГЕНЕЗЕ, КЛИНИКЕ, ДИАГНОСТИКЕ И ЛЕЧЕНИИ

Аннотация: *Тубулопатии представляют собой гетерогенную группу заболеваний почек, характеризующихся преимущественным нарушением функции почечных канальцев и процессов транспорта воды, электролитов, глюкозы, фосфатов, аминокислот и бикарбонатов. Заболевания могут иметь наследственную или приобретённую природу и нередко дебютируют в детском возрасте. В статье представлены современные сведения об этиологии, патогенезе, клинических проявлениях, диагностике и лечении основных форм тубулопатий у детей. Рассмотрены особенности проксимальных и дистальных тубулопатий, синдромов Фанкони, Барттера и Гительмана, а также почечного канальцевого ацидоза. Особое внимание уделено нарушениям водно-электролитного и кислотно-щелочного равновесия, задержке физического развития, полиурии, полидипсии, мышечной слабости и нарушениям костной ткани. Освещены современные подходы к лабораторной, инструментальной и молекулярно-генетической диагностике. Показано значение раннего выявления заболевания и своевременной коррекции электролитных и метаболических нарушений для профилактики осложнений и сохранения функции почек.*

Ключевые слова: *тубулопатии, дети, почечные канальцы, синдром Фанкони, синдром Барттера, синдром Гительмана, почечный канальцевый ацидоз, электролиты, диагностика, лечение.*

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TUBULOPATHIES IN CHILDREN: CURRENT CONCEPTS OF ETIOLOGY, PATHOGENESIS, CLINICAL PRESENTATION, DIAGNOSIS, AND TREATMENT

Abstract: *Tubulopathies constitute a heterogeneous group of renal disorders characterized primarily by impaired function of the renal tubules and disrupted transport processes involving water, electrolytes, glucose, phosphates, amino acids,*

and bicarbonates. These disorders may be hereditary or acquired in nature and frequently manifest during childhood. This article presents current information on the etiology, pathogenesis, clinical manifestations, diagnosis, and treatment of the main forms of tubulopathies in children. It examines the characteristics of proximal and distal tubulopathies, Fanconi, Bartter, and Gitelman syndromes, as well as renal tubular acidosis. Particular attention is paid to disturbances in water-electrolyte and acid-base balance, growth retardation, polyuria, polydipsia, muscle weakness, and bone abnormalities. Modern approaches to laboratory, instrumental, and molecular-genetic diagnostics are highlighted. The importance of early disease detection and timely correction of electrolyte and metabolic disturbances for preventing complications and preserving renal function is emphasized.

Keywords: *tubulopathies, children, renal tubules, Fanconi syndrome, Bartter syndrome, Gitelman syndrome, renal tubular acidosis, electrolytes, diagnosis, treatment.*

Введение

Тубулопатии относятся к числу редких заболеваний почек, при которых преимущественно нарушается транспортная функция канальцевого аппарата. Почечные канальцы обеспечивают поддержание гомеостаза посредством реабсорбции и секреции воды, натрия, калия, хлора, кальция, магния, фосфатов, бикарбонатов, глюкозы и других веществ [1-5].

Нарушение работы транспортных систем может быть связано с генетическими дефектами или приобретённым повреждением канальцев. В детском возрасте особое значение имеют наследственные формы заболевания, поскольку они могут проявляться уже в периоде новорождённости или раннего детства [4-8].

.Клиническая диагностика тубулопатий представляет определённые трудности вследствие неспецифичности начальных симптомов. Полиурия, жажда, задержка роста, мышечная слабость, обезвоживание или изменения электролитов могут первоначально рассматриваться как проявления других заболеваний. Современный клинический подход предполагает комплексную оценку крови, мочи, показателей кислотно-щелочного равновесия, функции почек и, при необходимости, проведение генетического исследования [9-16].

Этиология

По происхождению тубулопатии подразделяются на наследственные и приобретённые.

Наследственные тубулопатии обусловлены патогенными вариантами генов, кодирующих транспортные белки, ионные каналы, рецепторы и другие структуры, участвующие в функционировании нефрона. В зависимости от локализации генетического дефекта преимущественно нарушается транспорт определённых электролитов или органических веществ.

К наследственным тубулопатиям относятся синдромы Фанкони, Барттера и Гительмана, наследственные формы почечного канальцевого

ацидоза, почечная глюкозурия, гипофосфатемические заболевания и ряд других редких состояний [5-10].

Приобретённые тубулопатии могут развиваться вследствие лекарственных препаратов, токсических воздействий, инфекционных и системных заболеваний, метаболических нарушений, а также других патологических процессов, повреждающих эпителий почечных канальцев.

Патогенез

Основой патогенеза является нарушение транспорта веществ на определённом участке нефрона. Дефект транспортного белка приводит к уменьшению реабсорбции соответствующего вещества и его повышенной экскреции с мочой.

При нарушении реабсорбции натрия и хлора развивается почечная потеря соли, которая сопровождается активацией ренин-ангиотензин-альдостероновой системы. В результате может усиливаться потеря калия и водорода, что приводит к гипокалиемии и метаболическому алкалозу. Такой механизм характерен, в частности, для синдромов Барттера и Гительмана.

При поражении проксимального канальца возможно одновременное нарушение реабсорбции нескольких веществ. При синдроме Фанкони наблюдается потеря с мочой фосфатов, глюкозы, бикарбонатов, аминокислот и других низкомолекулярных веществ.

Нарушение способности почек регулировать кислотно-щелочное состояние приводит к развитию почечного канальцевого ацидоза. При проксимальном варианте нарушается реабсорбция бикарбоната, а при дистальном — секреция ионов водорода.

Основные клинические проявления тубулопатий

Клиническая картина тубулопатий зависит от типа заболевания, возраста ребёнка и степени выраженности канальцевого дефекта.

Наиболее характерными симптомами являются:

- полиурия;
- полидипсия;
- склонность к обезвоживанию;
- задержка физического развития;
- недостаточная прибавка массы тела;
- мышечная слабость;
- повышенная утомляемость;
- мышечные судороги;
- нарушения костной минерализации;
- нефрокальциноз или нефролитиаз при отдельных формах;
- изменения электролитов крови;
- нарушения кислотно-щелочного равновесия.

Нарушение роста является важной проблемой у детей с тубулопатиями. Современные данные указывают, что дефекты канальцевого транспорта, хронические электролитные нарушения и нарушения кислотно-щелочного

равновесия могут способствовать задержке роста и недостаточной прибавке массы тела[10-16].

Основные формы тубулопатий

СИНДРОМ ФАНКОНИ

Синдром Фанкони характеризуется генерализованным нарушением функции проксимального канальца. В результате происходит повышенная потеря с мочой глюкозы, фосфатов, бикарбонатов, аминокислот и других веществ.

У детей заболевание может проявляться полиурией, полидипсией, задержкой роста, мышечной гипотонией и рахитоподобными изменениями костной ткани. Диагностика основывается на выявлении сочетанных признаков проксимальной канальцевой дисфункции.

СИНДРОМ БАРТТЕРА

Синдром Барттера представляет собой группу наследственных солетеряющих тубулопатий, связанных преимущественно с нарушением транспорта натрия и хлора в толстом восходящем отделе петли Генле.

Клинические проявления могут возникать ещё внутриутробно или в раннем детстве. Возможны многоводие, преждевременные роды, полиурия, полидипсия, задержка физического развития и признаки хронической гипокалиемии.

Лабораторными признаками являются гипокалиемия, гипохлоремия, метаболический алкалоз и повышение активности ренин-ангиотензин-альдостероновой системы. При некоторых генетических вариантах характерен нефрокальциноз.

СИНДРОМ ГИТЕЛЬМАНА

Синдром Гительмана связан с нарушением функции натрий-хлорного котранспортера дистального извитого канальца. Заболевание чаще проявляется в более старшем возрасте и может иметь относительно малосимптомное течение.

Характерными лабораторными признаками являются гипокалиемия, метаболический алкалоз и гипомагниемия. Возможны мышечная слабость, судороги, повышенная утомляемость и нарушения сердечного ритма.

ПОЧЕЧНЫЙ КАНАЛЬЦЕВЫЙ АЦИДОЗ

Почечный канальцевый ацидоз развивается вследствие нарушения способности почек поддерживать нормальное кислотно-щелочное равновесие.

Основными вариантами являются проксимальный и дистальный канальцевый ацидоз. Заболевание у детей может проявляться задержкой роста, мышечной слабостью и нарушениями костной минерализации. При дистальном варианте возможно развитие нефрокальциноза.

Диагностика тубулопатий

Диагностика тубулопатий должна быть комплексной.

Первоначальное обследование включает:

- общий анализ крови и мочи;

- определение натрия, калия, хлора и бикарбоната в крови;
- определение кальция, магния и фосфора;
- креатинин и оценку скорости клубочковой фильтрации;
- исследование глюкозы и белка в моче;
- определение кальция, фосфатов и электролитов в моче;
- оценку кислотно-щелочного состояния;
- определение осмолярности крови и мочи по показаниям;
- определение активности ренина и альдостерона при подозрении на солетеряющую тубулопатию.

Инструментальная диагностика включает ультразвуковое исследование почек для выявления нефрокальциноза, нефролитиаза и других структурных изменений.

При подозрении на наследственную форму заболевания проводится молекулярно-генетическое исследование. Современные диагностические алгоритмы рассматривают генетическое тестирование как важный компонент обследования детей с клиническими признаками наследственной тубулопатии.

Дифференциальная диагностика тубулопатий

Дифференциальную диагностику проводят с заболеваниями и состояниями, сопровождающимися полиурией, гипокалиемией, нарушениями кислотно-щелочного состояния и задержкой роста.

При гипокалиемическом метаболическом алкалозе необходимо прежде всего исключить синдромы Барттера и Гительмана, рвоту, применение диуретиков и другие причины потери калия.

Определение хлора мочи помогает установить почечный характер потери соли. При синдромах Барттера и Гительмана экскреция хлора с мочой остаётся повышенной, несмотря на гиповолемию. Для разграничения двух синдромов важное значение имеют показатели магния и кальция в моче, клинический возраст дебюта и результаты генетического исследования.

Лечение тубулопатий

Основными принципами лечения являются коррекция водно-электролитных нарушений, восполнение дефицита необходимых веществ, профилактика осложнений и лечение основного заболевания при приобретённых формах.

При солетеряющих тубулопатиях используются препараты натрия и калия, а при гипомагниемии — препараты магния. При синдроме Барттера в соответствующих клинических ситуациях применяются нестероидные противовоспалительные препараты, уменьшающие простагландин-зависимую потерю соли и воды.

При синдроме Гительмана основное значение имеют коррекция гипокалиемии и гипомагниемии, достаточное потребление соли и индивидуальная коррекция питания.

При почечном канальцевом ацидозе проводится коррекция метаболического ацидоза с использованием щелочных препаратов в соответствии с вариантом заболевания.

Лечение должно проводиться длительно и требует регулярного лабораторного контроля. Дозировки препаратов корректируются индивидуально с учётом возраста, массы тела, выраженности электролитных нарушений и функции почек.

Диспансерное наблюдение и прогноз

Дети с наследственными тубулопатиями нуждаются в длительном наблюдении детского нефролога. Необходимо регулярно оценивать рост и массу тела, артериальное давление, электролиты, показатели кислотно-щелочного состояния и функцию почек.

При синдроме Барттера и Гительмана рекомендуется контролировать не только канальцевые нарушения, но и функцию клубочков. В долгосрочных наблюдениях у части детей описывались снижение расчётной скорости клубочковой фильтрации и патологическая протеинурия, что подчёркивает необходимость комплексного мониторинга.

Прогноз зависит от генетического варианта, тяжести заболевания, возраста установления диагноза и своевременности лечения. Раннее выявление и адекватная коррекция метаболических нарушений позволяют существенно снизить риск осложнений и улучшить качество жизни ребёнка.

Заключение

Тубулопатии у детей являются клинически и генетически гетерогенной группой заболеваний, характеризующихся нарушением транспортной функции почечных канальцев. Несмотря на редкость отдельных форм, своевременная диагностика имеет большое значение в педиатрической практике. Полиурия, полидипсия, задержка физического развития, мышечная слабость, судороги, нарушения электролитного состава крови и изменения кислотно-щелочного состояния должны рассматриваться как возможные признаки канальцевой дисфункции. Комплексное лабораторное и инструментальное обследование в сочетании с молекулярно-генетической диагностикой позволяет установить форму заболевания и определить оптимальную тактику лечения. Раннее начало терапии и регулярное диспансерное наблюдение способствуют профилактике осложнений, сохранению функции почек и обеспечению нормального физического развития детей.

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ИССЛЕДОВАНИЯ ПО РАЗВЕДЕНИЮ *HIERODULA TENUIDENTATA* (MANTODEA: MANTIDAE) И ЕЁ ПРИМЕНЕНИЮ ПРОТИВ ТЛЕЙ В ТЕПЛИЧНЫХ УСЛОВИЯХ УЗБЕКИСТАНА

Аннотация: *В статье представлены первоначальные результаты исследований по разведению распространённого в условиях Узбекистана вида Hierodula tenuidentata (древесного богомола) и его применению против тлей (Aphididae) в тепличных условиях. Исследования проводились в зимне-весенний период 2025–2026 годов. Оотеки, собранные в осенний период, содержались в лабораторных условиях при температуре +28 °C и относительной влажности 60 %, после чего были переведены в состояние диапаузы при температуре +10 °C. 5 марта 2026 года оотеки были помещены в теплицу. В результате было установлено, что из одной оотеки вышло более 200 личинок. В теплице наблюдалось полное (100 %) исчезновение популяции тлей. Полученные результаты свидетельствуют о перспективности использования местных видов богомолов в качестве средства биологической борьбы с вредителями в условиях Узбекистана.*

Ключевые слова: *Hierodula tenuidentata, Mantodea, оотека, диапауза, биологическая борьба, теплица, тля, Узбекистан.*

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STUDIES ON THE REARING OF *HIERODULA TENUIDENTATA* (MANTODEA: MANTIDAE) AND ITS APPLICATION AGAINST APHIDS UNDER GREENHOUSE CONDITIONS IN UZBEKISTAN

Abstract*: This article presents the preliminary results of research on the rearing of* Hierodula tenuidentata *(tree mantis), a species distributed in Uzbekistan, and its application against aphids (Aphididae) under greenhouse conditions. The study was conducted during the winter–spring season of 2025–2026. The oothecae*

collected in autumn were kept in laboratory conditions at a temperature of +28 °C and 60% relative humidity, and were subsequently transferred to diapause at +10 °C. On March 5, 2026, the oothecae were placed in a greenhouse. As a result, more than 200 nymphs were recorded emerging from a single ootheca. Complete (100%) disappearance of the aphid population was observed in the greenhouse. These results demonstrate the potential of using native mantis species as a biological control agent under the conditions of Uzbekistan.

Keywords: Hierodula tenuidentata*, Mantodea, ootheca, diapause, biological control, greenhouse, aphid, Uzbekistan.*

Актуальность проблемы

В современных тепличных хозяйствах основным методом борьбы с вредителями по-прежнему остаётся применение химических пестицидов. Однако негативные последствия данного метода — загрязнение окружающей среды, гибель полезных энтомофагов и формирование устойчивых к химическим веществам популяций вредителей — обусловливают необходимость развития методов биологической борьбы.

В частности, тли (Aphididae) являются одними из наиболее опасных вредителей тепличных культур, и биологические методы борьбы с ними получают всё более широкое применение.

В фауне Узбекистана зарегистрировано 8 видов богомолов (Mantodea): *Mantis religiosa*, *Hierodula tenuidentata*, *Bolivaria brachyptera*, *Armene pusilla*, *Iris polystictica*, *Empusa pennicornis*, *Rivetina* sp. и *Severinia turcomaniae*. Среди них *Hierodula tenuidentata* является эндемичным видом фауны Центральной Азии и обитает на деревьях, кустарниках и в виноградниках. Этот вид отличается от обыкновенного богомола наличием белого пятна («глазка») на передних крыльях.

В ходе проведения нашего исследования мы также ознакомились с международными научными исследованиями по биологии *Hierodula tenuidentata* и провели их анализ.

На международном уровне биология *Hierodula tenuidentata* изучалась, в частности, иранскими исследователями. В исследовании Mirzaee и соавторов (2022) было установлено, что средняя продолжительность инкубационного периода оотек, собранных в природных условиях, составляла 36,4 дня, тогда как для оотек, полученных в лабораторных условиях, этот показатель составлял 35,1 дня.

Из оотек, собранных в природных условиях, в среднем выходило 22,0 личинки, тогда как из оотек, полученных в лабораторных условиях, было зарегистрировано в среднем 97,1 личинки.

В другом исследовании оотеки *H. tenuidentata* инкубировали при температуре +25±1 °C, относительной влажности 50 % и фотопериоде 14:10.

Исследования, проведённые в Румынии, показали, что оотеки данного вида преимущественно располагаются на южной стороне деревьев (54 %) и чаще встречаются на высоте 1–3 м (66 %).

Целью настоящего исследования является научный анализ первоначальных результатов по разведению оотек *Hierodula tenuidentata* и её применению против тлей в тепличных условиях Узбекистана.



Материалы и методы

Исследование проводилось в зимне-весенний период 2025–2026 годов в лабораторных и тепличных условиях Узбекистана. В исследовании использовались оотеки *Hierodula tenuidentata*, собранные в осенний период в естественных условиях.

Осенью 2025 года в естественных условиях, на деревьях и кустарниках, были собраны зимующие оотеки. Оотеки имели тёмно-коричневую окраску и продолговатую форму. Согласно международным описаниям, оотеки *H. tenuidentata* имеют длину 1–3 см, относительно округлую форму и тёмно-коричневую окраску.

Условия хранения в лаборатории

1-й этап (лабораторный): оотеки содержались при температуре +28 °C и относительной влажности 60 %.

2-й этап (диапауза): оотеки были переведены в состояние зимнего покоя при температуре +10 °C. Согласно международным данным, для видов умеренного климата рекомендуемая продолжительность диапаузы составляет от 2 недель до 2–3 месяцев.

Результаты исследования

5 марта 2026 года оотеки были перенесены в теплицу. Условия в теплице: температура выше +20 °C, относительная влажность 60–70 %.

В ходе наблюдений регистрировались следующие показатели: количество личинок, вышедших из оотек, окраска и стадия развития личинок, а также состояние популяции тлей.

Выход личинок

После помещения в теплицу 5 марта из оотек, которые предварительно содержались при температуре +28 °C, а затем прошли диапаузу при +10 °C, начали выходить личинки.

Было установлено, что из одной оотеки вышло более 200 личинок. Данный показатель сопоставим с международными данными: из оотек *H. tenuidentata*, полученных в лабораторных условиях, в среднем выходило 97,1 личинки.

Полученный нами результат оказался выше данного показателя, что свидетельствует о высоком репродуктивном потенциале вида в условиях Узбекистана.

Таблица 1. Показатели выхода личинок из оотек

Показатель	**Полученное значение**	**Международные данные**
Температура хранения (1-й этап)	+28°C	+25±1°C
Относительная влажность при хранении	60%	50%
Температура диапаузы	+10°C	+3–5°C
Дата помещения в теплицу	5- марта	—
Количество личинок из одной оотеки	200+	97,1 ± 11,0
Выход личинок	100%	—

Развитие личинок

На начальном этапе личинки имели тёмно-коричневую окраску, которая впоследствии сменялась на зелёную. Согласно международным исследованиям, личинки *H. tenuidentata* после выхода из яйца до достижения взрослой стадии линяют 9–10 раз, а продолжительность данного периода составляет 89,1 дня.

В ходе наблюдений в теплице было отмечено полное (100 %) исчезновение популяции тлей. Этот результат, вероятно, мог быть обусловлен активным хищничеством личинок богомола. Международные исследования также указывают на эффективность богомолов в борьбе с вредителями в тепличных условиях.

В США существует более чем 10-летний опыт использования богомолов в теплицах. При этом оотеки хранят в холодильниках, а при необходимости помещают их в теплицу.

В нашем опыте оотеки хранились при температуре +10 °C. Международные исследования показывают, что виды умеренного климата, например *Mantis religiosa*, нуждаются в обязательной диапаузе, и без

прохождения холодного периода выход личинок не происходит. Для *H. tenuidentata* рекомендуется температура +25 °C, относительная влажность 50 % и фотопериод 14:10. Таким образом, применённый нами режим хранения при +28 °C с последующим переводом оотек в диапаузу при +10 °C сочетает данные условия.

Полное, 100%-ное исчезновение популяции тлей могло быть обусловлено несколькими факторами. Личинки богомола на ранних стадиях развития питаются мелкими насекомыми, в том числе тлями. Международные данные также свидетельствуют об эффективности богомолов в борьбе с вредителями в тепличных условиях.

Однако следует отметить, что в исследовании отсутствовала контрольная группа. В дальнейших исследованиях нами запланировано включение контрольной группы.



Преимущества использования богомолов в теплицах

- возможность отказа от применения химических пестицидов;
- длительное воздействие, поскольку личинки остаются активными в течение нескольких недель;
- возможность сбора оотек из естественной среды, что позволяет снизить затраты.

Недостатки

- **Каннибализм** — личинки могут поедать друг друга;
- **Полифагия** — богомолы могут наносить вред полезным насекомым;

• **Сложность контроля** — личинки могут активно распространяться по теплице.

В настоящее время в Узбекистане в лабораториях выращиваются полезные энтомофаги, которые применяются в тепличных хозяйствах. Данный опыт свидетельствует о возрастающем интересе к биологическим



методам борьбы в Узбекистане. Однако научных исследований по разведению и применению богомолов по-прежнему недостаточно.

Заключение

Результаты исследования показывают, что *Hierodula tenuidentata* (древесный богомол) может успешно размножаться в условиях Узбекистана и использоваться против тлей в тепличных условиях. Международные исследования подтверждают биологические и экологические особенности данного вида.

В ходе проведённых нами наблюдений из одной оотеки вышло более 200 личинок, а популяция тлей в теплице полностью исчезла (100 %). Полученные результаты сопоставимы с международными данными.

В условиях Узбекистана оотеки *Hierodula tenuidentata*, собранные осенью, содержались при температуре **+28 °C** и относительной влажности **60 %**, после чего были переведены в состояние диапаузы при температуре **+10 °C** и 5 марта помещены в теплицу.

Было зарегистрировано более **200 личинок из одной оотеки**, что демонстрирует возможность разведения *H. tenuidentata* в условиях Узбекистана. Данный показатель выше международного значения, составляющего **97,1 личинки**.

В теплице наблюдалось полное (100 %) исчезновение популяции тлей. Однако в связи с отсутствием сравнительного варианта борьбы необходимы дополнительные исследования.

В дальнейших исследованиях рекомендуется включить контрольную группу, испытать различные плотности выпуска личинок и провести оценку экономической эффективности их использования.

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ИЗУЧЕНИЕ СОВРЕМЕННОГО САНИТАРНО-ЭКОЛОГИЧЕСКОГО СОСТОЯНИЯ АЙДАР-АРНАСАЙСКОЙ СИСТЕМЫ ОЗЁР (НА ПРИМЕРЕ ОЗЕР АРНАСАЙ И ТУЗКАН) И ЦЕНТРАЛЬНО-ГОЛОДНОСТЕПСКОГО КОЛЛЕКТОРА ЦГК

Аннотация. *В статье представлены результаты полевых исследований, проведенных в 2026 году и посвященных современному санитарно-экологическому состоянию юго-западной части Айдар-Арнасайской системы озер (ААСО). Рассматриваются гидрологические и гидрохимические изменения, связанные со снижением уровня воды, ростом минерализации и сокращением площади водной поверхности. Отмечаются негативные последствия для биоразнообразия, включая деградацию мест обитания водоплавающих птиц и ихтиофауны, а также ухудшение условий для традиционной хозяйственной деятельности местного населения. Особое внимание уделено анализу проб воды, данным спутникового мониторинга и наблюдениям за динамикой состояния прибрежных экосистем. Также приведен сравнительный анализ на основе результатов, полученных в 2024 и 2026 годах.*

Ключевые слова. *Айдар-Арнасайская система озёр, гидроэкологическое состояние, минерализация воды, засоление, биоразнообразие, водные ресурсы, мониторинг, ЦГК, коллектора Клы и Акбулак.*

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STUDY OF THE CURRENT SANITARY AND ECOLOGICAL CONDITION OF THE AYDAR-ARNASAY LAKE SYSTEM (LAKES ARNASAY AND TUZKAN) AND THE CENTRAL HUNGER STEPPE COLLECTOR (CHSC)

Abstract. *The article presents the results of field research conducted in 2026 on the current sanitary and ecological condition of the southwestern part of the Aydar-Arnasay Lake System (AALS). Hydrological and hydrochemical changes associated with falling water levels, increasing salinity, and the reduction of the water surface area are examined. Negative impacts on biodiversity are highlighted, including the degradation of habitats for waterfowl and ichthyofauna, as well as the deterioration of conditions for traditional economic activities of the local population. Particular attention is paid to the analysis of water samples, satellite monitoring data, and observations of coastal ecosystem dynamics. A comparative analysis based on the results obtained in 2024 and 2026 is also provided.*

Keywords. *Aydar-Arnasay Lake System, hydroecological condition, water salinity, salinization, biodiversity, water resources, monitoring, Central Hunger Steppe Collector (CHSC), Kly and Akbulak collectors.*

Введение

Айдар-Арнасайская система озёр (ААСО) представляет собой один из крупнейших бессточных водных объектов на территории Республики Узбекистан, обладающий высоким народнохозяйственным, рыбохозяйственным и экологическим значением. Водоём расположен в среднем течении реки Сырдарьи, южнее Шардаринского водохранилища.

Формирование озерной системы началось в 1969 году в результате пропуска катастрофического паводка в бассейне р. Сырдарьи и аварийного сброса 21 млрд м³ воды из Чардаринского водохранилища в Арнасайскую

пониженность. В результате многолетнего регулируемого и нерегулируемого сброса стока к 2006 году объём воды в ААСО достиг 42,1 млрд м³, общая площадь акватории составила 300 тыс. га, а длина — 250 км. В настоящее время по объёму накопленной воды ААСО превосходит суммарный объём всех водохранилищ региона, а по площади озерная система занимает 40-е место среди крупнейших озёр мира.

Озерная система является важнейшей орнитологической территорией международного значения. В 2008 году ААСО и прилегающие территории были официально включены в Рамсарский список водно-болотных угодий. Водоём служит местом постоянных гнездовий, сезонных остановок на пролёте и зимовок многочисленных видов околоводных и водоплавающих птиц (уток, бакланов, чаек, белых цапель и пеликанов). Кроме того, система является ареалом обитания ондатры и важной нерестовой базой промысловых видов рыб. На прилегающих аридных территориях сохраняются массивы чёрного и белого саксаула, дающие приют многим пустынным животным.

В соответствии с Планом работы НИЦ МКВК на 2026 год, за счёт средств бюджетного финансирования, с 10 августа по 14 августа 2026 года специалистами центра проведены комплексные экспедиционные обследования восточной части ААСО. В частности, оз. Тузкан (восточный) и части водных объектов, которые впадают в озерную систему: коллектора Клы, и Акбулак, Пограничный, Безымянный, Центральный Голодностепский Коллектор (ЦГК), ЦК-11 и ЦК-9.

Основная цель проведенных экспедиционных работ заключалась в исследовании действующей системы управления Айдар-Арнасайской системой озёр (ААСО), современной водохозяйственной обстановки в её восточной части, а также степени оснащенности водных объектов средствами гидрометрического учета.

Программа исследований охватывала следующий комплекс задач:

- анализ действующей нормативно-правовой базы и организационной структуры управления ААСО;
- сбор и ретроспективный анализ данных по объемам коллекторно-дренажного стока (КДС), поступающего в озерную систему за 10-летний период (2016–2026 гг.);
- валидация спутниковых снимков путем сопоставления дистанционных данных о площади водного зеркала и водно-болотных угодий с результатами наземных измерений;
- полевое обследование гидротехнических сооружений и проведение разовых гидрометрических замеров расходов воды на коллекторах ЦГК, Клы, Акбулак, Пограничный, ЦК-11 и ЦК-9;
- пространственная привязка (GPS-координирование) каналов, коллекторов, гидросооружений и пунктов наблюдения за качеством воды;
- экспресс-оценка минерализации воды на ключевых водных объектах и визуальный мониторинг состояния прибрежных зон.

Площадь водной поверхности ААСО в 2016–2026 гг.

Мониторинг состояния водной поверхности Айдар-Арнасайской системы озёр за период 2016–2026 гг., осуществлен проведен на основе спутниковых данных. На графике 1 приведены результаты динамики площади водной поверхности по спутниковым снимкам.

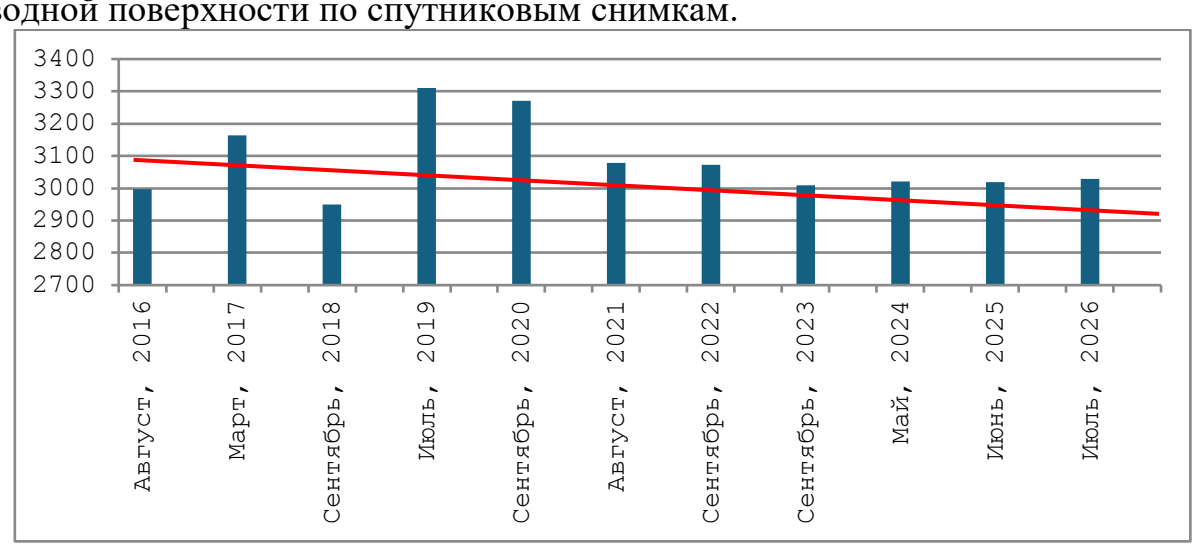


График 1. Динамика площади озёрной системы в 2016-2026 гг.

По данным спутникового мониторинга за период 2016-2026 гг. суммарная площадь водной поверхности ААСО варьировала в диапазоне от 2949,56 км² (сентябрь 2018 г.) до 3309,82 км² (июль 2019 г.), то есть максимальный разброс значений составил около 360 км² (порядка 12%). Устойчивого однонаправленного тренда за рассматриваемый период не наблюдается: площадь меняется волнообразно, что скорее всего связано с колебаниями объемов сбросов коллекторно-дренажных вод, а также с сезоном проведения съемки (данные получены в разные месяцы март – сентябрь), поскольку водная поверхность подвержена сезонным колебаниям наполнения и испарения.

По состоянию на июль 2026 года площадь водной поверхности составила 3029,15 км², что близко к среднемноголетнему уровню за весь период наблюдений (около 3074 км²). Таким образом, текущее состояние системы можно охарактеризовать как типичное, без выхода на экстремальные значения.

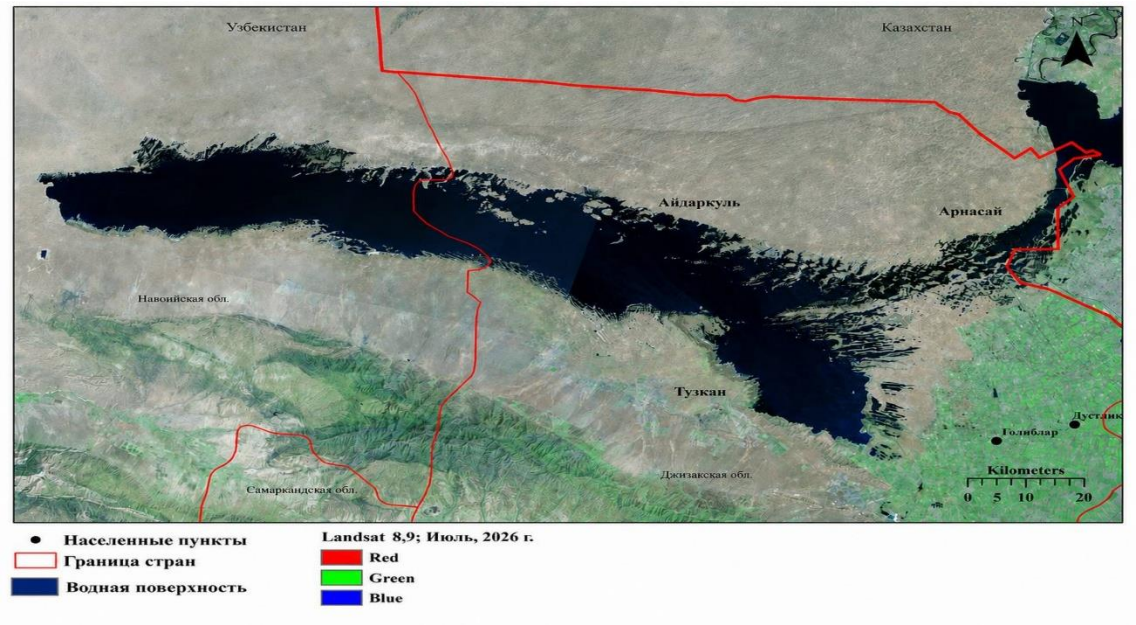


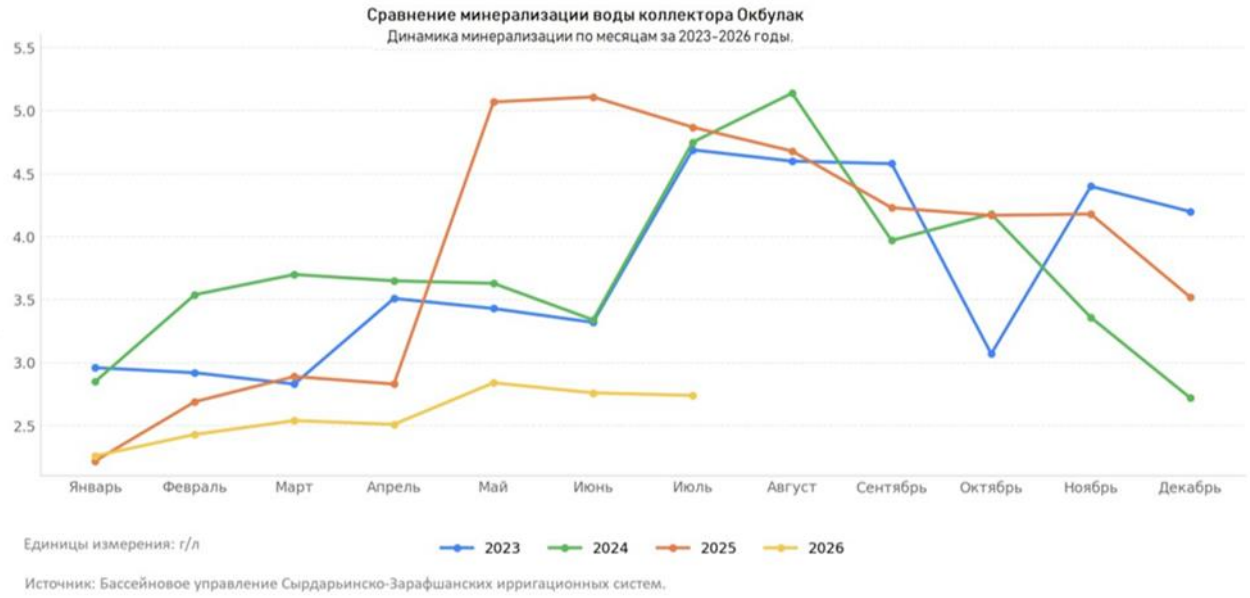
Рис. 1. Айдаро-Арнасайская система озера, июль 2026 г

Минерализация воды

В ходе экспедиции отобраны пробы воды в 11 точках наблюдения для определения показателей минерализации. Минерализация воды определена с помощью солемера «ProCheck».

Ниже представлена диаграмма по засоленности вод коллектора Акбулак и Клы, подготовленная по данным мелиоративных экспедиций





По результатам экспедиционных измерений 2026 г. минерализация воды в обследованных водных объектах изменялась в диапазоне от 1,901 г/л до 10,384 г/л. В коллекторе Акбулак она составила 2,898 г/л, в р. Клы — 3,078 г/л, в верхней части р. Клы (автодорожный мост)1,901 г/л, в коллекторе ЦГК — 3,816 г/л. Наиболее высокое значение зафиксировано в озере Тузкан — 10,384 г/л; на участке коллектора Акбулака, впадающего в Тузкан минерализация составила 4,860 г/л. В обследованном коллекторе, впадающем в озеро, минерализация составила 6,302 г/л, а в точке сброса воды с рыбных прудов — 4,988 г/л.

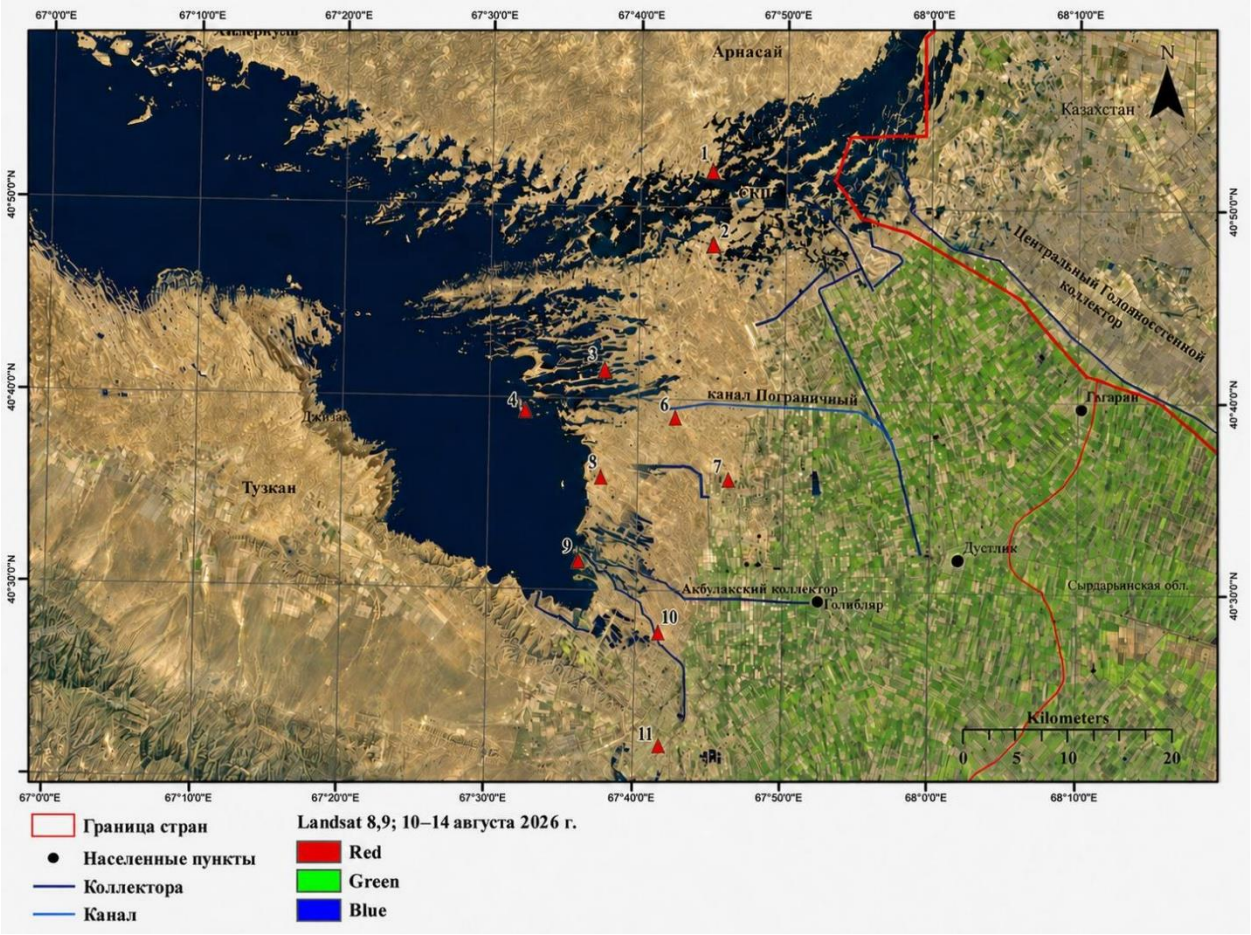


Рис.2. Точки замеров

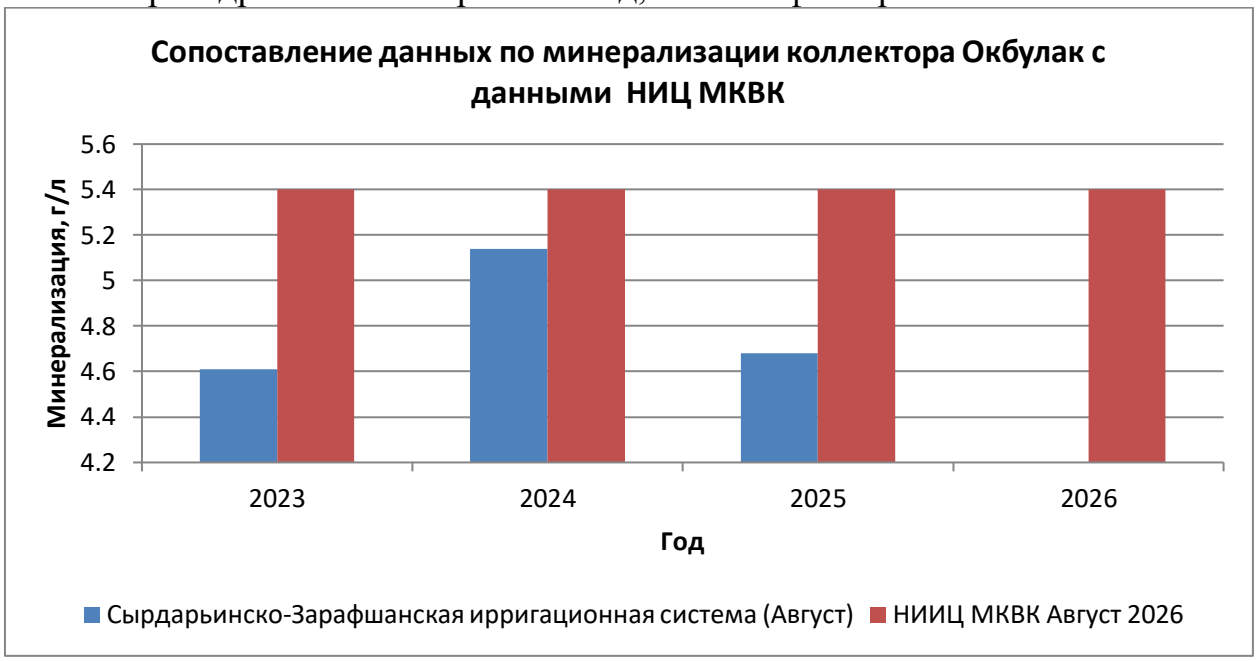
Сопоставление результатов 2024 и 2026 гг. по совпадающим точкам показывает разнонаправленную динамику. В коллекторе Акбулак минерализация практически не изменилась: 2,867 г/л в 2024 г. и 2,898 г/л в 2026 г. В р. Клы она снизилась с 4,273 до 3,078 г/л, в ЦГК — с 4,158 до 3,816 г/л, а в точке сброса с рыбных прудов — с 5,631 до 4,988 г/л. Одновременно на участке озера Тузкан от Акбулака к Тузкану отмечен рост с 2,652 до 4,860 г/л, а в озере Тузкан — с 9,414 до 10,384 г/л. В коллекторе, впадающем в озеро, значения были близкими: 6,488 г/л в 2024 г. и 6,302 г/л в 2026 г.

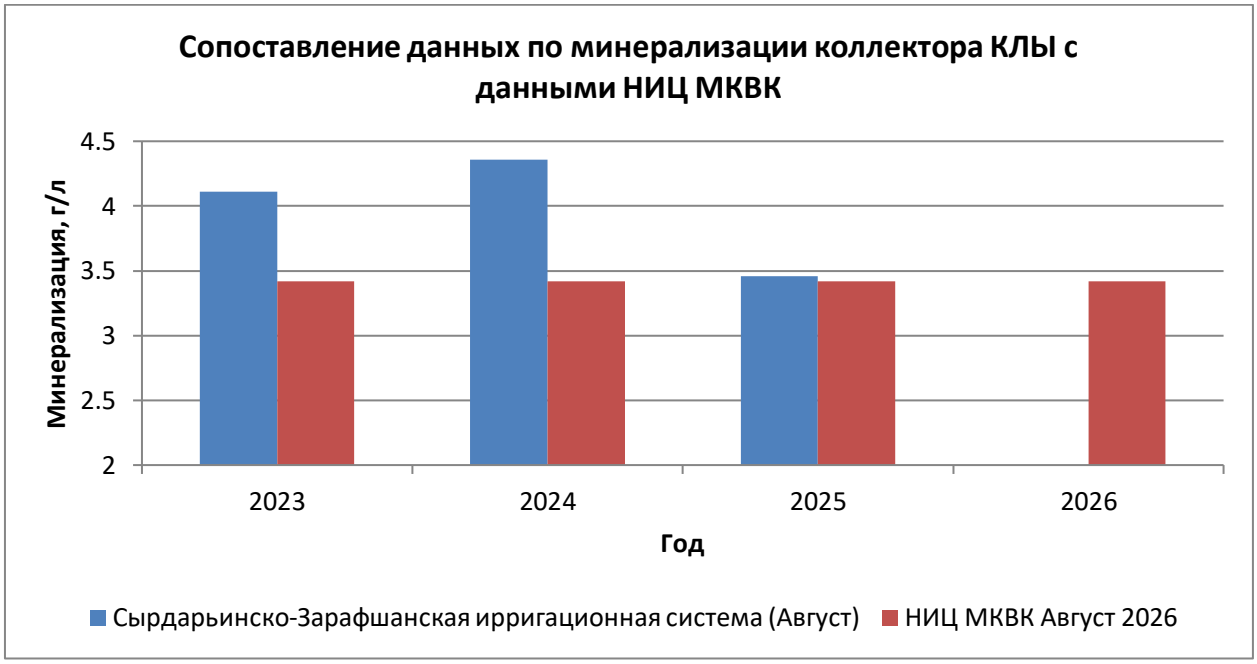
Сравнение результатов разовых замеров и результатов замера мелиоративными экспедициям показало следующие результаты (2026 г.). По данным разового замера, минерализация воды в коллекторе Акбулак составила 2,8 г/л, по результатам замеров мелиоративной экспедиции этот показатель варьируется от 2,2 до 2,8 г/л.

В Клы, по данным разового замера, минерализация воды составила 3,07 гр/л, по результатам замеров мелиоративной экспедиции этот показатель варьируется от 2,7 до 3,9 г/л. Результаты подтверждают достаточно приемлемую сходимость показателей.

При этом данные за 2026 год не указывают на повсеместный рост минерализации: в некоторых коллекторах её уровень снизился или остался почти неизменным, в то время как в озере Тузкан зафиксировано увеличение.

Самый заметный подъём показателей на аналогичных участках наблюдается между Акбулаком и Тузканом, что, скорее всего, обусловлено сбросом вод из рыбоводных прудов. Подобные результаты подчеркивают неравномерность минерализации по акватории и подтверждают важность регулярного мониторинга в единых контрольных точках с обязательным учётом объёмов коллекторно-дренажных и пресных вод, а также фактора сезонности.



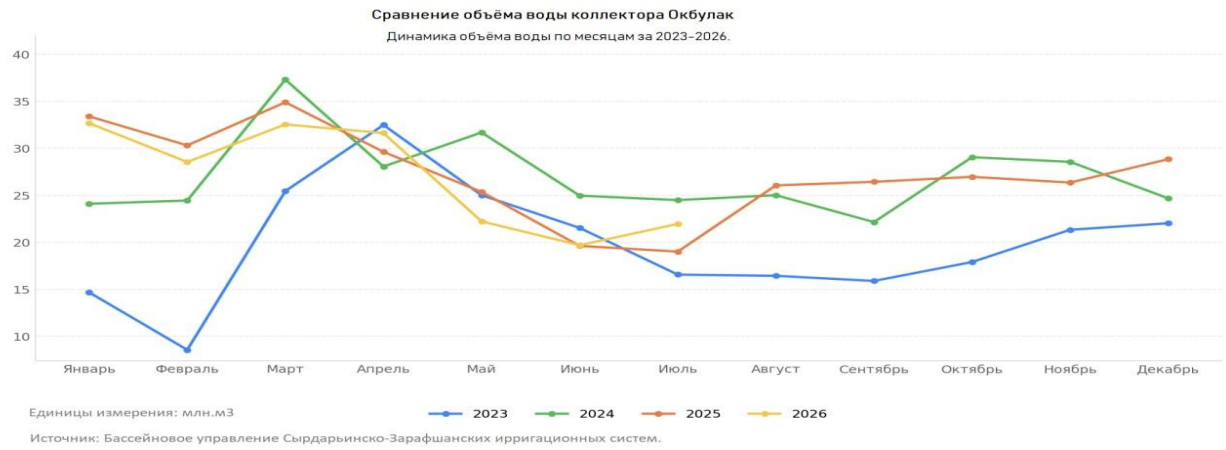


Температура воды является определяющим параметром протекания физико-химических и гидробиологических процессов в акватории. По данным разовых замеров, проведенных в ходе экспедиции 2026 г., температура воды в исследуемых точках находилась в пределах 25,8–33,3 °C. Учитывая единовременный характер наблюдений, зарегистрированные

значения характеризуют пространственную вариативность температурного поля непосредственно в период проведения работ и требуют дальнейшей детализации при исследовании сезонного режима водных объектов.

Формирование водного баланса Айдар-Арнасайской системы озёр происходит преимущественно за счёт поступления коллекторно-дренажных вод с орошаемых массивов Голодностепского и Джизакского регионов. Основной объём стока поступает через магистральные коллекторы Акбулак, Клы, а также ЦГК. Вклад сети мелких коллекторов в общий приходный баланс озерной системы незначителен.

По данным гидромелиоративных экспедиций Зафарабадского и Арнасайского районов Джизакской области (табл. 3 и 4), объём ежегодного притока воды в озеро Тузкан по коллектору Клы и системам Акбулака варьирует в диапазонах 196–346 млн м³ и 237–326 млн м³ соответственно, что суммарно составляет от 433 до 672 млн м³/год. Динамика расходов, суммарных объёмов и минерализации дренажного стока, поступающего в озеро Айдаркуль по коллекторной сети Арнасайского района, представлена ниже (прим.: или «в таблице X»).





Согласно данным, Гидромелиоративной экспедиции Сырдарьинской области по системе Центрального голодностепского коллектора в систему озёр за период 2023-2025 годы было сброшено соответственно: 1318, 1764, 1469 млн. м^3 воды. За последние два года (2025-2026) сброс в систему озёр из Арнасайского водохранилища не производился.

В целом, из приведённых данных (Акбулак, Клы, ЦГК) в озёрную систему ежегодно поступает порядка 2112 млн. м^3 воды (2025 год).



Перегараживающая дамба. Место сброса Акбулак.



Водомерная рейка на ЦГК

Визуальная оценка водности показала следующие результаты:

1. Коллектор Акбулак: В районе участка «Мост» расход воды визуально составляет всего 3–4 м³/сек, хотя по официальным отчётам этот показатель достигает 9–12 м³/сек (326 млн м³/год). В точке впадения в озеро Тузкан расход

падает до 0,3–0,5 м³/сек (около 16 млн м³/год по расчётам) — это в 20 раз ниже ведомственных данных. Таким образом, сток Акбулака практически не достигает озёрной системы.

2. Причина расхождения: Основная часть воды из Акбулака отводится на рыбоводные пруды, расположенные вдоль его русла, и теряется за счёт испарения и фильтрации. Указанные в официальных источниках объёмы поступления (326 млн м³/год) физически не могут поступать в озёра, что также подтверждается наличием перегораживающей дамбы.

3. Коллектор Клы и Центральный Голодностепский коллектор (ЦГК): Их водность остаётся стабильной из года в год. Однако вдоль их русел работают насосные станции, забирающие воду для нужд сельского хозяйства.Кроме этого следует отметить не эффективную систему учёта, поступающую непосредственно в озёрную систему. Техническое состояние средств учёта не соответствует установленным требованиям.

Как отмечено ранее, сток коллектора Акбулак практически не участвует в общем водном балансе. Из-за этого фактический объём поступающей в озёрную систему воды составляет лишь около 1802 млн м³/год (вместо заявленных 2112 млн м³/год за вычетом 310 млн м³/год).

По данным спутникового мониторинга за июль 2026 года, площадь акватории Арнасайской системы озёр (ААСО) составила 3029,15 км² (Таблица 1). Этот показатель не является постоянным и динамично меняется под влиянием сезонных процессов наполнения и испарения.

Для расчета объёма испарения воды с заданной площади были использованы гидрометеорологические данные по слою испарения https://www.cawater-info.net/bk/1-1-2-1-arnasay.htm .

В условиях аридного климата пустыни Кызылкум, где расположена Айдар-Арнасайская система озёр, средний слой испарения с открытой водной поверхности составляет от 1200 до 1500 мм в год (или 1,2 - 1,5 м/год).

Средний слой испарения (h):

- Минимальное среднее: 1200 мм/год = 1,2 м/год
- Среднее значение: 1350 мм/год = 1,3 м/год
- Максимальное среднее: 1500 мм/год = 1,5 м/год
- Расчет объема испарения (V = S x h)
- При минимальном слое испарения (1,2 м):

V = 3029, 15 км^2 x 0,0012 км = 3, 6 км3/год

- При среднееаридном слое испарения (1,3 м):

V = 3029, 15 км^2 x 0,0013 км = 4,1 км3/год

- При максимальном слое испарения (1,5 м):

V = 3029, 15 км^2 x 0,0015 км = 4,5 км3/год.

Ежегодно Айдар-Арнасайская система теряет на испарение в среднем около 4,1 млрд м³ воды, что служит ключевой причиной колебаний её уровня и роста минерализации. Расчёты показывают: для сохранения текущей площади акватории ААСО требуется ежегодный приток не менее 3,6 км³ воды.

Однако реальные объёмы подаваемой воды значительно ниже — к примеру, в 2025 году поступило всего 1,8 км³, что вдвое меньше нормы.

В связи с этим проблема пополнения озёрной системы и ее опреснения сохраняет высокую остроту и требует совместного решения со стороны Узбекистана и Казахстана.

Биологическое разнообразие

За более чем полвека (1969–2026 гг.) Айдар-Арнасайская система озёр стала важнейшим экологическим, социально-экономическим и рекреационным объектом региона. Крупный водоём формирует благоприятный микроклимат на сотни километров вокруг и играет ключевую природно-образующую роль для Узбекистана и всей Центральной Азии.

Благодаря водообеспечению и лесомелиорации вокруг ААСО сформировался богатый ландшафт с лесами, пастбищами и зарослями тростника. В самом водоёме произрастают 17 видов высших водных растений (из которых 5 — широко распространённые), а на побережье преобладают туранга, тамарикс, чёрный и белый саксаул, а также солянки.



Русло Акбулак. Устье



Территория междуречья Клы и Акбулак



Тугайная растительность. Высыхающее озеро по дороге на «Золотой мост»



Зелёная зона между Арнасайским водохранилищем и озером Арнасай

С 2019 года летняя площадь акватории ААСО стабилизировалась в пределах 3008–3078 км², однако сезонные усыхания продолжают вредить экосистеме.

Это отразилось на рыболовстве: если в 2014 году улов достигал 4196 тонн (сазан, судак, жерех, карась и др.), то к 2022–2023 годам он упал до 10–20% от прежних объёмов. Спад сохраняется и далее: в 2024 году добыто 187,6 тонн, а в 2025 — 260 тонн. Главная причина — переориентация на частные рыбхозы, которые перехватывают коллекторный сток для своих прудов, оставляя озёрной системе лишь малую часть воды.



Причал частного рыбоведческого предприятия «Fish CO»



Сток воды с рыбных прудов

Частные рыбхозы забирают коллекторную воду, сбрасывая в ААСО лишь малую её часть. При этом водоём имеет ключевое международное значение:

- орнитологическая ценность: ААСО лежит на пересечении Афро-Евразийского и Центрально-Азиатского миграционных путей. Здесь обитает свыше 100 видов водоплавающих птиц, а в период миграций и зимовок фиксируется до 209 видов (более 96 тыс. особей). В их числе 11 видов из Красной книги МСОП (кудрявый пеликан, белоглазый нырок, орлан-белохвост и др.) и 23 вида из Красной книги Узбекистана.

- природоохранный статус: с 2008 года ААСО входит в список Рамсарских водно-болотных угодий международного значения, а три её объекта («Северный Айдаркуль», «Озеро Тузкан» и «Арнасай») признаны ключевыми орнитологическими территориями (IBA).

- хозяйственное и рекреационное значение: Водоём служит базой для любительской рыбалки, массовой охоты (ежегодно добываются десятки тысяч птиц, а также кабаны, ондатры, барсуки) и привлекает экотуристов, включая иностранных охотников.

В последние годы отмечается развитие туристической инфраструктуры в районе Айдар-Арнасайской системы озёр (ААСО). В частности, в соответствии с Постановлением Президента Республики Узбекистан, от 30.01.2026 г. № ПП-35 (V. Развитие услуг и туризма), в период 2024–2026 годов Национальным банком Узбекистана на берегу озера Тузкан был возведен туристический комплекс.

В ходе мониторинга доступа на объект, установлено ограничение прохода. Следует отметить, что ООО «Арнасай» не располагает официальной информацией о деятельности и функционировании данного туристического комплекса, так как объект находится за пределами балансовой территории предприятия (за пределами 50-метровой охранной зоны ООО «Арнасай»).

В целом, ААСО представляет собой уникальный природный объект, обладающий значительной экологической, экономической и социально-культурной ценностью. Сохранение этой системы критически важно для поддержания биологического разнообразия, регулирования водного режима и фильтрации воды. Озера играют ключевую роль в развитии рыболовства, сельского хозяйства и экотуризма, обеспечивая доход и занятость для местного населения. Кроме того, они имеют культурное и историческое значение, способствуют улучшению здоровья и благополучия людей, а также помогают в борьбе с глобальными климатическими изменениями.

Таким образом, сохранение Айдар-Арнасайской системы озер необходимо для устойчивого развития региона и поддержания экологического баланса.

ВЫВОДЫ И РЕКОМЕНДАЦИИ

1. Гидрологическое состояние и гидроэкологические риски ААСО

Выводы:

- Текущее состояние системы озёр можно охарактеризовать как типичное, без выхода на экстремальные значения. Устойчивого однонаправленного тренда за рассматриваемый период не наблюдается:

площадь меняется волнообразно, поскольку водная поверхность подвержена сезонным колебаниям наполнения и испарения.

В июле 2026 г. общая площадь водной поверхности составила 3029,15 км², что близко к среднемноголетнему уровню за весь период наблюдений (около 3074 км²). Основная причина – сокращение притока коллекторно-дренажных, практическое отсутствие речных и вод, поступающих через Арнасайское водохранилище, а также природно-климатический фактор (испарение).

- Не совершенство системы учёта воды, непосредственно поступающей в систему озёр.

- Прогрессирующее засоление озера: по причине отсутствия пресного стока растет минерализация водоемов. Так, в озере Тузкан зафиксирован рост минерализации с 9,414 в 2024 году до 10,384 г/л в 2026 году. Дальнейшее отсутствие речного стока (Арнасайское водохранилище) приведет к полной утрате экологической значимости данных объектов, включая их статус Рамсарских водно-болотных угодий международного значения.

Рекомендации:

- В соответствии с пунктами 5 и 6 Приложения 1 к Постановлению Кабинета Министров № 136 от 26 марта 2022 повысить функциональность межправительственной рабочей группы по вопросу поступления воды из Чардаринского водохранилища Республики Казахстан в озерную систему, а также принять меры по ежегодному сбросу дополнительной воды в озерную систему через каналы ирригационной системы.

- Соблюдение природоохранного законодательства: В соответствии с Водным кодексом РУз, при распределении квот водозабора безусловный приоритет должен отдаваться санитарным и экологическим целям (ст. 52, 61). Объемы попусков коллекторно-дренажных вод необходимо жестко фиксировать в рамках водохозяйственных балансов, и планов водопользования (ст. 122).

- Обеспечение законности пользования водными ресурсам коллекторно-дренажного стока для нужд рыбного хозяйства (разрешение на специальное водопользование и лимиты).

2. Мониторинг водных объектов и межведомственное взаимодействие

Выводы:

- В настоящее время действующая система мониторинга не позволяет отслеживать все изменения в состоянии водных объектов из-за недостатка актуальных карт водохозяйственной инфраструктуры, неразвитой сети пунктов оперативного наблюдения и учёта вод.

- Отсутствует межведомственная координация между балансодержателями поставщиками воды (подразделения Минводхоза РУз) и ключевыми водопользователями (Национальный комитет по экологии и изменению климата РУз, ООО «Арнасай», Комитет рыбного хозяйства).

В то время как обслуживание водохозяйственной инфраструктуры, подающей воду в озёрные системы, возложено на соответствующие структуры Минводхоза, озерные системы находятся в ведении ООО «Арнасай». При этом вопросы контроля природоохранной деятельности в акватории озёрной системы возложены на природоохранные органы.

Рекомендации:

- Нормативное регулирование: чётко соблюдать требования законодательства в части прав и обязанностей поставщиков воды и водопользователей (ст. 72, 75, 80, 81 Водного кодекса).

- Спрос и предложение: с целью поддержания и увеличения площади водной поверхности озёрных систем соответствующим ведомствам необходимо определить их потребность в водных ресурсах и в установленном порядке обеспечить соблюдение лимитированной подачи воды.

- Учёт вод: в целях обеспечения достоверного контроля водоподачи, соблюдения установленных лимитов водопользования, рационального распределения водных ресурсов, выявления потерь воды, предотвращения несанкционированного водозабора, а также повышения прозрачности и эффективности управления водными ресурсами необходимо организовать учёт воды на границах эксплуатационной ответственности между водохозяйственными организациями и водопользователями (озёрные системы).

- Цифровизация и интеграция: объединить разрозненные данные мониторинга всех причастных министерств и ведомств в единую ведомственную информационную систему (площадь водной поверхности, расход воды, химические и гидробиологические показатели и т.д.), актуализировать карты водохозяйственной сети.

С учётом сформированной в ходе исследования информационной базы о текущем состоянии Айдар-Арнасайской системы озёр (ААСО) и практической значимости собранных данных для профильных министерств и ведомств, целесообразно продолжить дальнейшие исследования.

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СОВЕРШЕНСТВОВАНИЕ ПРОФИЛАКТИКИ ПРАВОНАРУШЕНИЙ, СВЯЗАННЫХ С НЕЗАКОННЫМ ОБОРОТОМ НАРКОТИЧЕСКИХ СРЕДСТВ И ПСИХОТРОПНЫХ ВЕЩЕСТВ СРЕДИ СТУДЕНТОВ

Аннотация: *В статье исследуются актуальные вопросы совершенствования системы профилактики правонарушений, связанных с незаконным оборотом наркотических средств и психотропных веществ среди студентов высших учебных заведений Республики Узбекистан. Анализируются современные факторы риска распространения наркомании в студенческой среде, включая цифровые каналы распространения, социально-психологические и экономические причины, а также негативное влияние на генофонд нации. На основе Указа Президента Республики Узбекистан № УП-207 от 3 ноября 2025 года, принципа «Благоустроенный и безопасный махалля», системы «Э-социальная профилактика» и международного опыта (венгерская модель) разработаны практические предложения по созданию адресной многоуровневой системы профилактики в вузах. Результаты подтверждают необходимость перехода от реактивной модели «преступление совершено — принимаем меры» к проактивной модели «риск возник — немедленно воздействуем». Предложены конкретные организационные, правовые и цифровые механизмы повышения эффективности профилактики.*

Ключевые слова: *студенты; профилактика правонарушений; наркотические средства; психотропные вещества; наркомания; наркопреступность; молодежь; высшие учебные заведения; социальная профилактика; общественная безопасность.*

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IMPROVING THE PREVENTION OF OFFENSES RELATED TO ILLICIT TRAFFICKING OF NARCOTIC DRUGS AND PSYCHOTROPIC SUBSTANCES AMONG STUDENTS

Abstract. *This article examines current issues related to improving the system of prevention of offenses connected with the illicit trafficking of narcotic drugs and psychotropic substances among students of higher educational institutions in the*

Republic of Uzbekistan. The study analyzes contemporary risk factors contributing to drug abuse in the student environment, including digital distribution channels, socio-psychological and economic causes, as well as their negative impact on the nation's gene pool. Based on the Decree of the President of the Republic of Uzbekistan No. UP-207 dated November 3, 2025, the principle of a "Well-Organized and Safe Mahalla," the "E-Social Prevention" system, and international experience (the Hungarian model), practical proposals have been developed for creating a targeted multi-level prevention system in higher education institutions. The findings confirm the necessity of shifting from a reactive model ("a crime has been committed — measures are taken") to a proactive model ("a risk has emerged — immediate intervention is provided"). Specific organizational, legal, and digital mechanisms aimed at enhancing the effectiveness of prevention activities are proposed.

Keywords: *students, crime prevention, narcotic drugs, psychotropic substances, drug addiction, drug-related crime, youth, higher education institutions, social prevention, public safety.*

Введение

В условиях усиливающейся глобализации, цифровой трансформации и роста транснациональных угроз незаконный оборот наркотических средств и психотропных веществ, а также профилактика наркомании стали одной из наиболее актуальных глобальных проблем. Данное явление представляет прямую угрозу социальной стабильности, здоровью населения, воспитанию молодежи, генофонду нации, общественной безопасности и устойчивому развитию государства [1].

Студенческая молодежь является наиболее активной, интеллектуальной и перспективной частью общества. Именно в этой возрастной группе профилактика правонарушений, связанных с незаконным оборотом наркотических средств и психотропных веществ, приобретает особое значение. В последние годы появление новых видов синтетических наркотических средств и сильнодействующих веществ, которые распространяются через социальные сети практически без участия человека, создает серьезную угрозу, особенно среди молодежи [2].

Указ президента республики узбекистан от 3 ноября 2025 года № уп-207 определил комплекс мер по эффективной защите здоровья населения и генофонда нации от наркомании и наркопреступлений. В документе закреплены такие приоритетные задачи, как ужесточение ответственности за наркопреступления в отношении молодежи, пресечение распространения через интернет, выявление организованных групп и нарколабораторий [1].

Целью настоящего исследования является анализ современного состояния профилактики правонарушений, связанных с незаконным оборотом наркотических средств и психотропных веществ среди студентов, выявление существующих недостатков и разработка научно обоснованных предложений по ее совершенствованию.

Обзор литературы и методы

Исследование носит теоретико-прикладной характер. Методологическую основу составили системный, сравнительно-правовой, формально-юридический и прогностический методы.

Нормативно-правовую базу исследования составили указы президента республики узбекистан (в том числе № уп-207 от 3 ноября 2025 г.), постановления кабинета министров республики узбекистан (№ 801 от 30 ноября 2024 г. И № 754 от 1 декабря 2025 г.), а также нормы уголовного кодекса республики узбекистан.

Эмпирической базой послужили материалы специального выпуска международного научно-практического журнала «криминология» (2026 г.), статистические данные о распространении наркомании в мире и республике узбекистан, а также анализ деятельности института «махаллинской семерки» и системы «э-социальная профилактика» [3; 4; 5].

Сравнительно-правовой анализ проведен на примере венгерской модели «нулевой терпимости», программы delta, системы быстрого контроля новых психоактивных веществ (c-schedule) и полицейско-образовательных программ dada и ellen-szer [6].

Результаты

Анализ показал, что основными факторами риска распространения наркомании среди студентов являются:

- Цифровые каналы распространения (социальные сети, мессенджеры, «даркнет»);
- Социально-психологические факторы (удаленность от семьи, адаптационный стресс, неэффективная организация свободного времени, влияние сверстников);
- Экономические факторы (финансовые трудности, поиск «легкого заработка»);
- Недостаточный уровень информированности о тяжелых последствиях употребления психоактивных веществ.

Установлено, что существующая система профилактики в высших учебных заведениях имеет следующие существенные недостатки:

- Мероприятия носят преимущественно общий пропагандистский характер и не обеспечивают адресного индивидуального подхода;
- Отсутствует системный мониторинг и механизмы раннего выявления в студенческих общежитиях;
- Информационный обмен между вузами, махаллями, органами внутренних дел и медицинскими учреждениями недостаточно интегрирован;
- Цифровые угрозы не имеют адекватного технического и правового противодействия;
- Отсутствуют постоянные интерактивные образовательные программы по формированию «антинаркотического иммунитета».

В то же время выявлено, что институт «махаллинской семерки», принцип «благоустроенный и безопасный махалля» и система «э-социальная

профилактика» создают благоприятную институциональную основу для построения эффективной адресной профилактики, которую необходимо адаптировать к условиям высших учебных заведений [3; 4; 5].

Сравнительный анализ показал высокую эффективность венгерской модели, включающей конституционный запрет на производство, потребление и пропаганду наркотиков, программу delta с расширенными полномочиями полиции, систему быстрого контроля новых психоактивных веществ и полицейско-образовательные программы, формирующие доверие между правоохранительными органами и молодежью [6].

Обсуждение

Полученные результаты подтверждают, что эффективная профилактика среди студентов должна строиться на трех опорных принципах: раннее выявление, индивидуальный (адресный) подход и межведомственное взаимодействие.

Переход от реактивной модели к проактивной требует создания внутри каждого вуза специализированного органа — совета по безопасности и профилактике студентов — с участием проректора по работе с молодежью, психологов, медицинских работников, представителей органов внутренних дел и органов студенческого самоуправления.

Особое значение приобретает интеграция вузовских информационных баз с системой «э-социальная профилактика», что позволит оперативно выявлять лиц группы риска и координировать меры воздействия.

Цифровая профилактика должна включать разработку программ на основе искусственного интеллекта для выявления и блокировки интернет-площадок, распространяющих наркотические средства (задача, поставленная до 1 июля 2026 года) [2].

Международный опыт венгрии демонстрирует целесообразность внедрения элементов «полицейско-образовательных» программ, которые позволяют сочетать правовое просвещение с формированием доверительных отношений.

Кроме того, требует законодательного усиления ответственность за вовлечение молодежи в незаконный оборот и пропаганду наркотических средств и психотропных веществ.

Заключение

Совершенствование профилактики правонарушений, связанных с незаконным оборотом наркотических средств и психотропных веществ среди студентов, является комплексной задачей, требующей объединения усилий системы образования, правоохранительных органов, института махалли и гражданского общества.

На основе проведенного исследования сформулированы следующие предложения:

1. Создать в каждом высшем учебном заведении совет по безопасности и профилактике студентов и профильные группы в общежитиях.

2. Обеспечить полную интеграцию информационных систем вузов с платформой «э-социальная профилактика».

3. Внедрить программы мониторинга и блокировки цифровых каналов распространения наркотиков на основе технологий искусственного интеллекта.

4. Адаптировать элементы венгерских полицейско-образовательных программ (dada, ellen-szer) к условиям узбекских вузов.

5. Внести в уголовный кодекс республики узбекистан специальную норму об ответственности за вовлечение молодежи в незаконный оборот и пропаганду наркотических средств и психотропных веществ.

6. Ввести обязательные интерактивные образовательные модули по формированию устойчивого «антинаркотического иммунитета» у студентов.

Реализация указанных мер позволит превратить высшие учебные заведения в действительно безопасную и здоровую среду, а студенческую молодежь — в поколение, надежно защищающее генофонд нации.

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АДАПТАЦИЯ РАСТЕНИЯ АМАРАНТ (AMARANTHUS CRUENTUS L.) К ЗАСОЛЕННЫМ ПОЧВАМ И ТЕХНОЛОГИЯ ЕГО ВЫРАЩИВАНИЯ

Аннотация: *В статье рассмотрена адаптация* Amaranthus cruentus L. *к засолению почв и основные приемы его выращивания. Показано, что солеустойчивость связана с поддержанием водного и ионного баланса, антиоксидантной защитой и изменением фотосинтеза. Засоление снижает всхожесть, рост и биомассу растений, при этом реакция зависит от генотипа. Эффективность выращивания амаранта определяется подбором устойчивых генотипов и оптимизацией почвенного, водного и минерального питания.*

Ключевые слова: Amaranthus cruentus L., *амарант, засоление, солевой стресс, солеустойчивость, адаптация, биомасса, агротехнология.*

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ADAPTATION OF AMARANTH (*AMARANTHUS CRUENTUS* L.) TO SALINE SOILS AND CULTIVATION TECHNOLOGY

Abstract: *This article examines the adaptation of Amaranthus cruentus L. to soil salinity and the main techniques for its cultivation. It is shown that salt tolerance is linked to the maintenance of water and ionic balance, antioxidant defense, and alterations in photosynthesis. Salinity reduces germination, growth, and plant biomass, with the response depending on the genotype. The efficiency of amaranth cultivation is determined by the selection of resistant genotypes and the optimization of soil, water, and mineral nutrition.*

Key words: *Amaranthus cruentus L., amaranth, salinity, salt stress, salt tolerance, adaptation, biomass, agrotechnology.*

Введение

Засоление почв является серьезной агроэкологической проблемой, особенно в засушливых и полузасушливых регионах. Избыток растворимых солей нарушает водный и ионный баланс растений, усиливает окислительный стресс и снижает прорастание, рост и продуктивность сельскохозяйственных культур. Одной из перспективных культур для засоленных земель является амарант (*Amaranthus spp.*), характеризующийся быстрым ростом, С4-фотосинтезом и многоцелевым использованием. Особый интерес представляет *Amaranthus cruentus L.*, устойчивость которого к солевому стрессу зависит от генотипа и уровня засоления. Цель исследования — обобщить данные об адаптации *A. cruentus L.* к засолению и основных агротехнологических приемах его выращивания на засоленных почвах.

Материалы и методы

Исследование основано на анализе и обобщении научной литературы о физиологических, биохимических и агротехнологических механизмах реакции Amaranthus на засоление. Анализировались данные о всхожести, росте и биомассе растений, водном и ионном обмене, фотосинтезе, антиоксидантной активности, содержании биологически активных соединений, минеральном питании, а также применении биостимуляторов и почвенных улучшителей. Результаты сопоставлялись с учетом уровня солевого стресса, вида или генотипа амаранта и исследуемых показателей.

Результаты и обсуждение

Анализ литературы показывает, что адаптация амаранта к засолению обусловлена физиологическими и биохимическими механизмами. На начальном этапе развивается осмотический стресс, затрудняющий поглощение воды, а при усилении засоления происходит накопление ионов Na^+ и Cl^-, нарушающее клеточный метаболизм. Адаптация амаранта к засолению связана с ионным гомеостазом, регуляцией водного обмена, антиоксидантной защитой и изменением фотосинтеза. При усилении стресса снижаются стоматическая проводимость и фотосинтез, а наиболее чувствительной стадией остаётся прорастание семян. У A. cruentus при умеренном засолении рост относительно стабилен, тогда как высокие концентрации солей снижают рост, биомассу и репродуктивную активность; устойчивость определяется генотипом.

Солеустойчивость представителей рода Amaranthus различается в зависимости от сорта. У A. cruentus при 50 мМ NaCl некоторые сорта сохраняли устойчивость, тогда как при 100 мМ наблюдалось снижение биомассы. Это указывает на наличие генотипических различий в реакции амаранта на солевой стресс.

Молекулярные исследования показывают различия в механизмах солевого стресса у *A. hypochondriacus* и *A. hybridus*. Поэтому важны подбор

устойчивых генотипов с учётом агроэкологических условий и активация антиоксидантной системы, защищающей растения от окислительного стресса.

У *A. tricolor* засоление изменяет содержание фенольных соединений, флавоноидов, пигментов и антиоксидантную активность. Эти изменения зависят от генотипа, концентрации соли и продолжительности стресса, поэтому их необходимо оценивать вместе с биомассой и урожайностью. Выращивание амаранта на засоленных почвах требует сочетания устойчивого генотипа с рациональным управлением почвенным и водным режимами.

Предпосевная подготовка должна обеспечивать оптимальную влажность почвы и, при необходимости, её промывку. Сроки и глубину посева следует определять с учётом влажности и засоления корнеобитаемого слоя, поскольку мелкие семена амаранта чувствительны к условиям прорастания.

Минеральное питание необходимо корректировать с учётом анализа почвы. Сбалансированное удобрение способствует росту и урожайности, тогда как его избыток может снижать качество продукции и создавать экологические риски. Перспективно сочетание удобрений с биостимуляторами и почвенными улучшителями; применение биочара может улучшать рост и физиологические показатели Amaranthus caudatus на засоленных почвах.

Биопрепараты и полезные микроорганизмы могут улучшать питание растений и повышать их устойчивость к окислительному стрессу. Реакция амаранта на засоление зависит от генотипа, состава и концентрации солей, продолжительности воздействия, стадии развития, влажности почвы и минерального питания. Усиление засоления снижает водный обмен, фотосинтез, рост и биомассу, поэтому результаты лабораторных опытов с NaCl необходимо подтверждать длительными полевыми исследованиями.

Для Каракалпакстана выращивание амаранта на засоленных почвах требует подбора устойчивых генотипов, оптимизации водного и минерального питания и применения почвенных улучшителей. Эффективность следует оценивать по урожайности, качеству продукции, содержанию биологически активных веществ и экономической эффективности. Перспективны полевые испытания сортов и изучение совместного влияния засоления, питания и биостимуляторов.

Заключение

Амарант (*Amaranthus cruentus L.)* обладает определенной устойчивостью к засолению, обеспечиваемой регулированием водного и ионного баланса, антиоксидантной защитой и адаптацией фотосинтетического аппарата. Степень устойчивости зависит от генотипа, стадии развития и уровня засоления. Эффективное выращивание культуры требует подбора устойчивых генотипов, оптимизации водного и минерального питания, подготовки почвы и применения почвенных улучшителей или биостимуляторов. Для Каракалпакстана перспективны полевые исследования различных генотипов A. cruentus на естественно

засоленных почвах с целью разработки адаптированной технологии выращивания.

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СТАТИСТИЧЕСКИЙ АНАЛИЗ ГРУЗОВЫХ ЖЕЛЕЗНОДОРОЖНЫХ ПЕРЕВОЗОК: ТЕОРИЯ И ПРАКТИКА

Аннотация: *в статье рассмотрены теоретические и методические основы проведения статистического анализа грузоперевозок на железнодорожном транспорте. Раскрыта система экстенсивных показателей оценки эффективности использования подвижного состава (коэффициенты перевозимости и транспортоёмкости продукции, густота грузовых перевозок, грузонапряжённость), а также факторная модель эксплуатационного грузооборота. На основе актуальных статистических данных АО «Ўзбекистон темир йўллари» показана динамика ключевых показателей отрасли — объёма грузовых перевозок и грузооборота — за 2022–2026 гг., что подтверждает практическую значимость предложенного методического инструментария для оценки эффективности работы железнодорожного транспорта Республики Узбекистан.*

Ключевые слова: *статистический анализ, грузооборот, анализ грузоперевозок, объёмные и качественные показатели, подвижной состав, экстенсивные факторы, железнодорожный транспорт Узбекистана.*

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STATISTICAL ANALYSIS OF RAIL FREIGHT TRANSPORTATION: THEORY AND PRACTICE

Abstract: *the article examines the theoretical and methodological foundations of conducting statistical analysis of freight transportation by rail. It reveals a system of extensive indicators for assessing the efficiency of rolling stock utilization (coefficients of transportability and transport intensity of products, density of freight traffic, traffic density/load per route-km), as well as a factor model of operational freight turnover. Based on up-to-date statistical data from JSC "O'zbekiston Temir Yo'llari," the dynamics of key industry indicators — the volume of freight transportation and freight turnover — for the period 2022–2026 are shown, confirming the practical significance of the proposed methodological toolkit for assessing the efficiency of railway transport operations in the Republic of Uzbekistan.*

Keywords: *statistical analysis, freight turnover, freight transportation analysis, volume and quality indicators, rolling stock, extensive factors, railway transport of Uzbekistan.*

Современная транспортная инфраструктура в Республике Узбекистан представляет собой единую транспортную сеть железнодорожных, автомобильных, водных, воздушных, беспроводных общегосударственных и промышленных коммуникаций.

Проблемой на железнодорожном транспорте на сегодняшний день является то, что транспортные издержки по перевозке грузов железнодорожным транспортом остаются достаточно высокими в силу географического фактора удаленности Узбекистана от морских портов территориями двух и более стран, так и низкой эффективности работы транспортного сектора. Низкая эффективность работы транспортного сектора обусловлена тем, что в настоящее время в Узбекистане наблюдается износ инфраструктуры и подвижного состава, парка транспортных средств и их нехватка. По статистическим данным АО «Ўзбекистон темир йўллари» средний износ парка магистральных тепловозов составляет 28,2%, маневровых тепловозов – 49%, электровозов – 48,8%, грузовых вагонов – 75%, пассажирских вагонов – 65,4%. 60% локомотивного состава находится в эксплуатации в течение 20-30 лет. В силу высокого износа подвижного состава скорость передвижения поездов имеет тенденцию снижения на 20-25%, при том, что повышаются издержки на эксплуатацию и текущий ремонт состава. Одной из основных причин неудовлетворительного состояния железных дорог является недостаток финансирования, который составляет 24,5% (в 2025 г.) от требуемого объёма. Исходя из проведённого исследования сформулированы основные задачи статистического анализа железнодорожных грузоперевозок, представленные на рисунке 1.

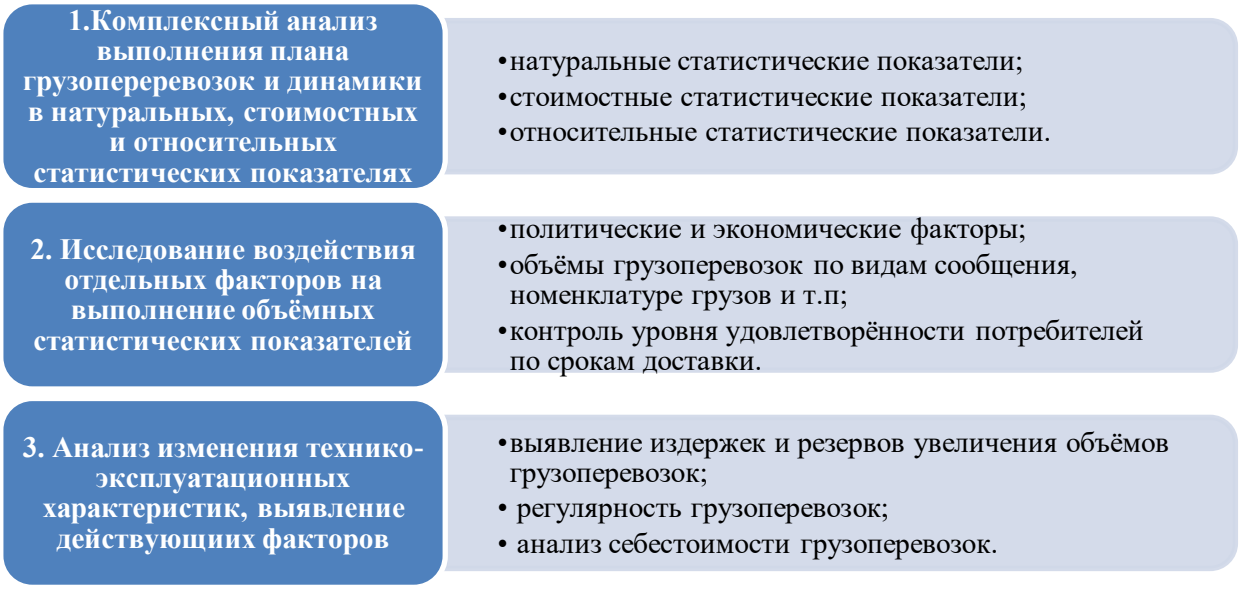


Рисунок 1. Основные задачи анализа грузоперевозок АО «УТЙ»

Основные специфические преимущества грузовых перевозок железнодорожного транспорта включают экстенсивные показатели:

— возможность массовых перевозок грузов и пассажиров и высокая пропускная и провозная способность железнодорожных линий, исчисляемая десятками миллионов тонн грузов в год в каждом направлении;

— регулярность перевозок независимо от климатических условий, времени года и суток;

— большая эффективность при перевозках массовых грузов на средние и дальние расстояния, особенно маршрутами;

— относительно невысокая себестоимость по сравнению с другими видами транспорта (кроме трубопроводного);

— высокая безопасность движения и более низкий экологический ущерб окружающей среде.

При всем этом себестоимость грузоперевозок на железнодорожном транспорте в отличие от автомобильного транспорта, заметно ниже. Существенный удельный вес заработной платы в совокупной сумме эксплуатационных затрат, большая грузоподъемность, и, следовательно, высокая производительность подвижного состава и используемого оборудования, и обуславливают весьма низкий уровень себестоимости. Статистические экстенсивные факторы, являющиеся резервами оптимизации себестоимости грузовых железнодорожных перевозок приведены на рисунке 2.

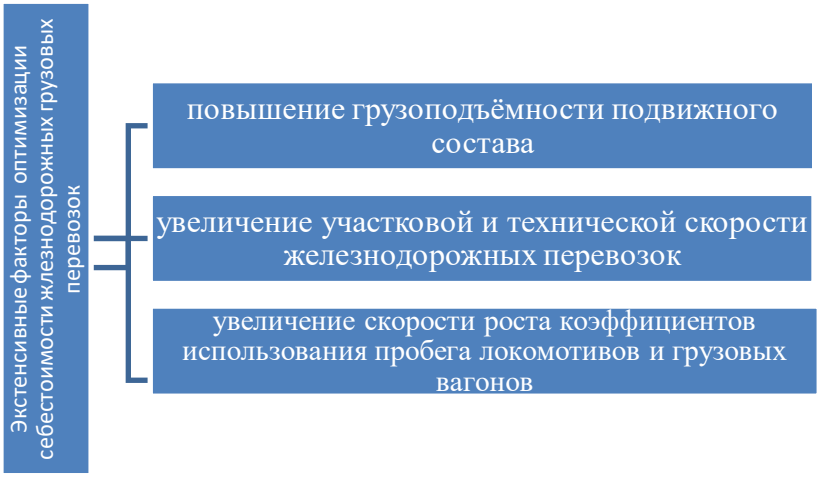


Рисунок 2. Экстенсивные факторы оптимизации себестоимости грузовых железнодорожных перевозок

На себестоимость перевозок оказывают влияние такие факторы, как объём перевозок, дальность перевозки грузов, величины качественных показателей использования подвижного состава, применяемые технологии перевозок грузов, применение ресурсосберегающих технологий, качество нормирования затрат ресурсов, производительность труда, природно-климатические условия и ряд других факторов.

С целью статистического анализа деятельности железнодорожного транспорта применяются приведенные в таблице экстенсивные показатели.

Таблица. Экстенсивные показатели оценки эффективности работы подвижного состава АО «Ўзбекистон темир йўллари»

Название коэффициента	Формула расчёта	Характеристика
Коэффициент перевозимости продукции, $К_{перев}$	$К_{перев} = \Sigma P_i / \Sigma Q_i$, где ΣP_i – объем перевозок i-го груза, тн; ΣQ_i – объём производства i-го груза, тн.	отношение объема перевозок i-го груза к объему его производства в целом
Коэффициент транспортоёмкости продукции, Ктрансп	$Ктрансп = \Sigma Pl_i / \Sigma Q_i$, где ΣPl_i – грузооборот i-го груза, тн; ΣQ_i – объем производства i-го груза, тн.	отношение грузооборота i-го груза к объему его производства в целом
Густота грузовых перевозок, $F_{густ}$	$F_{густ} = \Sigma P_i / \Sigma L_i$	интенсивность грузового потока отдельных участков и подразделений железных дорог
Грузонапряжённость, $Г_{АБ}$	$Г_{АБ} = \Sigma P_{АБ} / \Sigma P_{БА}$	сумма перевозок по направлениям «туда» и «обратно»
Средний показатель грузонапряжённости, $Г_{ср}$	$Г_{ср} = \Sigma Pl^i / LЭ$, где ΣPl_i – грузооборот, ткм; $\Sigma L_э$ – эксплуатационная длина, км.	частное от деления грузооборота (ΣPl_i) на соответствующую эксплуатационную длину ($L_э$)

Расчеты показали, что экономической характеристикой необходимости осуществления технического обслуживания и текущего ремонта подвижного состава является стоимость проведения данных работ, на один километр локомотивного и вагонного пробега, также включает затраты на осуществление технического обслуживания и текущего ремонта и связанные с этим транспортные расходы.

Состав анализируемых статистических показателей на транспорте должен учитывать специфику оказываемых железной дорогой услуг и их экономического значения. Грузооборот, выраженный в тонно-километрах (перевозка 1 тонны груза на расстояние 1 км) является основным показателем. Данный показатель является универсальным, так как он отражает перемещение грузов на определённое расстояние. На практике его применение позволяет соотнести транспортные издержки любых видов

транспорта и выбрать предприятиям-заказчикам оптимальные транспортные расходы. Он используется в системе стратегического управления предприятием, и наиболее эффективно отражает объем транспортной продукции.

Основой для анализа грузоперевозок это план и отчетность о его реализации, информация о движении кадрового состава основной деятельности в течение рассматриваемого периода, отчётные и базисные сведения об уровне технико-эксплуатационных показателей, сведения статистической внутриотраслевой отчётности и оперативного текущего учета.

Производственная программа по эксплуатации подвижного состава характеризуется следующими количественными показателями:

— общий пробег в километрах;

— объём перевозок грузов в тоннах;

— эксплуатационный грузооборот в тонно-километрах.

С целью статистического анализа предлагаем факторную линейную модель эксплуатационного грузооборота с учётом влияющих факторов:

$$\sum Y = Мэ \cdot Д \cdot П \cdot V_t \cdot Р \cdot Кв \cdot Кгр \cdot Кп, \text{ тн·км}$$

где $\sum Y$ - объем грузооборота; $М_э$ - среднегодовое число локомотивного парка; Д - количество дней, отработанных 1 локомотивом за год; П - длительность работы локомотива согласно «Маршрутного листа машиниста»; V_t - средняя техническая скорость локомотива; Р - средняя грузоподъёмность; $К_в$ - коэффициент фактически работающих локомотивов на железнодорожных путях; $К_{гр}$ - коэффициент использования грузоподъемности; $К_п$ - коэффициент использования пробега локомотивного парка.

Таким образом, проведённое исследование позволяет заключить, что для объективной оценки степени выполнения производственной программы структурными подразделениями железнодорожного транспорта АО «Ўзбекистон темир йўллари» целесообразно использовать грузооборот в качестве обобщающего (интегрального) показателя, выраженного как в условно-натуральных, так и в стоимостных единицах измерения.

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ПОТЕНЦИАЛ И ПЕРСПЕКТИВЫ РАЗВИТИЯ ЕСТЕСТВЕННОГО ОЗЕРА СЕЧАНКУЛЬ

Аннотация. *В данной статье с научно-практической точки зрения анализируются природно-географические положения, рекреационные ресурсы и экотуристический потенциал естественного озера Сечанкуль. При этом подчеркивается необходимость ведения деятельности на основе различных принципов, исходя из естественных гидрологических особенностей озера.*

Ключевые слова: *Сечанкуль, Ачинкуль, экотуризм, коллекторно-дренажные воды, глэмпинг, «Leave No Trace», «Overtourism». (Принцип «Не оставляй следов», Массовый туризм).*

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POTENTIAL AND DEVELOPMENT PROSPECTS OF THE SECHANKUL NATURAL LAKE

Abstract. *This article provides a scientific and practical analysis of the natural-geographical location, recreational resources, and ecotourism potential of the Sechankul natural lake. Furthermore, it emphasizes the necessity of applying specific operational principles based on the lake's natural hydrological characteristics.*

Keywords: *Sechankul, Achinkul, ecotourism, collector-drainage waters, glamping, "Leave No Trace", overtourism.*

Введение. В условиях, когда в мировой индустрии туризма неуклонно растет спрос на устойчивые и экологически чистые направления, научно обоснованное внедрение в практику существующих, но не до конца освоенных природных рекреационных ресурсов регионов нашей республики приобретает актуальное значение. В целях диверсификации региональной экономики и повышения туристической привлекательности, в протоколе видеоселекторного совещания при Президенте Республики Узбекистан от 3 июня 2024 года “Hududlarda turizm infratuzilmasini yaxshilash va xorijiy turistlar oqimini ko‘paytirish chora-tadbirlari” (Мера по улучшению туристической инфраструктуры в регионах и увеличению потока иностранных туристов) были обсуждены и определены ряд стратегических задач. В частности, в рамках данного документа указана необходимость эффективного

использования туристического потенциала естественных озер на местах, в том числе территорий озер Сечанкуль и Ачинкуль в Кашкадарьинской области, а также создания здесь современных зон отдыха [2].

Однако закрытые водоемы со сложным гидрологическим режимом, сформировавшиеся в аридной (засушливой) климатической зоне, представляют собой экосистему, чрезвычайно чувствительную к человеческому фактору и техногенным воздействиям. По этой причине при создании туристической инфраструктуры на территории Сечанкуля сохранение экологического баланса должна стать первостепенным критерием. В этом отношении Постановление Президента Республики Узбекистан от 11 июня 2019 года № ПП-484 “2019-2028-yillar davrida O‘zbekiston Respublikasida biologik xilma-xillikni saqlash strategiyasini tasdiqlash to‘g‘risida”gi («Об утверждении Стратегии сохранения биологического разнообразия в Республике Узбекистан на период 2019-2028 годов») служит основной научно-правовой базой, регулирующей рекреационную деятельность на данной территории. Приоритеты сохранения национальных экосистем, охраны уникальной флоры и фауны, обозначенные в данном документе, требуют их реализации на территории Сечанкуля не массового туризма (overtourism), а инновационных подходов, оказывающих минимальное воздействие на окружающую среду [1].

Обзор литературы. Вопросы туристического потенциала и устойчивого развития закрытых водоемов, расположенных в аридных (засушливых) регионах Узбекистана, в частности в пустынных зонах, исследовались местными учеными в различных научных направлениях. Природно-географическая и геоэкологическая база исследований, в первую очередь, была сформирована благодаря трудам А. Н. Нигматова (2020). В своих исследованиях ученый провел глубокий анализ гидрологических особенностей пустынной зоны, солончаков и коллекторно-дренажных водоемов Узбекистана, а также влияния на них глобальных изменений климата. Данные исследования позволяют правильно оценить экологическую емкость и риски перед началом любой человеческой деятельности на объектах со сложным и нестабильным гидрологическим режимом, таких как Сечанкуль [5].

Вопросы экономико-экологического баланса индустрии туризма широко освещены в исследованиях И. С. Тухлиева и Р. Хайитбоева (2021). Ученые научно обосновали важность внедрения моделей устойчивого туризма в экономику региона, в частности роль экологического жилья (эко-гостиниц, зеленых домов) в повышении территориальной привлекательности [6]. Эти принципы устойчивости нашли свое практическое подтверждение в региональном разрезе, в частности в рамках пустынных зон Кашкадарьинской области, в статье Б. Холматова и К. Турсунова (2022). Их исследование показывает, насколько перспективным для экономики области является развитие правильно управляемого экотуризма на пустынных ландшафтах как

на специфическом (эндемичном) природном объекте, несмотря на засушливые условия [9].

Вопрос коммерциализации туризма в условиях пустыни и его реализации через технологические решения стал основным объектом исследования М. Усманова (2023). Анализируя экономическую эффективность создания бизнес-моделей глэмпинга в засушливых (аридных) регионах Узбекистана, автор доказал необходимость отказа от тяжелого капитального строительства и внедрения мобильных конструкций, минимизирующих воздействие на природу и обладающих высокой рентабельностью (ROI) [7].

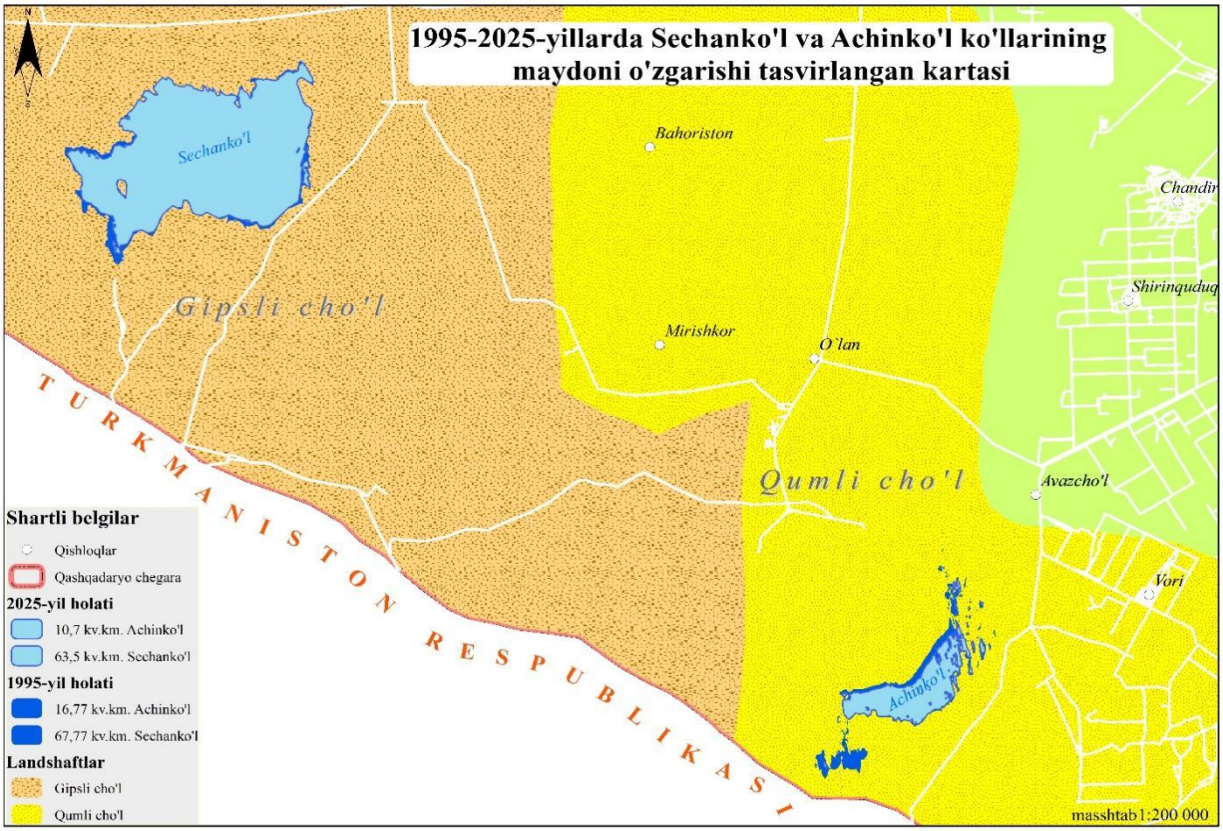
Результаты и обсуждение. В мировой индустрии туризма, отступая от экономических традиций, все больше усиливается внимание к нетрадиционным направлениям. В результате «ухудшения» экологической среды спрос на природные экотерритории в последние годы резко возрос как за рубежом, так и в нашей стране. В частности, за счет развития туристических отраслей на базе гидрологических объектов – озер и других водоемов, расположенных в пустынях и полупустынях, повышается возможность экономической диверсификации.

Гидроэкологический ландшафт – естественное озеро Сечанкуль, расположенное на юге Узбекистана, в Миришкорском районе Кашкадарьинской области, занимает высокое место в сфере экотуризма и рекреационного туризма. В пустынном туристическом подрайоне Кашкадарьинской области, кроме реки Кашкадарья, нет других проточных поверхностных рек. Однако в качестве объектов развития пустынного туризма имеются озера с большим потенциалом, такие как Сечанкуль и Ачинкуль, образовавшиеся в результате вывода коллекторно-дренажных вод. Сечанкуль – это естественное озеро, расположенное в Миришкорском районе, образованное за счет скопления сбросных коллекторных вод ПК 1035 и ЮК-Сечанкуль, которому в 1998 году решением хокимията Кашкадарьинской области на основании приказа № Х-262/7 был присвоен статус рыбного хозяйства «Сечанкуль». Площадь составляет 7813,167 га, оно сбрасывает воды южных коллекторов (5 м3/сек), объем колеблется в пределах 1200,0 – 1600,0 млн м3, а уровень солености составляет около 15 г/л (промилле) (1-рис.).

В результате постоянного притока коллекторно-дренажных вод уровень минерализации воды в озере составляет 15,0 г/л. Этот показатель переводит воду озера в категорию соленых и горько-соленых. С одной стороны, это обстоятельство ограничивает использование воды в питьевых и оросительных целях, с другой – создает основу для формирования специфических галофитных растений и микроорганизмов, а также бальнеологических грязевых слоев. Бассейн озера имеет важное биогеографическое значение в сохранении биоразнообразия, в частности, как транзитное место обитания для сезонных перелетных птиц (migratory waterfowl).

Второе крупное озеро – Ачинкуль, с площадью 2850 га и накопленным объемом воды до 160 млн м3, имеет среднюю соленость 11 г/л (промилле). В связи с освоением Каршинской степи коллекторы ЮВ, К-3 в Миришкорском и Нишанском районах сбрасывают сюда воду с 1978 года. Роль данных озер как водных объектов в пустынном туризме несравнима (1-таблица).

1-рис. Карта изменения площади озер Сечанкуль и Ачинкуль в 1995-2025 гг.



Источник: составлено автором на основе ГИС-технологий.

1-таблица. Некоторые показатели существующих водоемов в пустынном туристическом подрайоне Кашкадарьинской области

№	Название	Общая площадь, га	Объем воды	Состояние заиления чаши дна	Средняя соленость воды	Температура воды летом	Средняя глубина, м	Объем воды в реальном времени
1	Сечанкуль	7813.167	1200-1600 млн м3	Нет	15 г/л	21-23	60	790-810 млн м3
2	Ачинкуль	2850.74	160 млн м3	Нет	11 г/л	20-23	27	120 млн м3

Примечание: составлено автором на основе данных Мелиоративной экспедиции при Ати-Qarshi I.T.X.B.

Исходя из географического положения и природных параметров Сечанкуля, на данной территории имеется возможность формирования следующих основных направлений туристического кластера:

- Оздоровительный туризм;
- Экотуризм;
- Сафари;
- Этнографический туризм;
- Водный спортивный туризм и др.

В частности, в оздоровительном туризме высокая минерализация воды и наличие грязевых слоев на дне озера позволяют создавать открытые и закрытые бальнеологические санатории.

Создание специальных вышек и пунктов для наблюдения за птицами в акватории озера и прибрежных тугаях привлечет экотуристов и научные группы.

Пустынный ландшафт вокруг озера удобен для организации маршрутов на квадроциклах, багги и верблюдах (off-road и camel trekking). Организуя на прилегающих к берегу территориях лагеря из юрт (yurt camps) и глэмпинги, можно продемонстрировать местную культуру и традиционный образ жизни.

Организация экологически чистых и немоторизованных видов водного спорта (каякинг, каноэ, паддлбординг), а также контролируемой спортивной рыбалки.

При создании туристической зоны на пустынных озерах ведущим должен быть принцип «развитие через охрану». Проект не должен ограничиваться только коммерческими целями, он обязан опираться на четко научно обоснованную стратегию по сохранению экосистемы и рациональному использованию природных ресурсов. При этом необходимо учитывать демографическую нагрузку на территорию, и во избежание разрушения экосистемы озера, территория должна быть разделена на открытую зону для туристов, зону исключительно для научных целей и запретную зону (2-рис.).

2-рис. Сечанкуль



Источник: фотография сделана автором.

Гидрологические и химические показатели озера Сечанкуль за 2021–2025 годы свидетельствуют о том, что оно является не только сложной пустынной экосистемой, но и уникальной туристической дестинацией. Хотя высокий уровень солености и изменчивость уровня воды являются ограничением для стандартного пляжного туризма, они создают эксклюзивные возможности для специфических, высокодоходных туристических направлений.

Трансформация данных научных фактов в туристический потенциал выглядит следующим образом:

Гидрологический и химический показатель	**Туристическое направление и возможности**
Минерализация (11.48 – 14.65 г/л)	Бальнеологический и медицинский туризм: Высокое содержание солей и минералов в составе воды позволяет организовать услуги природного СПА и галотерапии, применяемые при лечении кожных заболеваний, болей в суставах и заболеваний нервной системы.
Содержание хлора (1.47 – 1.62 г/л)	Эффект «Мертвого моря»: Благодаря высокой плотности и антисептическим свойствам, туристам можно предложить уникальный опыт свободного плавания (удерживания на плаву) и релаксации на поверхности воды.
Нестабильность объема воды (695 – 864 млн м3)	Сезонный и фототуризм: Белоснежные солончаковые ландшафты и соляные пласты, появляющиеся на берегах в результате отступления уровня воды (особенно в засушливые периоды, как в 2023 году), являются идеальной локацией для фотографии и сафари по пустыне.
Заполненность проектной мощности на ~50%	Устойчивая зеленая инфраструктура: Обширная площадь (70.30 км²) и низкий уровень воды показывают, что самым правильным решением здесь является возведение не капитальных зданий, а адаптируемых к природе мобильных роскошных глэмпинг-комплексов.

Источник: подготовлен автором.

Роль Сечанкуля в развитии регионального туризма огромна, а обратная пропорциональность между объемом воды и соленостью означает, что терапевтические свойства озера меняются из года в год. На основе показателей (до 16.28 дС/м) и высокого уровня солености Сечанкуль можно брендировать как уникальную «соляную здравницу» в Центральной Азии. В рамках эксклюзивных эко-лагерей на 20 мест, построенных на берегу, внедрение соляных ванн, грязелечения и терапии пустынным климатом (климатотерапии) привлечет туристов с высокой платежеспособностью.

Тот факт, что объем озерной воды составляет всего 46,3% – 57,6% по отношению к проектному объему (1500 млн м3), указывает на крайнюю чувствительность данного водоема к изменениям климата и испарению. По этой причине допущение «Overtourism» (массового туризма) на этой территории исключено [3]. Вся туристическая деятельность должна строго управляться на основе принципа нулевых отходов (zero-waste), использования возобновляемых источников энергии и строгих международных стандартов «Leave No Trace» (Не оставляй следов) [4]. Этот подход не только сохранит природу, но и повысит эксклюзивный (VIP) статус объекта.

Поступление в озеро более пресной воды в 2024–2025 годах привело к некоторому смягчению экологической ситуации. Однако высокие температуры и испарение требуют использования в туристической инфраструктуре материалов, устойчивых к жаре, соленому ветру и коррозии.

Заключение. Сечанкуль, с его высокой соленостью и изменчивым уровнем воды, является не традиционным местом отдыха, а объектом эксклюзивного терапевтического и экологического туризма. Дефицит объема воды и высокие показатели минерализации за исследуемый 5-летний период подтверждают, что наиболее правильной экономической моделью здесь является создание не массового туризма, а высокомаржинальных глэмпинговых и оздоровительных комплексов, оказывающих минимальное воздействие на природу. Солоноватая вода озера — это не просто гидрологическая проблема, а мощный туристический ресурс, который можно монетизировать при помощи правильного маркетинга и строгих экологических норм.

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СОВРЕМЕННЫЕ СТРАТЕГИИ ПРОФИЛАКТИКИ ВИЧ-ИНФЕКЦИИ: РОЛЬ ДЛИТЕЛЬНО ДЕЙСТВУЮЩЕЙ АНТИРЕТРОВИРУСНОЙ ПРОФИЛАКТИКИ И НОВЫЕ ВОЗМОЖНОСТИ ПРИМЕНЕНИЯ ЛЕНАКОПАВИРА

Аннотация. *ВИЧ-инфекция сохраняет значение одной из важнейших проблем современной инфектологии. Несмотря на значительный прогресс в диагностике и антиретровирусной терапии, профилактика новых случаев ВИЧ остаётся актуальной задачей. Одним из перспективных направлений является использование длительно действующих антиретровирусных препаратов, позволяющих уменьшить зависимость профилактической эффективности от ежедневной приверженности пациента. Особое внимание в настоящее время уделяется ленакопавиру — ингибитору капсида ВИЧ-1 нового класса с продолжительным действием. В статье рассматриваются современные подходы к доконтактной профилактике ВИЧ, механизм действия ленакопавира, его потенциальные преимущества, ограничения и перспективы применения.*

Ключевые слова: *ВИЧ-инфекция, профилактика ВИЧ, доконтактная профилактика, PrEP, ленакопавир, антиретровирусная терапия, ингибитор капсида, лекарственная устойчивость.*

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CURRENT STRATEGIES FOR HIV PREVENTION: THE ROLE OF LONG-ACTING ANTIRETROVIRAL PROPHYLAXIS AND NEW OPPORTUNITIES FOR LENACAPAVIR

Abstract*: HIV infection remains an important global public health challenge. Despite major advances in diagnosis and antiretroviral therapy, prevention of new infections remains a priority. Long-acting antiretroviral agents represent a promising development because they can reduce dependence on daily adherence. Lenacapavir, a first-in-class HIV-1 capsid inhibitor with prolonged activity, has*

attracted particular attention as a novel prevention option. This review summarizes current approaches to HIV pre-exposure prophylaxis, the mechanism of lenacapavir, its potential advantages and limitations, and prospects for implementation.

***Keywords**: HIV infection, HIV prevention, pre-exposure prophylaxis, PrEP, lenacapavir, antiretroviral therapy, capsid inhibitor, drug resistance.*

Введение. ВИЧ-инфекция остаётся одной из наиболее значимых инфекционных проблем современности. По данным UNAIDS, несмотря на снижение числа новых инфекций и смертности, связанной с ВИЧ, глобальный прогресс недостаточен для достижения целей прекращения эпидемии СПИДа как угрозы общественному здравоохранению [1]. Современная профилактика включает тестирование на ВИЧ, раннее начало антиретровирусной терапии, доконтактную (PrEP) и постконтактную профилактику, профилактику передачи инфекции от матери ребёнку и другие мероприятия. Важным условием эффективности PrEP является соблюдение назначенного режима.

Ежедневный приём препаратов может быть затруднён вследствие забывчивости, особенностей образа жизни, стигматизации и других социальных факторов. Поэтому разработка длительно действующих лекарственных форм рассматривается как одно из перспективных направлений профилактики ВИЧ [2].

Длительно действующая профилактика ВИЧ. Длительно действующие антиретровирусные препараты позволяют увеличить интервал между введениями лекарственного средства и снизить зависимость профилактического эффекта от ежедневного поведения пациента.

Длительно действующая PrEP особенно важна для людей, которым трудно регулярно принимать таблетки или которые предпочитают более редкие медицинские вмешательства. По данным современных исследований, длительно действующие препараты обладают значительным потенциалом для расширения профилактических программ [2,3].

Ленакопавир: механизм действия и перспективы. Ленакопавир относится к новому классу антиретровирусных препаратов — ингибиторам капсида ВИЧ-1. Капсид участвует в нескольких ключевых этапах жизненного цикла вируса, поэтому его фармакологическое воздействие позволяет нарушать репликацию ВИЧ на различных стадиях [4].

Важной особенностью ленакопавира является длительное сохранение терапевтической активности. Это делает его перспективным для использования в длительно действующих профилактических схемах.

Современные клинические исследования продемонстрировали очень высокую эффективность ленакопавира в профилактике приобретения ВИЧ-инфекции [4,5]. Полученные результаты позволяют рассматривать препарат как потенциально важное дополнение к существующим стратегиям PrEP.

Значение приверженности и преимущества нового подхода

Одним из основных преимуществ длительно действующей профилактики является снижение необходимости ежедневного

самостоятельного приёма лекарственного средства. Это особенно важно, поскольку эффективность PrEP в реальной практике зависит не только от фармакологических свойств препарата, но и от приверженности пациента. К потенциальным преимуществам ленакопавира относятся длительное действие, высокая профилактическая эффективность и возможность индивидуального выбора профилактической стратегии. Использование различных форм PrEP позволяет учитывать медицинские, социальные и поведенческие особенности пациента [3,5].

Лекарственная устойчивость и безопасность

Несмотря на высокую эффективность ленакопавира, важной проблемой остаётся лекарственная устойчивость. Перед началом профилактики необходимо исключить уже существующую ВИЧ-инфекцию, поскольку применение препарата при нераспознанной инфекции может способствовать селекции устойчивых вариантов вируса.Регулярное тестирование на ВИЧ и соблюдение графика введения препарата являются важными условиями безопасного применения длительно действующей PrEP [4,6]. Другой проблемой является доступность. Высокая стоимость инновационных препаратов, необходимость подготовленного медицинского персонала и лабораторного контроля могут ограничивать их широкое применение, особенно в странах с ограниченными ресурсами [1,6].

Заключение

Длительно действующая антиретровирусная профилактика является одним из наиболее перспективных направлений современной профилактики ВИЧ. Ленакопавир, обладающий новым механизмом действия и продолжительной активностью, существенно расширяет возможности профилактических стратегий.

Его применение потенциально позволяет уменьшить зависимость профилактической эффективности от ежедневной приверженности и повысить удобство профилактики. Вместе с тем необходимы регулярное тестирование на ВИЧ, контроль лекарственной устойчивости, соблюдение интервалов введения и обеспечение доступности препарата.

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ЗАСОЛЕННОСТЬ ОСУШЕННОГО ДНА АРАЛЬСЬКОГО МОРЯ И ПОТЕНЦИАЛ ДАЛЬНЕГО ВЫНОСА СОЛЕЙ

Аннотация. *В статье представлены результаты исследования динамики засоленности осушенного дна Аральского моря (ОДА) и оценки потенциала дальнего выноса солей при пылевых бурях. Исследование выполнено на основе ГИС-картографирования пространственно-временной динамики засоленности, полевых экспериментов и расчетного моделирования. В июле 2025 г. на юго-восточной части ОДА были обследованы пять типичных ландшафтных участков, различающихся по механическому составу, степени засоленности, влажности почвы, растительному покрову и наличию солевой корки. Установлено увеличение засоленности почв за 2020–2025 гг. на 0,1% на старых осушках и до 0,5% на осушках последних десятилетий. Показано, что при скоростях ветра 5–8 м/с дальность выноса солей не превышает 100 км, тогда как при 15 м/с дальний перенос наблюдается примерно в 50% случаев и достигает в среднем 200 км. При штормовых скоростях ветра около 30 м/с вынос солей на расстояния свыше 100 км возможен для всех исследованных участков, а средняя дальность составляет около 300 км. Выявлена выраженная сезонная зависимость, с максимальным потенциалом дальнего выноса в теплый период года. Полученные результаты подтверждают высокую экологическую опасность засоленных участков ОДА как источников дальнего атмосферного переноса солевых аэрозолей.*

Ключевые слова: *осушенное дно Аральского моря, Аралкум, засоленность почв, пылевые бури, солевой аэрозоль, дальний перенос солей, дефляция, ГИС-картографирование, экологический риск, Аральское море.*

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SALINITY OF THE DRAINED ARAL SEA BED AND THE POTENTIAL FOR LONG-RANGE SALT TRANSPORT

Abstract. *This study presents the results of an investigation into the dynamics of salinity on the drained Aral Sea bed (DASB) and an assessment of the potential for long-range salt transport during dust storms. The study was based on GIS mapping of the spatial and temporal dynamics of soil salinity, field experiments, and computational modelling. In July 2025, five representative landscape sites in the southeastern part of the DASB were surveyed. The sites differed in soil texture, degree of salinity, soil moisture, vegetation cover, and the presence of a salt crust. An increase in soil salinity during 2020–2025 was established, amounting to 0.1% on older exposed areas and up to 0.5% on areas exposed during the last several decades. The results showed that at wind speeds of 5–8 m/s, the salt transport distance did not exceed 100 km, whereas at 15 m/s, long-range transport occurred in approximately 50% of cases, reaching an average distance of about 200 km. At storm wind speeds of approximately 30 m/s, salt transport over distances exceeding 100 km was possible from all investigated sites, with an average transport distance of approximately 300 km. A pronounced seasonal dependence was identified, with the highest potential for long-range salt transport occurring during the warm period of the year. The findings confirm the high environmental hazard posed by saline areas of the DASB as sources of long-range atmospheric transport of salt-containing aerosols.*

Keywords: *drained Aral Sea bed, Aralkum, soil salinity, dust storms, salt aerosol, long-range salt transport, deflation, GIS mapping, environmental risk, Aral Sea.*

Введение. Глобальное потепление, увеличивая энергетику атмосферных процессов, в частности скорость ветра, способствует увеличению масштабов и количества ПБ на планете (11, 12, 18, 19, 20). Важно отметить, что кроме климатических изменений экологическими предпосылками увеличения ПБ является повсеместно растущее опустынивание и уменьшение растительного покрова, существенно сдерживающего пыление поверхности. Планетарное значение

интенсификации ПБ определено провозглашением ООН 2025-2034гг. «десятилетием борьбы с пылевыми и песчаными бурями» в связи с многочисленными негативными последствиями.

Особое место в глобальной проблеме ПБ занимает антропогенная пустыня Аралкум с увеличивающейся площадью и засоленностью ввиду выноса вместе с почвенными частицами канцерогенных сульфатов. Помимо роста заболеваний вследствие выноса солей с осушенного дна Арала (ОДА), осаждение частиц солей на ледниках Памиро-Алая и Тянь-Шаня может вызвать их ускоренное таяние, что усугубляет и без того острую проблему водных ресурсов в регионе. Твердые частицы из бассейна Аральского моря могут переноситься на несколько сотен или даже тысяч километров, затрагивая Ферганский бассейн (долина в Центральной Азии, простирающаяся через восточный Узбекистан, южный Кыргызстан и северный Таджикистан), который находится в 1000 км от бассейна Аральского моря (16, 21). Мелкодисперсный материал из бассейна Аральского моря может также воздействовать на прибрежные районы Грузии и центральной и восточной Сибири, а также на арктические районы России (16, 17, 21) и на северо-западе Ирана (13, 15). Пыль из бассейна Аральского моря также может переноситься в Беларусь и Литву на северо-западе и в Афганистан на юго-востоке (14, 11).

Увеличение солевого выноса в атмосферу сказалось на минерализации атмосферных осадков, которая возросла в Приаралье в 6–7 раз. Увеличилось содержание аэрозолей (пыли) в атмосфере до 8 ПДК, достигая 10–12 ПДК во время пыльных бурь (9). В составе Аральской пыли содержание сульфатных солей достигает 25-48%, хлоридных - 18-30%, карбонатных – 10-20% (2).

В связи с вышесказанным актуальна цифровизация динамики засоленности ОДА и оценки потенциала дальности переноса солей. С этой целью проведены агрегированная модельная картография ПВД засоленности ОДА и расчеты потенциала отдельных участков постаквальной суши экологически опасного выноса солей на расстояния свыше 100 км. В работе для уточнения и подтверждения полученных при моделировании данных (4, 5) использовались результаты полевых экспериментов, выполненных в рамках проектов Министерство высшего образования, науки и инноваций РУз «AL-9424114994-Количественная оценка метеорологических и экологических условий прогноза пылевых бурь на осушенном дне Аральского моря».

Методы. Областью исследования является (рис. 1), юго-восточная часть осушенного дна Аральского моря (ОДА) как наименее изученная с точки зрения пылящих свойств подстилающей поверхности (ПП). В первой экспедиции (июль, 2025) проложен маршрут, по которому выбраны экспериментальные участки с различными параметрами механического и вещественного состава почвы, покрытости растительностью.

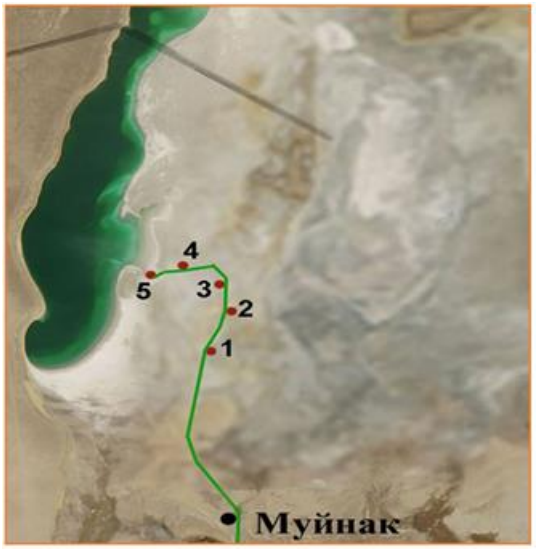
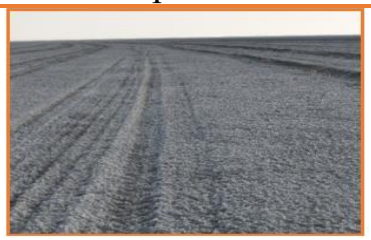


Рис. 1. Маршрут экспедиционных выездов.

По ходу маршрута были выбраны 5 экспериментальных участков с наиболее типичными для осушенного дна Аральского моря ландшафтами (рис.2.2). Нумерация участков соответствует обозначенным на рис.2.

Ландшафт №1. Супесь.
Координаты: Ш. 44°28"12 Д.58°56"15. Влажная темно-серая супесь, остатки ракушек. Соленость 19,8%. Песок покрыт твердой коркой толщиной 0,5-1 см. Растительности нет.



Ландшафт №2. Песок.
Координаты: Ш. 44°45"28 Д.58°49"20. Сухой светло-серый песок, с остатками ракушек, их мелкими фракциями и примесью растительных остатков. Соленость 5,2%. Растительный покров 60%.



Ландшафт №3. Песок.
Координаты: Ш. 44°44"56 Д.58°46"6. Серая супесь с остатками ракушек. Соленость 8,6%. Растительный покров 30%.



Ландшафт №4. Засоленные земли.
Координаты: Ш. 44°43"34 Д.59°1"12. Светло-серый песок с мелкими фракциями ракушек. Засоленная почва с твердой коркой толщиной 1-1,5 см. Соленость 2,8%. Растительности нет.



Ландшафт №5. Солончак.
Координаты: Ш. 44°43"21Д.58°43"14. Влажная темно-серая глинистая почва с фрагментами ракушек. Солончак с твердой коркой толщиной 1-2 см. Соленость 13,6%. Растительности нет.



Рис.2. Экспериментальные участки маршрута.

Полевые эксперименты по эродируемости различных ландшафтов проводились с помощью приборов для измерения концентрации пыли (счетчики аэрозольных частиц SorhisSX-L301T, АЗ-10-0,3), скорости ветра (UNI-T UT363), температуры и влажности воздуха (Testo 625), ветрогенератор 345ВТ, прибор для определения влажности и температуры почвы (ECHO PB-770, измерительРН) и Мини-лаборатория ФТ-ГТ5 (рис. 3).

Исследование почвенных образцов проводилось методом водной вытяжки, изложенным в методах исследования почв и почвенного покрова (6). Водную вытяжку почв опытных участков готовили по общепринятой методике – почва/вода в соотношении 1:5 (1). Степень засоления почвогрунтов оценивали по шкале (3).

Содержание в фильтрате сульфатов определялось арбитражным методом. Сульфаты осаждались в кислой среде 0,05 н раствором хлористого бария, осадок фильтровался через обеззоленный фильтр "синяя лента", прокаливался в муфельной печи при 400-450 ^{0}С до постоянного веса. Суммарное содержание натрия и калия учитывалось по разнице сумы анионов – карбонатов, бикарбонатов, хлоридов, сульфатов и катионов – кальция и магния.



Рис.3. Ипользованные приборы

Данные полевых экспериментов обрабатывались также на предмет содержания солей в поднятой пыли.

Методика моделирования засоленности почв ОДА подробно изложена в работах (7, 8). При картографировании использованы ГИС-технологии (QGIS и ArcMap).

Наибольшее экологическое и практическое значение имеет дальний (более 100 км) вынос солей с ОДА. Основная цель решения данной задачи – определить потенциал дальнего выноса солей при ПБ каждого из исследуемых участков.

Масштабный вынос солей при ПБ средней продолжительности (3 часа) определен как превышение ПДК сульфатов (30 мкг/м3) на расстояниях больше 100км. Схема вычислений следующая:

$$C_{ПДК}(x, y) = C_H \exp(-0{,}015x - 0{,}6) \quad (1)$$

где $C_H = 3{,}3k$ (Тлеум 2018), k=7,7м$^{-1}$, V=$F_{эксп}$ $T_б$, $T_б$ – продолжительность ПБ.

Мощность источника (мкг/м^2/с) по результатам экспериментов определяется по формуле:

$$F_{ЭКСП}(\cup) = C_S C_{ЭКСП}/M \quad (2)$$

где М-время экспозиции счетчика аэрозоля, C_S – засоленность почвы (%), $C_{ЭКСП}$ – показание счетчика аэрозоля.

По формуле (2) определяется расстояние х, если оно больше 100 км соответствующий ансамбль характеристик подстилающей поверхности (ПП) считается благоприятствующим масштабному дальнему выносу солей с осушенного дна Аральского моря. Таким образом были проведены расчеты для каждого экспериментального участка.

Результаты. В рамках проекта «AL-9424114994-Количественная оценка метеорологических и экологических условий прогноза пылевых бурь на осушенном дне Аральского моря» выполнена картография динамики засоленности ОДА с использованием ГИС-технологий и результатов полевых исследований (рис.4).

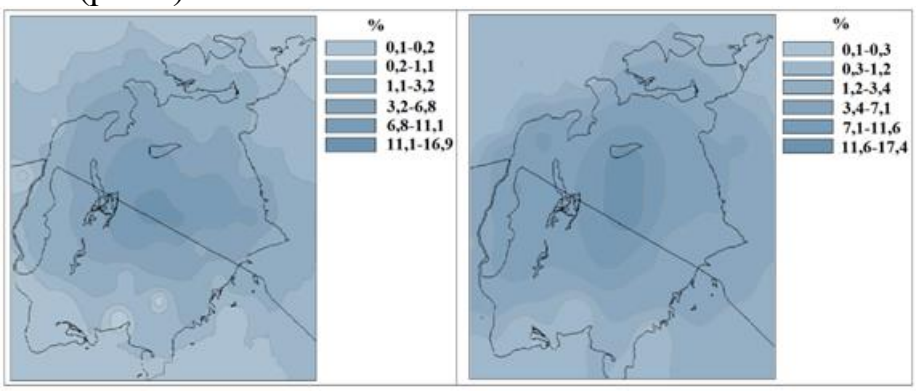


Рис. 4. Агрегированная засоленность ОДА (%) в 2020г. и 2025гг.

Сравнивая карты засоленности почв на 2020 и 2025 годы, можно отметить возрастание засоленности за 5 лет с 0,1% на старых осушках до 0,5% на осушках последних десятилетий. Возрастание засоленности на старых осушках вопреки сложившемуся мнению, что на них происходит непрерывное рассоление, можно объяснить масштабным ветровым перераспределением при ПБ. Замеры засоленности почв на экспериментальных участках осредненные за год совпадают со значениями в соответствующих точках карты на 2025г. Результаты картографии

засоленности ОДА с использованием ГИС- технологий сравнивались с выполненными ранее (4, 5) расчетами средней засоленности десятилетних полос осушения без применения ГИС-технологий. Сравнительный анализ показал хорошее согласие результатов картографии по обоим вариантам расчетов, несмотря на сплайновую интерполяцию, применяемую в ГИС-технологиях (рис.5).

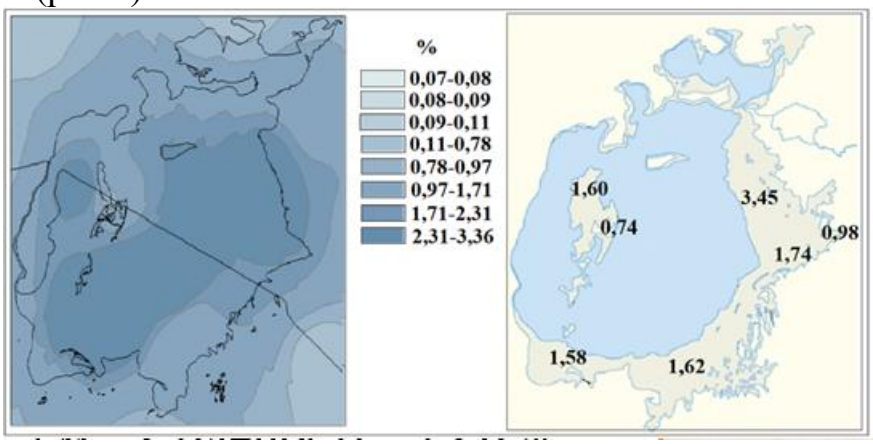


Рис.5. Картография засоленности ОДА в 1990г. по двум вариантам расчетов

Имеющий важное экологическое и практическое значение вынос солей с ОДА на прилегающие территории определен в данной работе как расстояние сезонного распространения потока солей с единицы площади. Предварительно на основе обработки экспериментальных данных вычисляется содержание солей в поднятой ветрогенераторами пыли. Результаты по участкам и месяцам приведены в табл. 1.

Таблица 1.

Расчетная концентрация (мг/м^3) солей
в поднимаемой пыли на исследуемых участках

0	Участок 1	Участок 2	Участок 3	Участок 4	Участок 5
Август	0,38	0,091	0,89	0,02	0,13
Сентябрь	0,009	0,190	0,13	0,22	0,06
Октябрь	0,01	0,05	0,01	0,02	0,01
Ноябрь	0,37	0,75	0,08	2,47	4,49
Февраль	0,78	0,02	0,016	0,173	0,004
Март	0,89	0,03	0,019	0,205	0,006
Апрель	0,29	0,005	0,008	0,015	0,003
Май	0,34	0,008	0,012	0,021	0,004
Июнь	0,46	0,015	0,019	0,019	0,008

Вычисленная $C_S C_{ЭКСП}$ подставляется в (2) для определения потенциала дальнего выноса солей с каждого экспериментального участка (табл.2). Потенциал конкретных ландшафтов по масштабному выносу солей

оценивался по расстоянию, на котором пыль с данного участка во время одной ПБ превышает ПДК сульфатов (30 мкг/м^3).

Таблица 2

Расстояние от источника ПП с содержанием солевой пыли выше ПДК (км)

Место эксперимента	скорость ветра м/с	Месяцы									
		II	III	IV	V	VI	VII	VIII	IX	X	XI
Участок-1	5	17	19	97	43	50	47	0	2	3	28
	15	92	38	125	69	66	61	173	7	5	91
	30	261	288	307	334	400	421	427	47	108	163
Участок-2	5	89	99	87	50	42	38	132	19	38	44
	15	184	187	103	138	141	146	397	236	212	87
	30	261	288	307	334	396	478	489	463	415	302
Участок-3	5	37	45	22	41	32	52	34	95	16	4
	15	118	128	52	86	88	92	175	149	66	7
	30	261	288	261	345	404	418	427	466	345	271
Участок-4	5	118	133	60	79	84	92	16	32	34	81
	15	319	328	140	183	186	192	71	90	65	196
	30	345	361	261	288	386	261	261	307	261	311
Участок-5	5	2	0	31	63	75	85	39	8	17	54
	15	17	5	101	203	211	215	172	122	48	166
	30	215	215	261	288	386	261	261	288	215	307

Примечание: закрашенные ячейки – вынос солей с превышением ПДК сульфатов на расстояния более 100 км.

Выявлено, что при умеренных скоростях ветра (5-8 м/с) вынос солей для всех участков не превышает 100 км, т.е. не достигает орошаемых территорий. При скорости ветра 15м/с дальний вынос происходит в 50% случаев со средним значением 200км и представляет средний экологический риск. При этом наиболее опасны 2 и 4 участки. При пылевых бурях со скоростью ветра 30м/с дальний вынос солей (со средним значением 300км) происходит на всех участках. Таким образом потенциал дальнего выноса солей для всех исследуемых участков достаточно высок при штормовых метеоусловиях. Отметим, что незначительный вынос в сентябре объясняется тем, что эксперименты проведены через сутки после выпавших осадков и влажность почвы была поэтому достаточно высокой. Это лишний раз доказывает значимость осадков в подавлении пылевых явлений.

Заключение. Проведённое исследование показало, что осушенное дно Аральского моря (ОДА) сохраняет высокий потенциал формирования и дальнего атмосферного переноса солесодержащего аэрозоля. Совместное

использование ГИС-картографирования, полевых исследований и расчётного моделирования позволило оценить пространственно-временную динамику засоленности почв и установить зависимость дальности переноса солей от характеристик подстилающей поверхности и метеорологических условий.

1. Засоленность ОДА продолжает увеличиваться. За период 2020–2025 гг. её прирост составил около 0,1% на старых осушках и до 0,5% на осушках последних десятилетий. Полученные результаты свидетельствуют о сохранении процессов перераспределения и аккумуляции солей на поверхности ОДА, в том числе вследствие ветрового переноса солесодержащего материала.

2. Потенциал дальнего выноса солей имеет выраженную сезонную зависимость. Максимальные значения характерны для тёплого периода года (апрель–сентябрь), когда сочетание повышенной сухости подстилающей поверхности и благоприятных ветровых условий способствует усилению дефляционных процессов. После выпадения осадков дальность переноса существенно снижается вследствие повышения влажности почвы.

3. Скорость ветра является одним из основных факторов, определяющих дальность переноса солей. При скоростях 5–8 м/с дальность переноса, как правило, не превышает 100 км. При скорости около 15 м/с дальний вынос на расстояния более 100 км отмечается примерно в половине рассмотренных случаев, а средняя дальность достигает около 200 км. При штормовых скоростях порядка 30 м/с превышение порога 100 км наблюдается для всех исследованных участков, при этом средняя расчётная дальность переноса составляет около 300 км.

4. Наиболее высоким потенциалом дальнего выноса характеризуются участки с сочетанием повышенной доступности солесодержащего материала и благоприятных условий дефляции. В условиях ветра 15 м/с наиболее опасными по расчётным показателям оказались участки №2 и №4. Однако при штормовых условиях различия между участками уменьшаются, и дальний перенос становится возможным практически со всех исследованных ландшафтов.

5. Засоленность почвы и состояние поверхности определяют интенсивность формирования солесодержащего аэрозоля. Наличие плотной солевой корки, повышенная влажность и растительный покров ограничивают дефляцию и, соответственно, уменьшают потенциальную дальность переноса. Наиболее существенное кратковременное снижение пылеобразования наблюдается после выпадения осадков, что подтверждается низкими значениями дальности переноса в сентябре после увлажнения почвы.

6. Экологическая опасность ОДА определяется не только локальным пылеобразованием, но и возможностью трансграничного переноса солесодержащего аэрозоля. При сильных и штормовых ветрах сформировавшийся аэрозоль может распространяться на сотни километров, что создаёт потенциальную угрозу прилегающим территориям, сельскохозяйственным угодьям и природным экосистемам.

Таким образом, полученные результаты подтверждают необходимость учёта засоленности почв, влажности, состояния солевой корки, растительного покрова и скорости ветра при оценке риска дальнего переноса солей с ОДА. Разработанный подход может быть использован для пространственного районирования ОДА по степени потенциальной опасности, совершенствования прогноза пылевых бурь и обоснования приоритетных мероприятий по закреплению наиболее опасных участков Аралкума.

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АНАЛИЗ ТЕХНИЧЕСКИХ И ЭКОНОМИКО-ПРАВОВЫХ МЕР ПО СОКРАЩЕНИЮ ПОТЕРЬ ВОДЫ В ИРРИГАЦИОННЫХ СИСТЕМАХ: ОПЫТ ВНЕДРЕНИЯ СОВРЕМЕННЫХ ТЕХНОЛОГИЙ И СТРАТЕГИИ УЗБЕКИСТАНА

***Аннотация**: В данной работе представлен системный анализ инженерных и экономико-правовых стратегий, направленных на радикальное сокращение потерь водных ресурсов в ирригационных сетях. Проблема деградации фильтрационных завес и испарения в открытых каналах рассматривается как ключевой барьер для устойчивого развития агропромышленного комплекса в аридных регионах. В статье синтезирован передовой мировой опыт применения геосинтетических барьеров (Bentofix®, Carbofol®), модульных плавающих покрытий и инновационных «солнечных каналов» (Solar Canals), обеспечивающих синергию генерации энергии и водосбережения. Особое внимание уделено реализации государственной стратегии Республики Узбекистан в рамках постановлений Президента ПП-47 и ПП-79. В работе обоснована необходимость цифрового мониторинга через интеграцию с ИС «Сув ҳисоби» и применение жестких фискальных мер, таких как двукратное увеличение ставки налога за водопользование при отсутствии «умных» систем учета.*

***Ключевые слова:** Открытые каналы, фильтрация воды, испарение, гидроизоляция, HDPE геомембрана, геосинтетические маты (GCL), солнечные панели (solar canals), закрытые трубопроводы, модульные плавающие покрытия, водосберегающие технологии, государственные субсидии.*

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ANALYSIS OF TECHNICAL AND ECONOMIC-LEGAL MEASURES TO REDUCE WATER LOSSES IN IRRIGATION SYSTEMS: EXPERIENCE OF IMPLEMENTING MODERN TECHNOLOGIES AND STRATEGIES IN UZBEKISTAN

***Abstract:** This paper presents a systems analysis of engineering and economic-legal strategies aimed at radically reducing water losses in irrigation*

networks. The problem of degradation of filter curtains and evaporation in open canals is considered a key barrier to the sustainable development of the agro-industrial complex in arid regions. The article synthesizes the best international practices in the application of geosynthetic barriers (Bentofix®, Carbofol®), modular floating covers, and innovative "solar channels" (Solar Canals), which ensure synergy between energy generation and water conservation. Particular attention is paid to the implementation of the state strategy of the Republic of Uzbekistan within the framework of Presidential Decrees PP-47 and PP-79. The paper substantiates the need for digital monitoring through integration with the "Suv Hisobi" information system and the application of strict fiscal measures, such as a twofold increase in the tax rate for water use in the absence of "smart" metering systems.

Keywords: *Irrigation canals, seepage losses, evaporation control, geomembrane lining, geosynthetic clay liners (GCL), solar canals, canal-to-pipeline conversion, floating covers, water productivity, agricultural subsidies, water conservation policy.*

Введение. Глобальный дефицит пресной воды в засушливых зонах диктует необходимость пересмотра традиционных подходов к эксплуатации ирригационной инфраструктуры. Основными деструктивными факторами эффективности открытых каналов остаются инфильтрация, интенсивное испарение, береговая эрозия и неконтролируемое биообрастание, снижающее дебит систем.

Для узбекистана данная проблематика носит критический характер ввиду исчерпания проектного ресурса большинства объектов. Значительная часть магистральных и распределительных сетей была введена в эксплуатацию в 1930–1950-х годах; таким образом, возраст инфраструктуры достигает 90 и более лет, что значительно превышает нормативные сроки эксплуатации. Традиционные методы облицовки демонстрируют низкую надежность: бетонные покрытия без современных геосинтетических подложек подвержены растрескиванию из-за температурных деформаций и пучения грунтов, что превращает их из водонепроницаемых барьеров в «защитную броню», не препятствующую фильтрационным потерям.

Методология. Исследование базируется на междисциплинарном аналитическом подходе, включающем:

Инженерно-технический аудит: сравнительный анализ гидравлической эффективности систем облицовки на базе бентонитовых матов (gcl) и полимерных мембран (hdpe) в сравнении с монолитным бетоном.

Синтез международных данных: оценка эффективности модульных покрытий (по данным awtt) и расчетных показателей проекта project nexus (uc merced) по перекрытию каналов фотоэлектрическими панелями.

Экономико-правовой анализ: оценка нормативно-правовой базы узбекистана (пп-47 от 05.02.2026 и пп-79 от 05.03.2026) в контексте субсидирования и внедрения цифровых систем мониторинга.

Технические и инженерные решения для минимизации потерь. Противофильтрационные системы: геосинтетические экраны и бетон. Современная гидротехническая практика требует перехода к комбинированным многослойным экранам.

Инженерное преимущество систем «геомембрана + бетон» заключается в том, что полимерный экран сохраняет герметичность даже при неизбежном нарушении целостности бетонного слоя, который в данном случае выполняет лишь функцию балласта и защиты от механических повреждений.

Таблица. 1

Сравнительная характеристика материалов для облицовки

Критерий	Bentofix® (GCL)	Carbofol® (HDPE)	Традиционный бетон
Коэффициент фильтрации (k)	$\leq 5 \times 10^{-11}$ м/с	Практически 0 (абсолютный барьер)	Высокий ($> 10^{-6}$ м/с) при деградации
Самовосстановление	Высокое (разбухание бентонита)	Требуется экструзионная сварка	Отсутствует; высокая хрупкость
Монтажные особенности	Возможна укладка под водой	Требует подготовки основания	Трудоемкая логистика смеси
Механизмы отказа	Практически отсутствуют в проектных циклах	Риск прокола при монтаже	Термическое растрескивание; отсутствие гибких швов

Борьба с испарением: Плавающие покрытия и солнечные каналы. Потери на испарение в условиях Узбекистана могут достигать критических величин (до 2500 мм водного столба в год).

Модульные покрытия: Применение систем Hexa-Cover или Rhombo Hexoshield® обеспечивает закрытие до 99% зеркала воды, сокращая испарение на 98% и подавляя рост водорослей за счет блокировки фотосинтеза.

Концепция «Solar Canals»: Установка фотоэлектрических панелей над руслами каналов создает уникальный технологический симбиоз:

Экономия ресурса: до 63 млрд галлонов воды в год (по моделированию UC Merced).

Повышение КПД панелей: конвективное охлаждение за счет близости водного потока повышает эффективность выработки энергии.

Защита от сорняков: затенение минимизирует эксплуатационные расходы на очистку русла.

Землепользование: размещение 13 ГВт потенциальной мощности без изъятия плодородных земель из оборота.

Конверсия открытых каналов в закрытые трубопроводы. Переход на закрытую транспортировку является наиболее радикальным методом повышения эффективности: 100% устранение инфильтрационных и испарительных потерь.

Гравитационный напор: использование естественного пьезометрического напора позволяет исключить использование насосных станций, что дает колоссальную экономию O&M.

Повышение КПД доставки до уровня 95–100%.

Ликвидация эрозии и заиления русла.

Стабильность качества воды (отсутствие внешнего загрязнения).

Снижение затрат на очистку от растительности и наносов.

Надежность: полное исключение рисков размыва дамб и аварийных прорывов.

РЕЗУЛЬТАТЫ И ОБСУЖДЕНИЕ: ЭКОНОМИЧЕСКИЙ АНАЛИЗ НА ПРИМЕРЕ УЗБЕКИСТАНА. Финансовые механизмы и государственная поддержка (ПП-47 и ПП-79). Государственная стратегия модернизации базируется на масштабном финансовом обеспечении: 480 млрд сумов выделено на целевые работы по бетонированию каналов и оросительных сетей. 2,6 трлн сумов — объем льготного кредитования через коммерческие банки для частных инициатив. 800 млрд сумов — объем прямых государственных субсидий.

Размер субсидий составляет 8–12 млн сумов за гектар при внедрении водосберегающих систем. Особо выделены регионы со сложной водохозяйственной обстановкой — Республика Каракалпакстан и Хорезмская область, где применяется повышающий коэффициент 1,25 к базовым выплатам.

Прогнозируемая эффективность и показатели мониторинга. Целевыми индикаторами реформ являются экономия 206 млн м³ воды и 26 млн кВтч электроэнергии. Модернизация затронет 389 км каналов с критическими потерями.

Инструменты контроля и санкции:

«Умный» водоучет: Обязательная установка приборов измерения с интеграцией в систему «Сув ҳисоби». С 2027 года при отсутствии таких приборов ставка налога за использование воды увеличивается в 2 раза (двукратный размер).

Цифровая маркировка: Использование QR-кодов на оборудовании и GPS-трекеров для мониторинга хода работ и исключения нецелевого использования бюджетных средств.

ЗАКЛЮЧЕНИЕ. Максимальный гидротехнический эффект достижим только при конвергенции современных материалов (HDPE/GCL) с методами активной борьбы с испарением (Solar Canals). Инвестиции в размере 480 млрд сумов и создание системы льготного кредитования (2,6 трлн сумов) в Узбекистане являются фундаментом для перехода к рациональному водопользованию. Однако техническая модернизация должна сопровождаться жестким правовым регулированием, включая штрафные коэффициенты налогообложения, что обеспечит экономическую мотивацию всех участников водохозяйственного цикла.

Использованные источники:

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СТАТУС КАК СОЦИАЛЬНО ПРИЗНАННАЯ СПОСОБНОСТЬ РЕШАТЬ ЗАДАЧИ: ЭВОЛЮЦИОННО-ПСИХОЛОГИЧЕСКАЯ МОДЕЛЬ ЧЕЛОВЕЧЕСКОЙ ДЕЯТЕЛЬНОСТИ

Аннотация: *Статья посвящена теоретическому анализу взаимосвязи между социальной иерархией, человеческой деятельностью, кооперацией и стремлением к повышению статуса. Предлагается рассматривать человека как биологически и культурно встроенный элемент иерархически организованных социальных систем, устойчивость которых зависит от способности участников решать взаимосвязанные задачи различного масштаба и сложности. На основании анализа исследований по эволюционной психологии, теории социального статуса, культурной эволюции, кооперации, социальной идентичности и самоопределению формулируется рабочее определение статуса как социально признанной способности человека решать задачи с определённым уровнем сложности, неопределённости, масштаба и ответственности. Показано, что стремление к статусу может быть связано с доступом к ресурсам, партнёрам, поддержке, влиянию и возможностям воспроизводства, однако не сводится к доминированию или материальному вознаграждению. Обосновывается гипотеза о том, что значительная часть человеческой деятельности направлена на увеличение личной и коллективной способности решать задачи, а повышение статуса является одним из механизмов координации этих усилий. Одновременно анализируются ограничения данной модели: неоднородность человеческих мотивов, значение автономии и привязанности, возможность деструктивного повышения статуса, а также несоответствие между сложностью задачи и её общественной ценностью.*

Ключевые слова: *эволюционная психология, социальный статус, престиж, доминирование, кооперация, иерархия, культурная эволюция, человеческая деятельность, социальная идентичность, смысл деятельности.*

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STATUS AS A SOCIALLY RECOGNIZED ABILITY TO SOLVE PROBLEMS: AN EVOLUTIONARY-PSYCHOLOGICAL MODEL OF HUMAN ACTIVITY

***Abstract*:** *This article presents a theoretical analysis of the relationship between social hierarchy, human activity, cooperation, and the pursuit of status. It proposes viewing humans as biologically and culturally embedded in hierarchically organized social systems whose stability depends on the ability of their members to solve interconnected tasks of varying scale and complexity. Based on an analysis of research in evolutionary psychology, social status theory, cultural evolution, cooperation, social identity, and self-determination, the article develops a working definition of status as the socially recognized ability of an individual to solve tasks characterized by a particular level of complexity, uncertainty, scope, and responsibility. The analysis shows that the pursuit of status may be associated with access to resources, partners, support, influence, and reproductive opportunities, but it cannot be reduced to dominance or material rewards. The article advances the hypothesis that a substantial part of human activity is directed toward increasing individual and collective problem-solving capacity, while status enhancement functions as one of the mechanisms coordinating these efforts. At the same time, the article examines the limitations of this model, including the diversity of human motives, the importance of autonomy and attachment, the possibility of destructive status-seeking, and the lack of a necessary correspondence between task complexity and social value.*

Keywords: *evolutionary psychology, social status, prestige, dominance, cooperation, hierarchy, cultural evolution, human activity, social identity, meaning of activity.*

Введение

Человеческое поведение формируется на пересечении нескольких уровней организации: биологического организма, межличностных отношений, малых групп, институтов и человеческой цивилизации. Человек зависит от социальной среды не только в эмоциональном и культурном отношении, но и в отношении базового выживания. Доступ к пище, медицинской помощи, знаниям, защите и экономическим ресурсам обеспечивается сложными системами кооперации, которые не могут поддерживаться отдельным индивидом.

Эта особенность делает человеческую деятельность принципиально социальной. Даже действия, направленные на индивидуальное благополучие, обычно опираются на результаты труда других людей и одновременно поддерживают или изменяют коллективные системы. Врач лечит конкретного пациента, но участвует в поддержании здоровья населения; инженер решает техническую задачу, но поддерживает инфраструктуру; учитель передаёт знания, обеспечивая воспроизводство компетенций; исследователь расширяет совокупность доступных человечеству знаний.

Вопрос о том, какие механизмы направляют человеческую деятельность, занимает центральное место в эволюционной психологии и смежных дисциплинах. Одно направление исследований подчёркивает стремление к ресурсам и репродуктивным преимуществам, другое — значение кооперации, взаимности и репутации, третье — роль автономии, принадлежности и поиска смысла. Особое место занимает проблема социального статуса: люди чувствительны к признанию, сравнению, уважению и угрозе понижения, а социальное положение влияет на доступ к ресурсам и характер взаимодействий.

Цель настоящей статьи — разработать и критически обсудить теоретическую модель, согласно которой статус можно рассматривать как уровень сложности задач, которые человек способен решать и за которые общество готово признавать его ответственность. Основная гипотеза состоит в том, что повышение статуса часто выступает не самостоятельной конечной целью, а механизмом, через который индивид получает доступ к более сложным задачам, ресурсам и возможностям влияния на коллективную систему.

Теоретические основания

Человек как вид, зависящий от кооперации

Эволюция человека происходила в условиях высокой зависимости от сотрудничества. Использование орудий, добыча пищи, защита от опасностей, уход за детьми и передача знаний требовали координации между несколькими участниками. В отличие от многих видов, человеческое детство продолжительно, а потомство нуждается в длительной заботе и обучении. Это способствовало развитию механизмов взаимопомощи, обучения, разделения труда и контроля над нарушителями норм.

Теории группового отбора и культурной эволюции подчёркивают, что человеческие группы могли получать преимущества благодаря нормам сотрудничества, наказанию нарушителей и способности передавать социальные практики между поколениями (Boyd & Richerson, 1985; Henrich & Boyd, 2001; Boyd et al., 2003). При этом кооперация не исключает конкуренции. Напротив, во многих случаях индивиды конкурируют за положение внутри группы, одновременно участвуя в совместной деятельности.

Современное человечество представляет собой многоуровневую систему: локальные группы встроены в организации, организации — в государства, государства — в глобальные сети обмена, науки и коммуникации. На каждом уровне возникают задачи, требующие координации множества участников. Поэтому выживание человека как индивида зависит от поддержания систем, которые превосходят его непосредственные интересы и временной горизонт.

Утверждение о том, что деятельность человека направлена на сохранение человечества как вида, требует осторожной формулировки. Эволюция не наделяет индивида сознательной целью «сохранить

человечество». Естественный отбор формирует механизмы, которые в определённых условиях повышают вероятность выживания, кооперации и воспроизводства. Забота о будущем вида является, как правило, культурно сформированной и сознательной формой деятельности, а не прямым универсальным инстинктом. Поэтому корректнее говорить, что человеческие способности к сотрудничеству, обучению и долгосрочному планированию создают возможность для коллективного сохранения и развития вида.

Социальная иерархия и статус

Иерархия является способом распределения доступа к ресурсам, влиянию, ответственности и информации. В человеческих группах положение индивида определяется не одним фактором. Оно может зависеть от силы, богатства, родства, возраста, компетентности, щедрости, репутации и способности координировать других.

В исследованиях социального ранга обычно различают два механизма приобретения статуса: доминирование и престиж. Доминирование основано на способности принуждать, угрожать и контролировать других. Престиж связан с компетентностью, успехом, полезностью и добровольным признанием со стороны группы (Henrich & Gil-White, 2001). Эти механизмы могут сосуществовать, но имеют разные психологические последствия. При доминировании окружающие подчиняются из-за угрозы издержек, а при престиже ориентируются на человека как на источник знаний и успешных моделей поведения.

Эмпирические исследования показывают, что статус связан с целым комплексом последствий. Он может повышать внимание со стороны окружающих, расширять возможности влияния, облегчать доступ к социальным ресурсам и изменять ожидания партнёров по взаимодействию (Anderson et al., 2015; Cheng et al., 2013). Однако высокий статус не всегда означает большую власть, а власть не всегда сопровождается уважением. Следовательно, статус необходимо отличать от формальной должности, дохода и способности принуждать.

Эволюционное значение стремления к повышению статуса

С точки зрения эволюционной психологии, стремление к повышению статуса может иметь несколько взаимосвязанных функций. Во-первых, высокий статус исторически мог повышать доступ к пище, защите, союзникам и другим ресурсам. Во-вторых, он мог влиять на вероятность получения помощи и участия в выгодных обменах. В-третьих, статус мог повышать привлекательность в качестве социального или брачного партнёра. В-четвёртых, он мог увеличивать влияние индивида на распределение ресурсов и принятие решений.

При этом статус является относительной характеристикой. Значение имеет не только абсолютный объём ресурсов, но и положение человека по сравнению с другими членами группы. Поэтому социальное сравнение становится важным регулятором поведения (Festinger, 1954). Человек

стремится не просто обладать некоторым количеством благ, но и понимать, как его положение соотносится с положением окружающих.

Исследования показывают, что статусная мотивация может проявляться в стремлении к уважению, признанию, превосходству, компетентности и влиянию. Однако эти формы нельзя объединять автоматически. Желание быть компетентным специалистом отличается от желания унижать соперников; стремление получить признание отличается от стремления контролировать других.

Статус как уровень сложности решаемых задач

Рабочее определение

Предлагается определить профессиональный и социальный статус как степень социально признанной способности индивида самостоятельно и ответственно решать задачи определённого уровня сложности.

В таком определении сложность задачи включает несколько компонентов:

- количество взаимосвязанных факторов, которые необходимо учитывать;
- уровень неопределённости и неполноты информации;
- масштаб затрагиваемой системы и число заинтересованных участников;
- длительность временного горизонта;
- степень ответственности за последствия;
- необходимость координации действий других людей;
- цену ошибки и трудность исправления результата.

Например, выполнение стандартной операции требует одного набора навыков. Проектирование процесса требует понимания взаимосвязей между операциями. Управление организационным изменением требует учитывать интересы нескольких групп, распределять ресурсы, предвидеть риски и поддерживать кооперацию в течение длительного времени. Формальная должность может различаться, но именно рост сложности и ответственности задач позволяет содержательно сравнивать уровни деятельности.

Отличие от традиционного понимания статуса

В социологии статус часто понимается как социальная позиция, связанная с набором прав и обязанностей (Linton, 1936). В психологии статус может описываться как относительная престижность, уважение или влияние человека в группе (Anderson et al., 2015). Предлагаемая модель не отменяет эти определения, а добавляет функциональный критерий: статус связан с тем, какие задачи общество считает возможным доверить человеку.

Однако сложность задач не является достаточным условием статуса. Задача может быть сложной, но незначимой для окружающих, вредной или выполняемой без общественного признания. Поэтому необходимы три компонента:

1. объективная или межсубъективно оцениваемая сложность задачи;
2. способность человека получать воспроизводимый результат;

3. социальное признание этой способности и готовность передавать ему соответствующие полномочия.

Такое определение позволяет связать индивидуальную компетентность с социальной структурой. Более высокий статус означает не просто большую ценность человека «вообще», а расширенный круг задач, решений и последствий, которые ему доверяются.

Анализ предшествующих подходов

Теории доминирования и престижа

Henrich и Gil-White (2001) предложили свой подход к различению доминирования и престижа. Их модель особенно важна для настоящей концепции, поскольку показывает: социальное положение может возникать не только из принуждения, но и из добровольного признания компетентности. В рамках предлагаемой модели сложные задачи являются одним из источников престижа, если человек демонстрирует способность решать их в интересах группы.

Cheng и коллеги (2013) развили идею двух независимых путей к статусу и показали, что доминирование и престиж связаны с разными формами поведения и восприятия. Это ограничивает упрощённую формулу «более сложные задачи автоматически означают более высокий статус». Человек может контролировать значимые ресурсы, не обладая соответствующей компетентностью, и, напротив, быть высоко уважаемым специалистом без формальной власти.

Anderson и соавторы (2015) рассматривали статус как уважение и влияние в группе. Их подход согласуется с тезисом о социально признанной способности решать задачи, но подчёркивает, что статус формируется в конкретном контексте. Один и тот же человек может обладать высоким статусом в профессиональной группе и низким статусом в другой области.

Кооперация и репутация

Теории косвенной взаимности связывают кооперацию с репутацией. Если действия человека наблюдаются другими, репутация может влиять на готовность окружающих сотрудничать с ним в будущем (Nowak & Sigmund, 2005). С этой точки зрения статус выступает не только наградой, но и механизмом распределения доверия. Группе выгодно предоставлять больше возможностей человеку, который уже продемонстрировал способность надёжно решать значимые задачи.

Проблема состоит в том, что репутация может быть ошибочной или манипулируемой. Публичность, самопрезентация и принадлежность к престижной группе способны создавать видимость компетентности. Поэтому устойчивый статус требует не только символического признания, но и воспроизводимых результатов, подтверждённых опытом взаимодействия.

Социальная идентичность

Теория социальной идентичности показывает, что человек определяет себя не только как отдельного индивида, но и как участника групп (Tajfel & Turner, 1979). Статус группы влияет на самооценку её членов, а действия

человека могут быть направлены на повышение положения не только самого себя, но и собственной группы.

Этот подход расширяет индивидуалистическую модель статусной мотивации. Человек может стремиться к престижу профессии, университета, научного сообщества или государства. В таком случае повышение статуса воспринимается как вклад в коллективную идентичность. Одновременно групповая конкуренция может провоцировать враждебность и препятствовать сотрудничеству между группами.

Теория самоопределения и множественность мотивов

Теория самоопределения выделяет базовые потребности в автономии, компетентности и связанности с другими людьми (Deci & Ryan, 2000). Она показывает, что стремление к развитию не сводится к внешнему статусу. Человек может решать сложные задачи потому, что испытывает интерес, хочет быть компетентным или стремится приносить пользу, даже если внешнее признание минимально.

Этот результат важен для критической проверки исходной гипотезы. Статус может быть социальным следствием компетентной деятельности, но не всегда является её сознательной целью. Для некоторых людей первичным мотивом выступает интерес к содержанию задачи, забота о других или соответствие личным ценностям. Поэтому утверждение о том, что смысл любой деятельности состоит в повышении статуса, следует заменить более осторожным тезисом: деятельность человека часто организуется вокруг расширения компетентности, принадлежности и влияния, а социальный статус является одним из возможных результатов и регуляторов этого процесса.

Предлагаемая модель

На основании рассмотренных подходов можно представить следующую последовательность:

1. Социальная система сталкивается с задачами, которые не могут быть решены одним человеком.
2. Между участниками распределяются роли, ресурсы и ответственность.
3. Люди демонстрируют способность решать задачи различной сложности.
4. Группа оценивает результаты и формирует репутацию.
5. Репутация влияет на доступ к более сложным задачам, ресурсам и каналам влияния.
6. Успешное решение таких задач может приводить к повышению статуса.
7. Повышенный статус позволяет участвовать в координации более масштабных процессов.

Эта модель предполагает положительную обратную связь: компетентность повышает репутацию, репутация открывает доступ к ресурсам и задачам, а новые ресурсы позволяют развивать компетентность.

Но обратная связь может быть нарушена. Если статус распределяется по наследству, через принуждение или манипуляцию, он может не соответствовать реальной способности решать задачи. Возникает разрыв между формальным положением и функциональной компетентностью.

Модель также предполагает, что статус имеет не только индивидуальный, но и системный аспект. Человек повышает свой статус устойчивым образом тогда, когда его деятельность увеличивает способность группы решать проблемы. Если повышение положения достигается за счёт разрушения доверия, присвоения чужих результатов или эксплуатации участников, оно может быть краткосрочно успешным, но снижать устойчивость социальной системы.

Ограничения модели

Во-первых, стремление к повышению статуса не является универсальным и единственным мотивом человеческой деятельности. Значимую роль играют привязанность, забота о потомстве, любопытство, моральные нормы, автономия, удовольствие от процесса и стремление к смыслу.

Во-вторых, не всякая сложная задача общественно полезна. Высокий уровень интеллектуальной или организационной сложности сам по себе не гарантирует положительного результата. Разработка оружия массового поражения, манипулятивных информационных систем или схем экономической эксплуатации может требовать значительной компетентности, но при этом снижать устойчивость общества. Поэтому сложность задачи должна рассматриваться вместе с её последствиями, социальной ценностью и соответствием этическим нормам.

В-третьих, формальный статус и реальная способность решать сложные задачи могут не совпадать. Иерархические системы иногда распределяют полномочия на основании наследования, богатства, политической лояльности или принадлежности к определённой группе. В таких условиях статус может быть слабо связан с компетентностью, а социальное признание с реальным вкладом.

В-четвёртых, статус является контекстуальным. Человек может обладать высоким статусом в одной сфере и не иметь особого влияния в другой. Кроме того, критерии признания различаются между культурами, организациями и историческими периодами. То, что одна группа считает признаком компетентности, другая может оценивать иначе.

В-пятых, тезис о повышении статуса не объясняет деятельность людей, которые сознательно отказываются от высокого положения, действуют анонимно или жертвуют личными преимуществами ради других. Альтруизм, родительская забота, моральная обязанность и религиозная или мировоззренческая преданность могут направлять поведение даже тогда, когда они не повышают индивидуальный статус. В подобных случаях возможно говорить не об отсутствии социальной мотивации, а о том, что

объектом ценности становится группа, норма или будущее поколение, а не положение самого индивида.

Наконец, чрезмерная ориентация на статус может иметь отрицательные последствия. Она усиливает социальное сравнение, тревогу, чувствительность к критике и склонность воспринимать сотрудничество как соревнование. Если статус связывается преимущественно с превосходством над другими, человек может выбирать демонстративные или агрессивные стратегии вместо решения действительно важных задач. Устойчивое общество поэтому должно поддерживать такие формы признания, которые вознаграждают компетентность, надёжность, заботу о других и вклад в общее благо, а не только внешнюю власть.

Обсуждение

Предложенная модель позволяет объединить несколько направлений исследований. Эволюционная психология объясняет, почему человек чувствителен к социальному рангу и репутации. Теория доминирования и престижа показывает, что статус может приобретаться через разные механизмы: принуждение либо добровольное признание компетентности. Исследования кооперации демонстрируют, что репутация влияет на готовность других людей вступать во взаимодействие. Теория социальной идентичности объясняет, почему люди стремятся повышать статус не только себя, но и значимых групп. Теория самоопределения, в свою очередь, показывает, что компетентность, автономия и принадлежность могут быть самостоятельными источниками мотивации.

В этом синтезе статус следует понимать не как универсальную ценность, к которой сводятся все человеческие желания, а как механизм социальной координации. Общество должно решать задачи различного масштаба и поэтому распределяет доверие, полномочия и ресурсы между участниками. Статус сообщает другим, кому можно поручить более сложную задачу, чьему мнению следует уделить больше внимания и на кого можно рассчитывать в ситуации неопределённости.

Такое понимание позволяет уточнить исходный тезис. Смысл деятельности человека не обязательно заключается в сознательном стремлении занять более высокое место в иерархии. Более точная формулировка состоит в том, что человеческая деятельность часто направлена на расширение способности действовать: приобретать компетентность, поддерживать отношения, влиять на окружающую среду, заботиться о потомстве и участвовать в решении коллективных задач. Социальное признание этой способности проявляется в виде статуса.

Следовательно, статус можно рассматривать как посредник между индивидуальной деятельностью и общественной организацией. Человек решает задачи, общество оценивает результаты, а оценка влияет на последующий доступ к возможностям и ответственности. При благоприятных условиях этот процесс образует положительную обратную связь: компетентность повышает доверие, доверие открывает доступ к более

сложным задачам, а решение новых задач увеличивает вклад человека в устойчивость социальной системы.

Однако положительная обратная связь возможна только при наличии механизмов проверки. К ним относятся прозрачные критерии оценки, ответственность за последствия, независимая экспертиза, возможность критики и институты, ограничивающие злоупотребление властью. Без этих механизмов иерархия может начать воспроизводить сама себя, поддерживая высокий статус тех, кто обладает ресурсами, но не способен эффективно решать общественно значимые задачи.

Практическое значение

Модель имеет несколько возможных применений. В организациях она позволяет оценивать карьерное развитие не только по формальной должности, но и по увеличению масштаба ответственности, уровню неопределённости решаемых задач и способности координировать других. В образовании она подчёркивает важность перехода от воспроизведения знаний к самостоятельной постановке и решению проблем. В государственном управлении она предлагает связывать легитимность руководителей с качеством решений и долгосрочными последствиями, а не только с публичной популярностью.

Для оценки профессионального развития можно использовать следующие показатели:

- способен ли человек самостоятельно формулировать проблему;
- умеет ли он учитывать интересы нескольких групп;
- может ли принимать решения при неполной информации;
- создаёт ли он воспроизводимые процессы, а не только разовые результаты;
- способен ли обучать других и передавать компетенции;
- берёт ли ответственность за последствия решений;
- увеличивает ли его деятельность способность группы решать будущие задачи.

Эти критерии позволяют отличить устойчивое повышение статуса от его внешней имитации. Человек может стать более заметным, но не более компетентным; получить власть, но не приобрести доверие; добиться публичного признания, но не увеличить способность системы справляться с проблемами. Поэтому статус должен оцениваться во времени и по результатам, а не по одному эпизоду.

Заключение

Человек является биологически и культурно зависимым от общества видом. Его выживание обеспечивается не только индивидуальными качествами, но и языком, нормами, разделением труда, технологиями, институтами и межпоколенческой передачей знаний. Поэтому индивидуальная человеческая деятельность всегда включена в систему коллективного решения задач.

Социальный статус в данной системе можно определить как социально признанную способность решать задачи определённого уровня сложности, неопределённости, масштаба и ответственности. Такое определение связывает статус с компетентностью и вкладом, но не отождествляет его с формальной властью, богатством или доминированием.

Эволюционно стремление к повышению статуса сформировалось потому, что положение в группе влияло на доступ к ресурсам, защите, союзникам, информации и партнёрам. В человеческих обществах оно реализуется через два основных пути: доминирование и престиж. Для сложных кооперативных систем особенно важен престиж, основанный на компетентности, полезности и способности обеспечивать результат.

Исходный тезис статьи требует существенного уточнения. Нельзя утверждать, что смысл деятельности любого человека полностью сводится к повышению статуса. Человеческая мотивация множественна и включает заботу, привязанность, автономию, любопытство, моральные нормы и поиск смысла. Вместе с тем повышение способности решать сложные задачи и получение социального признания действительно являются важными механизмами, связывающими индивидуальное развитие с устойчивостью общества.

В наиболее продуктивной форме повышение статуса означает не превосходство над другими, а расширение ответственности и общественной полезности. Человек повышает свой функциональный статус, когда способен решать более сложные и значимые задачи, действовать в условиях неопределённости, координировать других, передавать знания и учитывать долгосрочные последствия. В таком случае индивидуальный успех становится частью более широкого процесса — сохранения и развития человеческих сообществ и человечества как вида.

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ФИЗИКО-ХИМИЧЕСКИЕ ПОКАЗАТЕЛИ АДДУКТОВ ФУЛЛЕРЕНОВ

Аннотация: *Фуллерены и их аддукты представляют собой новое поколение углеродных наноструктур, обладающих уникальными физико-химическими свойствами. Изучение аддуктов фуллеренов актуально, поскольку модификация структуры фуллерена позволяет целенаправленно изменять его свойства — растворимость, электропроводность, реакционную способность и биологическую активность. Эти соединения открывают широкие возможности для создания новых материалов, нанокомпозитов, лекарственных средств и катализаторов. Благодаря высокой стабильности и способности взаимодействовать с различными веществами аддукты фуллеренов становятся важным объектом исследований в нанотехнологиях, медицине, электронике и энергетике.*

Ключевые слова: *Фуллерены, C_{70}, аддукты фуллеренов, нанокомпозиты, нанотехнологии, электропроводность.*

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PHYSICOCHEMICAL PROPERTIES OF FULLERENE ADDUCTS

Abstract: *Fullerenes and their adducts represent a new generation of carbon nanostructures with unique physicochemical properties. The study of fullerene adducts is of particular relevance because modification of the fullerene structure makes it possible to purposefully alter its properties, including solubility, electrical conductivity, reactivity, and biological activity. These compounds offer broad opportunities for the development of new materials, nanocomposites, pharmaceuticals, and catalysts. Due to their high stability and ability to interact with various substances, fullerene adducts have become important research objects in nanotechnology, medicine, electronics, and energy.*

Keywords: *Fullerenes, C_{70}, fullerene adducts, nanocomposites, nanotechnology, electrical conductivity.*

Введение

Целью исследования является изучение физико-химических свойств аддуктов фуллеренов, а также выявление влияния различных функциональных групп на структуру, реакционную способность и устойчивость этих соединений.

Для достижения поставленной цели необходимо:

- Проанализировать особенности строения аддуктов фуллеренов;
- Рассмотреть их физические свойства, включая оптические, электрические и термические характеристики;
- Изучить основные химические реакции с участием аддуктов;
- Определить возможности практического применения данных веществ в науке, технике и медицине.

Материалы и методы

Материалы исследования включали:

- Молекулы фуллеренов, в первую очередь c_{60} и c_{70};
- Различные аддукты фуллеренов, полученные при присоединении атомов водорода, галогенов, гидроксильных и аминогрупп;
- Органические растворители (бензол, толуол, ацетон, спирты);
- Катализаторы и реагенты, применяемые для модификации фуллеренов.

В исследовании использовались следующие методы:

1. **Физико-химический анализ** — для изучения структуры и состава аддуктов.
2. **Ик-спектроскопия и уф-спектроскопия** — для определения изменений в электронной структуре при присоединении функциональных групп.
3. **Электронная микроскопия** — для анализа морфологии частиц.
4. **Термогравиметрический анализ (тга)** — для оценки термической устойчивости аддуктов.
5. **Электрохимические методы** — для изучения окислительно-восстановительных свойств.

Методы исследования аддуктов фуллеренов

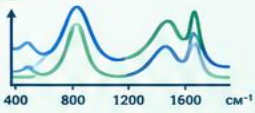
1 Физико-химический анализ



- Структура аддуктов
- Состав
- Молекулярная масса
- Растворимость
- Термическая стабильность

Позволяет определить основные физико-химические характеристкии и общие свойства соединений.

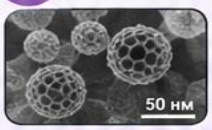
2 ИК- и УФ-спектроскопия



- Функциональные группы
- Электронная структура
- Характерные полосы поглощения

Позволяет идентифицировать функциональные группы и оценить электронное строение аддуктов фуллеренов.

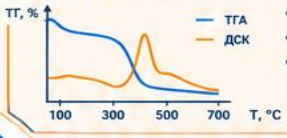
3 Электронная микроскопия



- Морфология
- Размер частиц

Позволяет изучить форму, распределение и размеры частиц аддуктов фуллеренов.

4 Термический анализ (ТГА/ДСК)



- Термостабильность
- Температура разложения
- Фазовые переходы

Позволяет оденить термическую устойчивость и поведение аддуктов при нагревании.



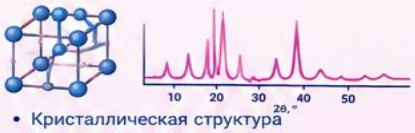
5 Электрохимические методы



- Окислительно-восстановительные свойства
- Электрохимическая активность

Позволяют изучить редокс-поведение и электрохимические характеристики аддуктов фуллеренов.

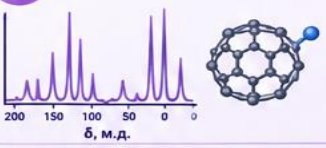
6 Рентгеноструктурный анализ (XRD)



- Кристаллическая структура
- Степень кристалличности

Позволяет определить пространственное строение и степень упорядоченности аддуктов.

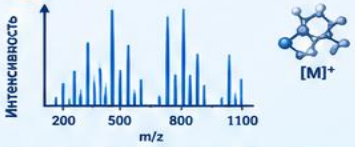
7 ЯМР-спектроскопия



- Химическое окружение атомов углерода
- Структура аддуктов

Позволяет определить локальное окружение атомов и подтвердить структуру аддуктов фуллеренов.

8 Масс-спектрометрия



- Молекулярная масса
- Состав аддуктов

Позволяет определить молекулярную массу, состав и фрагментацию аддуктов фуллеренов.

9 Хроматографические методы (ВЭЖХ/ВЭТСХ)



- Разделение
- Идентификация
- Количественная оценка

Позволяют разделить компоненты смеси, установить их природу и определить содержание аддуктов в образцах.

10 Элементный анализ



Элемент	%
C	—
H	—
N	—
Другие	—

- Определение C, H, N и других элементов

Позволяет установить элементный состав аддуктов фуллеренов.

Комплексное применение современных методов исследования позволяет всесторонне охарактеризовать аддукты фуллеренов и установить их структуру, свойства и потенциал применения.

Результаты исследования

В ходе изучения физико-химических свойств аддуктов фуллеренов установлено, что модификация структуры фуллерена значительно влияет на его свойства.

Изменение строения. Присоединение функциональных групп (h, cl, oh, nh_2 и др.) К поверхности фуллерена приводит к частичному разрушению π-системы и переходу атомов углерода из состояния sp^2 в состояние sp^3-гибридизации. Это делает молекулу более химически активной.

Растворимость. Аддукты фуллеренов обладают повышенной растворимостью в полярных растворителях (спиртах, ацетоне) по сравнению с чистыми фуллеренами, что упрощает их использование в химических реакциях и биомедицинских целях.

Термическая устойчивость. При исследовании методом термогравиметрического анализа показано, что аддукты менее термостойки, чем c_{60}, однако сохраняют устойчивость до 300–400 °c, что делает их пригодными для практического применения.

Электрические и оптические свойства. Введение заместителей изменяет электронную структуру фуллерена. Аддукты демонстрируют снижение электропроводности, но при этом появляются новые оптические полосы поглощения и флуоресценция, что представляет ценность для фотонных и сенсорных технологий.

Химическая активность. Аддукты проявляют высокую реакционную способность в реакциях замещения, окисления и восстановления. Это позволяет использовать их как исходные соединения для синтеза новых функциональных наноматериалов.

Практическая значимость. На основе анализа данных показано, что аддукты фуллеренов находят применение в различных областях:

- **медицина** — как антиоксиданты и носители лекарственных веществ;
- **электроника** — в органических солнечных элементах и полупроводниках;
- **катализ** — в реакциях окисления органических соединений;
- **нанотехнологии** — при создании новых материалов с заданными свойствами.

Заключение

Аддукты фуллеренов представляют собой важный класс производных углерода, образующихся при присоединении различных функциональных групп к молекуле фуллерена. В результате модификации фуллеренов изменяются их физико-химические свойства — повышается растворимость, изменяются электропроводность, оптические и термические характеристики. Присоединение атомов и групп к углеродному каркасу приводит к переходу части атомов из sp^2 в sp^3-гибридизацию, что усиливает реакционную способность аддуктов.

Аддукты фуллеренов обладают высокой химической активностью и могут участвовать во многих реакциях, включая окислительно-

восстановительные реакции, реакции замещения и присоединения. Благодаря своим уникальным свойствам аддукты фуллеренов находят широкое применение в медицине, нанотехнологиях, электронике и катализе. Изучение их физико-химических свойств имеет большое значение для развития нанохимии и создания новых функциональных материалов.

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КОРЕНЬ СОЛОДКИ (GLYCYRRHIZA GLABRA): ПОЛЬЗА И РИСКИ

Аннотация: *Корень солодки (Glycyrrhiza glabra L.) представляет собой ценное лекарственное растительное сырьё, широко применяемое в традиционной и современной фитотерапии. Биологическая активность растения обусловлена наличием комплекса биологически активных соединений, среди которых особое значение имеют тритерпеновые сапонины, прежде всего глицирризин, а также флавоноиды, фенольные соединения, полисахариды и органические кислоты. Целью настоящего исследования является обобщение литературных данных о химическом составе корня солодки, его основных биологических свойствах, потенциальном терапевтическом применении и возможных рисках для здоровья. На основе анализа научных источников рассмотрены противовоспалительные, антиоксидантные, гастропротекторные и отхаркивающие свойства биологически активных компонентов Glycyrrhiza glabra. Особое внимание уделено безопасности применения препаратов солодки и нежелательным эффектам, связанным с длительным употреблением или высокими дозами глицирризина. Полученные данные свидетельствуют о значительном биологическом потенциале корня солодки, однако его применение требует соблюдения рекомендуемых дозировок и учёта индивидуальных факторов риска.*

Ключевые слова: *Корень солодки, Glycyrrhiza glabra L., глицирризин, флавоноиды, биологически активные вещества, противовоспалительное действие, антиоксидантная активность, гастропротекторное действие, безопасность, побочные эффекты.*

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LIQUORICE ROOT (*GLYCYRRHIZA GLABRA*): BENEFITS AND RISKS

Abstract: *Liquorice root (Glycyrrhiza glabra L.) is a valuable medicinal plant material widely used in traditional and modern phytotherapy. The biological activity of the plant is attributed to a complex of biologically active compounds, among which triterpene saponins, particularly glycyrrhizin, as well as flavonoids, phenolic compounds, polysaccharides, and organic acids are of particular importance. The aim of this study is to summarize the available literature data on the chemical composition of liquorice root, its main biological properties, potential therapeutic applications, and possible health risks. Based on an analysis of scientific sources, the anti-inflammatory, antioxidant, gastroprotective, and expectorant properties of the biologically active components of Glycyrrhiza glabra are reviewed. Particular attention is given to the safety of liquorice preparations and adverse effects associated with prolonged use or high doses of glycyrrhizin. The findings indicate that liquorice root possesses significant biological potential; however, its use requires adherence to recommended dosages and consideration of individual risk factors.*

Keywords: *Liquorice root, Glycyrrhiza glabra L., glycyrrhizin, flavonoids, biologically active compounds, anti-inflammatory activity, antioxidant activity, gastroprotective effect, safety, adverse effects.*

Введение

Солодка (*glycyrrhiza glabra* l.) Является многолетним лекарственным растением семейства fabaceae, которое на протяжении многих веков используется в традиционной медицине различных регионов мира. В качестве лекарственного растительного сырья преимущественно применяются корни и корневища растения. Традиционно препараты солодки использовались главным образом при заболеваниях органов дыхания и пищеварительной системы. Интерес к *glycyrrhiza glabra* сохраняется и в современной фармакологии благодаря наличию в растительном сырье широкого комплекса

биологически активных соединений. Наиболее изученным из них является глицирризин, которому приписывается ряд фармакологических эффектов, включая противовоспалительное и гастропротекторное действие. Кроме того, значительный интерес представляют флавоноиды и другие фенольные соединения, обладающие антиоксидантной активностью. Вместе с тем биологическая активность солодки не исключает потенциальных рисков. Избыточное поступление глицирризина в организм, особенно при длительном применении, может нарушать водно-электролитный баланс и способствовать повышению артериального давления. В связи с этим комплексная оценка химического состава, биологических свойств и безопасности корня солодки имеет важное научное и практическое значение. Целью настоящего исследования является систематизация и обобщение научных данных о химическом составе, биологической активности, потенциальном терапевтическом применении и безопасности корня *glycyrrhiza glabra*.

Материалы и методы

Материалом исследования послужили научные публикации и литературные источники, посвящённые ботанической характеристике, химическому составу, фармакологическим свойствам и безопасности применения *glycyrrhiza glabra*.

В работе использован метод анализа и обобщения научной литературы. Основное внимание уделялось данным о биологически активных веществах корня солодки, включая тритерпеновые сапонины, флавоноиды и фенольные соединения, а также сведениям об их потенциальных фармакологических эффектах.

При анализе источников учитывались данные экспериментальных и фармакологических исследований, посвящённых противовоспалительной, антиоксидантной, гастропротекторной и отхаркивающей активности компонентов растения. Отдельно анализировались сведения о возможных нежелательных эффектах, лекарственных взаимодействиях и факторах, ограничивающих безопасное применение препаратов солодки.

Результаты исследования

Анализ научной литературы показал, что химический состав корня *glycyrrhiza glabra* характеризуется значительным разнообразием биологически активных соединений. К основным компонентам относятся тритерпеновые сапонины, прежде всего глицирризин, флавоноиды, фенольные соединения, полисахариды и органические кислоты.

Глицирризин является одним из наиболее изученных компонентов солодки и в значительной степени определяет фармакологическую активность растения. В организме он метаболизируется с образованием глицирретиновой кислоты, которая участвует в реализации ряда биологических эффектов. На основании экспериментальных исследований установлено, что компоненты солодки способны оказывать противовоспалительное действие посредством воздействия на различные механизмы воспалительного ответа.

Флавоноиды, включая ликвиритин, ликвиритигенин и изоликвиритигенин, характеризуются антиоксидантной и противовоспалительной активностью. Их присутствие может способствовать снижению окислительного стресса и объяснять часть биологических эффектов растительного сырья.

Анализ литературных данных также показывает, что препараты солодки обладают потенциальным гастропротекторным действием. Компоненты растения могут способствовать защите слизистой оболочки желудка и снижению выраженности отдельных воспалительных процессов. Однако применение солодки при диагностированных заболеваниях желудочно-кишечного тракта не должно рассматриваться как замена стандартной медицинской терапии. Традиционное применение корня солодки при заболеваниях дыхательных путей связано преимущественно с его отхаркивающими и смягчающими свойствами. Препараты растения могут способствовать облегчению отхождения бронхиального секрета и уменьшению выраженности кашля, что обусловливает их использование в составе средств для симптоматической терапии. В литературе также описывается потенциальная гепатопротекторная и дерматологическая активность отдельных компонентов *glycyrrhiza glabra*. Однако значительная часть соответствующих данных получена в экспериментальных исследованиях, поэтому для окончательной оценки клинической эффективности необходимы дополнительные контролируемые исследования.

Отдельного внимания заслуживает безопасность применения солодки. Установлено, что длительное употребление или использование высоких доз препаратов, содержащих глицирризин, может приводить к задержке натрия и жидкости, снижению концентрации калия в крови и повышению артериального давления. В отдельных случаях такие изменения способны увеличивать риск сердечно-сосудистых осложнений. Таким образом, результаты анализа литературы свидетельствуют о наличии у *glycyrrhiza glabra* широкого спектра потенциально полезных биологических свойств. При этом выраженность фармакологического эффекта зависит от состава препарата, концентрации активных веществ, дозировки и продолжительности применения.

Заключение

Корень *glycyrrhiza glabra* l. Является перспективным лекарственным растительным сырьём, содержащим комплекс биологически активных соединений, среди которых ведущую роль играют глицирризин и флавоноиды. Анализ научной литературы свидетельствует о наличии у компонентов солодки противовоспалительной, антиоксидантной, гастропротекторной и отхаркивающей активности. Полученные данные подтверждают значительный фармакологический потенциал растения и возможность его использования в качестве источника биологически активных соединений. Вместе с тем степень доказанности различных терапевтических эффектов неодинакова, поскольку значительная часть сведений основана на

экспериментальных исследованиях. Особое значение имеет соблюдение принципов безопасности. Длительное или чрезмерное употребление препаратов, содержащих глицирризин, может вызывать нарушения водно-электролитного баланса, задержку жидкости, снижение уровня калия и повышение артериального давления. Поэтому дальнейшее изучение фармакологических свойств *glycyrrhiza glabra* должно проводиться одновременно с оценкой эффективности и безопасности её применения.

Таким образом, рациональное использование корня солодки должно основываться на научно обоснованных данных о составе и дозировке конкретного препарата, продолжительности его применения и индивидуальных факторах риска.

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ОТ ИДЕЙ ХО ШИ МИНА О ДВИЖУЩИХ СИЛАХ ЭКОНОМИЧЕСКОГО РАЗВИТИЯ К НОВЫМ НАПРАВЛЕНИЯМ РАЗВИТИЯ НА XIV СЪЕЗДЕ КОММУНИСТИЧЕСКОЙ ПАРТИИ ВЬЕТНАМА

Аннотация: *В статье рассматриваются представления Хо Ши Мина о движущих силах экономического развития и их преемственность и развитие в экономическом мышлении Коммунистической партии Вьетнама в период обновления, особенно в новом направлении развития, определённом на XIV съезде Коммунистической партии Вьетнама. На основе историко-логического, системного и развивающего подходов, а также методов анализа, синтеза, систематизации и сравнительного анализа автор выделяет пять взаимосвязанных групп движущих сил в экономической мысли Хо Ши Мина: человека и труд; интересы, социальную справедливость и механизмы стимулирования; многоукладную экономику и мобилизацию общественных ресурсов; роль государства и организационно-институциональные условия; опору на внутренние силы в сочетании с международным сотрудничеством. В статье обосновывается, что за 40 лет обновления эти положения получили институциональное развитие в формировании социалистически ориентированной рыночной экономики, развитии многоукладной экономики, мобилизации общественных ресурсов, стимулировании частного сектора, расширении международной интеграции и укреплении экономической самостоятельности. XIV съезд Коммунистической партии Вьетнама развивает данную систему движущих сил в новых условиях, смещая акцент от преимущественной мобилизации ресурсов к формированию новых производительных возможностей на основе науки и технологий, инноваций, цифровой трансформации, роста производительности труда и укрепления внутреннего потенциала экономики. В статье делается вывод о том, что методологическое значение идей Хо Ши Мина заключается не в прямом переносе исторически обусловленных экономических форм, а в принципах выявления, высвобождения, организации и эффективного использования движущих сил развития в соответствии с конкретными условиями.*

Ключевые слова: *Хо Ши Мин; движущие силы экономического развития; экономическое мышление; Коммунистическая партия Вьетнама; социалистически ориентированная рыночная экономика; частный сектор; инновации; цифровая трансформация.*

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FROM HO CHI MINH'S IDEAS ON THE DRIVING FORCES OF ECONOMIC DEVELOPMENT TO NEW DEVELOPMENT DIRECTIONS AT THE 14TH NATIONAL CONGRESS OF THE COMMUNIST PARTY OF VIETNAM

Abstract: *This article examines Ho Chi Minh's ideas on the driving forces of economic development and their continuity and development in the economic thinking of the Communist Party of Vietnam during the period of renovation (Đổi Mới), particularly in the new development direction defined at the 14th National Congress of the Communist Party of Vietnam. Based on historical-logical, systemic, and developmental approaches, together with methods of analysis, synthesis, systematization, and comparative analysis, the author identifies five interconnected groups of driving forces in Ho Chi Minh's economic thought: people and labor; interests, social justice, and incentive mechanisms; a multi-sector economy and the mobilization of social resources; the role of the state and organizational and institutional conditions; and reliance on internal strengths combined with international cooperation. The article argues that over 40 years of renovation, these ideas have been institutionally developed through the formation of a socialist-oriented market economy, the development of a multi-sector economy, the mobilization of social resources, the promotion of the private sector, expanded international integration, and the strengthening of economic autonomy. The 14th National Congress of the Communist Party of Vietnam further develops this system of driving forces under new conditions, shifting the emphasis from the predominant mobilization of resources toward the creation of new productive capacities based on science and technology, innovation, digital transformation, growth in labor productivity, and the strengthening of the economy's internal potential. The article concludes that the methodological significance of Ho Chi Minh's ideas lies not in directly transferring historically conditioned economic forms, but in applying principles for identifying, unleashing, organizing, and effectively utilizing the driving forces of development in accordance with specific conditions.*

Keywords: *Ho Chi Minh; driving forces of economic development; economic thought; Communist Party of Vietnam; socialist-oriented market economy; private sector; innovation; digital transformation.*

1. Введение

За 40 лет обновления (đổi mới) во вьетнаме сформировалась и постепенно совершенствуется социалистически ориентированная рыночная экономика, расширяется международная интеграция и всё более разнообразно используются ресурсы для развития. В период 2021–2025 гг. Среднегодовые темпы роста ввп составили около 6,2%; только в 2025 г. Рост достиг 8,02%, а объём ввп превысил 514 млрд долл. Сша (коммунистическая партия вьетнама, 2026). Вместе с тем модель роста по-прежнему сталкивается с ограничениями, связанными с производительностью труда, качеством человеческих ресурсов, промышленным потенциалом, инновационной активностью, а также

способностью эффективно мобилизовать и распределять ресурсы. Эти проблемы требуют решительного перехода от модели роста, в значительной степени основанной на расширении ресурсной базы, к модели, всё более опирающейся на производительность, науку, технологии и инновации.

В этом контексте xiv съезд коммунистической партии вьетнама определил целевой среднегодовой рост ввп на уровне не менее 10% в период 2026–2030 гг., одновременно обозначив науку, технологии, инновации и цифровую трансформацию в качестве основных движущих сил новой модели роста. Наряду с этим поставлены задачи активного развития частного сектора, повышения производительности труда, развития цифровой, зелёной и циркулярной экономики, а также формирования независимой и самостоятельной экономики, связанной с международной интеграцией (коммунистическая партия вьетнама, 2026). Эти изменения обусловливают необходимость более глубокого осмысления идейной основы и процесса развития экономического мышления вьетнама.

В системе идей хо ши мина экономическое развитие всегда связывалось с повышением уровня жизни народа и созданием материальной основы для национальной независимости и социализма. Хо ши мин рассматривал народ как субъекта и важнейшую движущую силу развития; одновременно он уделял внимание интересам, справедливости, организации производства, многоукладности экономики, роли государственного управления, бережливости, развитию внутренних сил и сочетанию внутренних сил с международным сотрудничеством (фам нгок фыонг, 2020). Эти положения образуют систему факторов, стимулирующих экономическое развитие, и обладают методологическим значением для выявления движущих сил развития в различных исторических условиях.

Существующие исследования достаточно широко рассматривают экономические идеи хо ши мина, уделяя внимание человеку, интересам, социальной справедливости, экономическим укладам, частному сектору, роли государства и развитию внутренних сил (данг конг тхань, 2023; фам нгок фыонг, 2020). Ряд исследований также анализирует процесс обновления экономического мышления коммунистической партии вьетнама, развитие социалистически ориентированной рыночной экономики и возрастающую роль частного сектора, науки, технологий и инноваций. Однако взаимосвязь между системой движущих сил экономического развития в идеях хо ши мина, процессом развития экономического мышления коммунистической партии вьетнама и формированием новой системы факторов роста, определённой xiv съездом, пока не получила систематического анализа.

Исходя из выявленного исследовательского пробела, статья направлена на поиск ответов на три вопроса: какие факторы составляют систему движущих сил экономического развития в идеях хо ши мина? Каким образом коммунистическая партия вьетнама унаследовала и развила эти положения в процессе обновления? Каким образом xiv съезд развил данную систему движущих сил, превратив её в новые факторы экономического роста?

В статье используются методы анализа, синтеза, систематизации и сравнительного анализа на основе произведений хо ши мина, документов коммунистической партии вьетнама и соответствующих научных исследований. Статья направлена на достижение двух результатов: систематизацию идей хо ши мина о движущих силах экономического развития в виде взаимосвязанной структуры; а также выявление перехода от мобилизации и использования имеющихся ресурсов к формированию новых движущих сил роста, основанных на науке и технологиях, инновациях, цифровой трансформации, производительности и укреплении самостоятельного потенциала экономики.

2. Подходы и методы исследования

В статье используются историко-логический, системный, развивающий и политико-институциональный подходы. Историко-логический подход позволяет рассмотреть идеи хо ши мина о движущих силах экономического развития в конкретных исторических условиях и проследить их преемственность и развитие в экономическом мышлении коммунистической партии вьетнама за 40 лет обновления. Системный подход используется для выявления взаимосвязей между человеком, интересами, экономическими укладами, государством, внутренними силами и международным сотрудничеством. Развивающий подход позволяет разграничить методологически значимые положения и исторически обусловленные формы экономической организации. Политико-институциональный подход применяется для анализа их конкретизации в экономической политике и современных направлениях развития.

Основными методами являются анализ документов, контент-анализ, синтез, систематизация и сравнительный анализ. Источниковую базу составляют произведения и выступления хо ши мина, документы коммунистической партии вьетнама, прежде всего материалы xiv съезда, резолюции по экономическому развитию и частному сектору, а также соответствующие научные исследования (коммунистическая партия вьетнама, 2026). Контент-анализ, синтез и систематизация используются для выявления и структурирования движущих сил; сравнительный анализ — для сопоставления идей хо ши мина, их развития в период обновления и новых направлений, определённых xiv съездом.

На этой основе сформирована аналитическая рамка из пяти групп движущих сил: (1) человек и труд; (2) интересы, справедливость и механизмы стимулирования; (3) экономические уклады и мобилизация общественных ресурсов; (4) государство и институциональная среда; (5) внутренние силы в сочетании с международным сотрудничеством. Данная рамка используется для анализа преемственности, развития и трансформации движущих сил экономического развития в новую систему факторов роста вьетнама.

3. Идеи хо ши мина о движущих силах экономического развития

Экономические идеи хо ши мина не были оформлены как отдельная теория «движущих сил развития». Однако его взгляды на цели развития,

человека, интересы, экономические уклады, роль государства, организацию производства и соотношение внутренних и внешних сил позволяют выявить систему взаимосвязанных факторов экономического развития: человек и труд; интересы и справедливость; многоукладная экономика и общественные ресурсы; государство и организация экономики; опора на собственные силы в сочетании с международным сотрудничеством (фам нгок фыонг, 2020).

3.1. Человек и труд как внутренние движущие силы экономического развития

В идеях хо ши мина экономическое развитие прежде всего связано с повышением уровня жизни народа. Цели национальной независимости и социализма предполагают обеспечение материального и духовного благосостояния народа; «богатый народ, сильная страна» выступает целью и критерием развития (фам нгок фыонг, 2020). Поэтому народ является субъектом, целью и источником движущей силы экономического развития.

Хо ши мин подчёркивал творческий потенциал народа в труде и производстве. Экономическая мотивация, следовательно, связана не только с капиталом и ресурсами, но прежде всего с трудовым потенциалом, сознательностью, инициативой и участием человека (фам нгок фыонг, 2020). Повышение производительности он связывал с образованием, организацией труда и качествами работника. Таким образом, развитие человека и производительных возможностей образует единую взаимосвязанную систему.

3.2. Интересы, справедливость и механизмы стимулирования как непосредственный механизм формирования мотивации

Хо ши мин рассматривал экономические движущие силы через отношения интересов, связывая личные интересы с коллективными интересами и интересами страны и нации. Организация производства и распределения должна учитывать вклад работника и обеспечивать согласование различных интересов.

Важное место занимали сдельные и подрядные формы организации труда, производственное соревнование, бережливость и рациональное использование ресурсов. Эти положения свидетельствуют, что мотивация реализуется через соответствующие механизмы организации и регулирования интересов (фам нгок фыонг, 2020).

Социальную справедливость хо ши мин связывал со стабильностью и способностью мобилизовать силы народа: «не бояться нехватки, а бояться несправедливости; не бояться бедности, а бояться, что народ не будет спокоен» (хо ши мин, 2011, т. 15, с. 224). Поэтому экономическое развитие должно сочетать эффективность, интересы и справедливость.

3.3. Многоукладная экономика как основа мобилизации общественных ресурсов

Хо ши мин признавал объективное существование различных форм собственности и экономических укладов в переходный период. В работе *обычная политическая жизнь* (*thường thức chính trị*, 1953) он выделил пять типов экономики: государственную, кооперативную, индивидуальную,

частнокапиталистическую и государственно-капиталистическую. Государственная экономика рассматривалась как ведущая, тогда как другие уклады предполагалось использовать и развивать в соответствии с конкретными условиями и социалистической ориентацией (хо ши мин, 2011, т. 8).

Такой подход не отождествлял социалистическую цель с немедленным устранением различных экономических форм. В отношении частного сектора хо ши мин придерживался практического подхода, поддерживая законную предпринимательскую деятельность и связывая её с общественными интересами (фам нгок фыонг, 2020).

С точки зрения движущих сил развития многоукладная экономика расширяет возможности мобилизации капитала, труда, управленческого опыта и производственного потенциала общества. Тем самым формируется основа для использования всех общественных ресурсов в интересах развития.

3.4. Государство и экономическая организация как условие преобразования ресурсов в движущие силы развития

Хо ши мин не рассматривал ресурсы как факторы, автоматически обеспечивающие развитие. Организация производства, экономическое управление, бережливость, борьба с коррупцией и расточительством, а также совершенствование государственного аппарата непосредственно влияют на эффективность использования ресурсов (фам нгок фыонг, 2020).

Поэтому важное значение имеет эффективность организации и управления. Одинаковые объёмы капитала, труда и природных ресурсов могут давать разные результаты в зависимости от способов их организации и использования. Хо ши мин требовал повышать производительность, совершенствовать методы работы и формировать аппарат, служащий народу (хо ши мин, 2011, т. 10).

Роль государства в данном подходе заключается в создании условий, организации, управлении и направлении экономических процессов, обеспечивающих эффективное использование ресурсов и достижение целей развития.

3.5. Опора на собственные силы в сочетании с международным сотрудничеством как основа самостоятельного развития

Сквозным элементом идей хо ши мина является развитие внутренних сил при использовании внешних ресурсов. Он подчёркивал принцип «опоры прежде всего на собственные силы», рассматривая внутренний потенциал как решающий фактор, одновременно выступая за международную помощь и сотрудничество для укрепления возможностей страны (хо ши мин, 2011, т. 12, с. 470; фам нгок фыонг, 2020).

В экономической сфере это означает отказ как от замкнутости, так и от зависимости. Внешние ресурсы должны дополнять и укреплять внутренний потенциал, а международная интеграция становится устойчивой движущей силой тогда, когда способствует развитию производственного, технологического и кадрового потенциала страны.

3.6. Системная структура движущих сил экономического развития в идеях хо ши мина

Экономические идеи хо ши мина о движущих силах развития можно обобщить в виде пяти взаимосвязанных групп факторов: человек и труд формируют внутренний потенциал; интересы и справедливость создают механизм мотивации; многоукладная экономика расширяет возможности мобилизации общественных ресурсов; государство и экономическая организация обеспечивают условия их эффективного использования; опора на собственные силы в сочетании с международным сотрудничеством укрепляет самостоятельность развития.

Ключевая особенность данной структуры заключается в том, что движущая сила развития формируется во взаимодействии человека, интересов, ресурсов, институтов и среды развития, а не сводится к отдельному фактору или простому наращиванию ресурсов. Поэтому методологическая ценность идей хо ши мина состоит в логике выявления, мобилизации, организации и эффективного использования движущих сил в конкретных исторических условиях.

Эта логика создаёт основу для дальнейшего развития экономического мышления коммунистической партии вьетнама — от высвобождения и мобилизации имеющихся ресурсов к повышению производительности, развитию науки и технологий, инноваций, цифровой трансформации и укреплению самостоятельного потенциала экономики.

4. От идей хо ши мина к новым направлениям развития, определённым xiv съездом коммунистической партии вьетнама

В процессе обновления положения идей хо ши мина о развитии экономики постепенно трансформировались в экономический курс, политические установки и механизмы функционирования экономики. От признания многоукладности, развития общественных ресурсов, внимания к интересам и повышения эффективности управления коммунистическая партия вьетнама перешла к формированию социалистически ориентированной рыночной экономики. Xiv съезд развивает эту логику в новых условиях, смещая акцент от преимущественного высвобождения и мобилизации ресурсов к формированию новых движущих сил роста, основанных на производительности, науке, технологиях, инновациях, цифровой трансформации и самостоятельном потенциале экономики (коммунистическая партия вьетнама, 2026).

4.1. От мобилизации экономических ресурсов к развитию социалистически ориентированной рыночной экономики

В период обновления коммунистическая партия вьетнама постепенно перешла от централизованного планирования к признанию товарно-рыночных отношений, многообразия форм собственности и экономических укладов, формируя модель социалистически ориентированной рыночной экономики.

К xiv съезду эта модель определяется как современная социалистически ориентированная рыночная экономика, интегрированная в международную

экономику, функционирующая в соответствии с законами рынка и находящаяся под управлением социалистического правового государства и руководством коммунистической партии вьетнама (коммунистическая партия вьетнама, 2026).

Данное развитие связано с идеями хо ши мина об использовании различных экономических форм в переходный период. Если исходной задачей было использование существующих ресурсов и экономических укладов, то в период обновления эта логика получила развитие через формирование рыночного механизма, способного эффективнее мобилизовать, распределять и использовать ресурсы.

Таким образом, преемственность заключается не в сохранении конкретной экономической модели, а в логике развития общественных ресурсов посредством соответствующего историческим условиям механизма организации экономики. Xiv съезд продолжает эту логику, одновременно повышая требования к качеству рынка, эффективности распределения ресурсов и государственному управлению.

4.2. От признания частного сектора к определению его как одной из важнейших движущих сил

В идеях хо ши мина частный сектор рассматривался как объективная форма экономической деятельности, способная участвовать в производстве, занятости и товарообороте. Он выступал за поддержку законной предпринимательской деятельности при её ориентации на интересы народа и государства (фам нгок фыонг, 2020).

В период обновления понимание роли частного сектора расширялось — от признания его существования к стимулированию развития и формированию равноправной предпринимательской среды. Резолюция № 68-nq/tw от 4 мая 2025 г. Политбюро определила частный сектор как «одну из важнейших движущих сил национальной экономики», одновременно обозначив его роль в науке, технологиях, инновациях и цифровой трансформации (политбюро коммунистической партии вьетнама, 2025).

Xiv съезд продолжает это направление, ставя цель довести к 2030 г. Число действующих предприятий примерно до 2 млн и сформировать частные предприятия, способные участвовать в глобальных цепочках создания стоимости (коммунистическая партия вьетнама, 2026).

Новым этапом становится рассмотрение частного сектора как субъекта формирования производственных возможностей, технологических инноваций и экономического роста. При этом частный сектор сохраняется в общей структуре социалистически ориентированной рыночной экономики наряду с государственным, коллективным и другими секторами.

4.3. От развития ресурсов к повышению производительности и качества роста

Современный подход предполагает переход от роста, преимущественно основанного на расширении факторов производства, к росту, основанному на производительности и эффективности использования ресурсов.

В идеях хо ши мина требования экономии, борьбы с расточительством, совершенствования организации труда и повышения производительности были сформулированы достаточно рано (фам нгок фыонг, 2020). В современной экономике они развиваются в требования повышения совокупной факторной производительности (tfp), производительности труда, качества человеческих ресурсов и эффективности распределения капитала.

Xiv съезд установил цель обеспечить вклад tfp в экономический рост свыше 55% и рост производительности труда примерно на 8,5% в год в 2026–2030 гг. (коммунистическая партия вьетнама, 2026).

Тем самым производительность становится самостоятельной характеристикой новой модели роста: задача заключается не только в расширении ресурсной базы, но и в создании большей экономической стоимости при более эффективном использовании имеющихся ресурсов.

4.4. Наука, технологии, инновации и цифровая трансформация как новые движущие силы роста

Xiv съезд определяет развитие науки, технологий, инноваций и национальной цифровой трансформации как центральную движущую силу развития (коммунистическая партия вьетнама, 2026). Это отражает изменение структуры производительных сил и международной конкуренции.

Если в идеях хо ши мина человек, труд, инициатива, организация производства и эффективность рассматривались как факторы развития, то в современной экономике их реализация всё больше зависит от знаний, технологий и инновационных возможностей. Поэтому технологии выступают не только инструментом производства, но и фактором изменения производительности, способов производства и бизнес-моделей.

Xiv съезд связывает это направление с развитием цифровой, зелёной и циркулярной экономики, а также новых экономических моделей. Цель довести долю цифровой экономики примерно до 30% ввп к 2030 г. В сочетании с повышением tfp и производительности труда отражает переход от дополнительного освоения ресурсов к формированию новых производственных возможностей (коммунистическая партия вьетнама, 2026).

При этом нельзя утверждать, что хо ши мин непосредственно рассматривал цифровую экономику или инновации в современном понимании. Преемственность заключается в методологическом подходе к роли человека, знаний, инициативы, организации и эффективности производства, который в современных условиях развивается через науку, технологии, инновации и цифровую трансформацию.

4.5. От опоры на собственные силы к самостоятельной экономике, связанной с международной интеграцией

Опора на собственные силы при использовании внешних ресурсов является сквозным элементом идей хо ши мина. В условиях углубления международной интеграции этот подход развивается в направлении формирования независимой и самостоятельной экономики, способной эффективно использовать международные ресурсы.

Xiv съезд связывает стратегическую самостоятельность и самоусиление с глубокой и эффективной международной интеграцией (коммунистическая партия вьетнама, 2026).

Самостоятельность экономики сегодня всё теснее связана с технологическими возможностями, потенциалом отечественных предприятий, участием в глобальных цепочках создания стоимости и устойчивостью перед внешними потрясениями. Поэтому международная интеграция должна одновременно укреплять внутренний производственный и технологический потенциал.

Такой подход продолжает логику хо ши мина: внешние ресурсы используются для усиления внутренних сил, а не для их замены.

4.6. Новая модель роста и количественные цели на 2026–2030 гг.

Рассмотренные изменения конкретизируются в системе целей xiv съезда. На 2026–2030 гг. Поставлена задача обеспечить среднегодовой рост ввп не менее 10%, довести ввп на душу населения примерно до 8 500 долл. Сша, долю обрабатывающей промышленности — примерно до 28% ввп, цифровой экономики — до 30% ввп, вклад tfp — свыше 55%, а рост производительности труда — примерно до 8,5% в год (коммунистическая партия вьетнама, 2026).

Эти показатели отражают изменение структуры движущих сил: экономический рост должен опираться не только на капитал и расширение занятости, но и на производительность, технологии, качество человеческих ресурсов, цифровую экономику и инновации. При этом сохраняется значительная роль инвестиций, однако их эффективность должна возрастать.

Таким образом, целевой рост не менее 10% в год выступает ориентиром перехода от расширения масштабов к повышению качества и производительности роста.

4.7. Преемственность и развитие: от идей хо ши мина через обновление к xiv съезду

Между идеями хо ши мина, экономическим мышлением коммунистической партии вьетнама в период обновления и направлениями xiv съезда существует непрерывная, но не тождественная линия развития.

На исходном этапе хо ши мин подчёркивал развитие человеческого потенциала, обеспечение интересов, использование различных экономических укладов, повышение производительности, развитие внутренних сил и международное сотрудничество. В период обновления эти положения получили институциональное развитие в формировании многоукладной и социалистически ориентированной рыночной экономики, открытости и международной интеграции. На современном этапе система движущих сил развивается далее: наука, технологии, инновации, цифровая трансформация, производительность и самостоятельный потенциал становятся центральными факторами роста (коммунистическая партия вьетнама, 2026).

Преемственность заключается не в прямом соответствии каждой современной политике отдельным положениям хо ши мина, а в преемственности логики развития: человек как центр, развитие и мобилизация ресурсов, согласование интересов, эффективная организация экономики, укрепление внутренних сил при использовании внешних возможностей.

В этом контексте основное изменение можно обобщить как переход от мобилизации ресурсов к созданию новых возможностей; от расширения факторов производства к повышению производительности; от использования существующих преимуществ к формированию новых производительных сил.

5. Обсуждение: проблемы реализации новых движущих сил развития

Xiv съезд сформировал систему движущих сил роста, в центре которой находятся наука, технологии, инновации и цифровая трансформация; частный сектор определён как одна из важнейших движущих сил, а производительность труда и tfp — как ключевые показатели эффективности роста. Одновременно повышение самостоятельности экономики связывается с международной интеграцией (коммунистическая партия вьетнама, 2026). Однако определение новых движущих сил само по себе не обеспечивает их реализации. Для этого необходимы соответствующие институты, человеческий потенциал, производственные возможности предприятий и эффективное распределение ресурсов.

5.1. Институциональная реформа как условие высвобождения и развития движущих сил

Опыт 40 лет обновления показывает, что устранение институциональных барьеров способно высвобождать ресурсы и стимулировать предпринимательскую и инвестиционную активность. Напротив, сложные процедуры, неопределённость прав собственности, ограниченный доступ к ресурсам и несогласованность законодательства повышают издержки и ослабляют стимулы развития.

Это особенно важно для науки, технологий и инноваций, которые требуют пространства для экспериментирования, принятия рисков, автономии и оперативного принятия решений. Если управление преимущественно ориентировано на контроль и сопровождается чрезмерными процедурами, интеллектуальные ресурсы с трудом превращаются в продукты и рост производительности.

Поэтому институциональная реформа должна быть направлена на формирование стимулирующей и предсказуемой среды, обеспечивающей конкуренцию, защиту законных прав, снижение административных издержек и условия для инвестиций и инноваций (коммунистическая партия вьетнама, 2026). В этом проявляется преемственность с подходом хо ши мина к организации и эффективному использованию ресурсов.

5.2. Развитие частного сектора должно быть связано с повышением производственных возможностей

Определение частного сектора как одной из важнейших движущих сил требует оценивать не только его количественный рост, но и качество вклада в экономику. Увеличение числа предприятий при сохранении небольшого масштаба, низкой производительности и ограниченных технологических возможностей не обеспечит переход к новой модели роста.

Поэтому задача должна смещаться от «большего числа предприятий» к «большим производственным возможностям». Это предполагает развитие управленческих и технологических компетенций, исследований и разработок, инноваций, доступа к капиталу и участия в цепочках создания стоимости. Особое значение имеют связи между отечественными частными предприятиями, государственными предприятиями, предприятиями с иностранными инвестициями, научными учреждениями и университетами.

В этом контексте частный сектор должен становиться не только источником ввп и занятости, но и субъектом создания технологий, продуктов и новых конкурентных возможностей. Такое направление соответствует резолюции № 68-nq/tw, которая подчёркивает роль частного сектора в науке, технологиях, инновациях и цифровой трансформации (политбюро коммунистической партии вьетнама, 2025).

5.3. Человеческие ресурсы и производительность труда как решающий фактор

Наука, технологии и цифровая трансформация не обеспечивают рост автоматически: необходимы люди, способные их создавать, воспринимать и применять. Поэтому качество человеческих ресурсов является непосредственным звеном между технологическими факторами и производительностью.

Цель повышения производительности труда примерно на 8,5% в год в 2026–2030 гг. Требует не столько увеличения числа обученных работников, сколько повышения качества, структуры и способности рабочей силы адаптироваться к технологическим изменениям (коммунистическая партия вьетнама, 2026). Цифровые технологии, современная промышленность и новые отрасли требуют профессиональных и цифровых навыков, способности к инновациям и непрерывному обучению.

Здесь проявляется связь с идеями хо ши мина, который рассматривал человека и труд как непосредственные ресурсы развития и подчёркивал значение обучения, инициативы и совершенствования труда (хо ши мин, 2011; фам нгок фыонг, 2020). В современных условиях эти требования приобретают форму технологической компетентности и высокого качества человеческого капитала.

5.4. Повышение внутреннего потенциала в условиях глубокой международной интеграции

Международная интеграция является важным источником роста экономики вьетнама, однако участие в глобальных цепочках поставок

одновременно повышает требования к внутреннему потенциалу. Ограниченные связи между предприятиями с иностранными инвестициями и отечественным бизнесом могут приводить к тому, что внутренняя экономика получает меньшую добавленную стоимость по сравнению с масштабами внешнеторговой деятельности.

Поэтому задача заключается не в сокращении интеграции, а в повышении её качества. Привлечение иностранных инвестиций должно быть связано с развитием технологий, подготовкой кадров, исследованиями и разработками, передачей технологий и формированием связей с отечественными предприятиями. Одновременно вьетнамские предприятия должны повышать способность участвовать в звеньях цепочек с более высокой добавленной стоимостью.

Это соответствует логике опоры на собственные силы хо ши мина: внешние ресурсы должны использоваться для укрепления внутренней мощи, а не для её замены. В современных условиях самостоятельность всё теснее связана с технологическими возможностями, отечественными предприятиями, человеческими ресурсами и способностью обеспечивать устойчивость стратегически значимых цепочек.

5.5. Высокие темпы роста должны сочетаться с социальным прогрессом и устойчивостью

Целевой рост ввп не менее 10% в год требует масштабной мобилизации ресурсов, однако долгосрочная значимость такого роста определяется его воздействием на уровень жизни населения, социальную справедливость и качество окружающей среды.

Хо ши мин связывал экономическое развитие с повышением уровня жизни народа и обеспечением справедливости, а не рассматривал увеличение материального богатства как самоцель (хо ши мин, 2011, т. 15, с. 224; фам нгок фыонг, 2020). Поэтому новые движущие силы должны обеспечивать сочетание экономической эффективности и социального прогресса.

Ориентация xiv съезда на зелёную и циркулярную экономику, сокращение выбросов и эффективное использование ресурсов отражает это требование в современных условиях (коммунистическая партия вьетнама, 2026). Конкурентоспособность в долгосрочной перспективе должна всё больше основываться на производительности, технологиях, знаниях и эффективности использования ресурсов.

Таким образом, ключевой вызов 2026–2030 гг. Заключается не столько в наличии ресурсов и определении новых направлений, сколько в способности преобразовать движущие силы в реальные производственные возможности. Наука, технологии и инновации становятся факторами роста только при их соединении с предприятиями, человеческими ресурсами, институтами и рынком; частный сектор — при повышении его производственного потенциала; международная интеграция — при одновременном укреплении внутренних сил. В этом смысле центральная проблема нового этапа состоит в переходе от высвобождения ресурсов к созданию возможностей развития.

6. Заключение

Идеи хо ши мина об экономическом развитии содержат взаимосвязанную систему движущих сил: человек и труд; интересы и справедливость; многоукладная экономика и мобилизация общественных ресурсов; государство и эффективная организация; опора на собственные силы в сочетании с международным сотрудничеством (хо ши мин, 2011; фам нгок фыонг, 2020). Их особенность заключается в рассмотрении развития как результата взаимодействия человека, ресурсов, институтов и среды, а не отдельного фактора.

За 40 лет обновления эти положения были унаследованы и развиты в направлении формирования социалистически ориентированной рыночной экономики, развития многоукладности, частного сектора, международной интеграции и экономической самостоятельности. Xiv съезд развивает данную систему в условиях изменения производительных сил и международной конкуренции, выдвигая на первый план науку, технологии, инновации, цифровую трансформацию, производительность и укрепление самостоятельного потенциала экономики (коммунистическая партия вьетнама, 2026).

Основной вывод статьи состоит в выявлении перехода от высвобождения и мобилизации ресурсов к созданию новых возможностей развития. Это требует повышения технологического потенциала частного сектора, качества человеческих ресурсов, эффективности использования ресурсов и способности международной интеграции укреплять внутренние силы экономики.

Значение идей хо ши мина для современного этапа заключается не в прямом переносе исторических экономических форм, а в методологической логике выявления, организации и развития движущих сил в соответствии с конкретными условиями. Xiv съезд развивает эту логику в новых условиях, где способность создавать знания, технологии, производительность и добавленную стоимость становится важнейшим условием высоких темпов роста, повышения уровня жизни народа и укрепления независимой и самостоятельной экономики.

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ФОРМЫ ИЗМЕНЧИВОСТИ ВЕТВЕЙ ПРАВОЙ ВЕНЕЧНОЙ АРТЕРИИ СОБАКИ

Аннотация. *Изучены варианты ветвления правой венечной артерии (ПВА) на 50 сердцах собак и их значение при экспериментальной окклюзии. Выделено 5 типов по числу крупных ветвей к правому желудочку: I — 16 %, II — 36 % (самый частый), III — 26 %, IV — 16 %, V — 6 %. При перевязке ПВА (46 животных) выжило 36 собак; наилучшая выживаемость — при II типе. У собак выражено левовенечное преобладание; площадь кровоснабжения ПВА зависит от числа её крупных ветвей.*

Ключевые слова: *правая венечная артерия, собака, кровоснабжение сердца, правый желудочек, анатомическая изменчивость, ангиокардиография, анастомозы, перевязка коронарной артерии.*

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FORMS OF VARIABILITY OF THE BRANCHES OF THE RIGHT CORONARY ARTERY IN THE DOG

Abstract. *Variants of right coronary artery (RCA) branching were studied in 50 dog hearts and tested under experimental occlusion. Five types were identified by the number of large right-ventricular branches: I — 16 %, II — 36 % (most common), III — 26 %, IV — 16 %, V — 6 %. After RCA ligation (46 dogs) 36 animals survived; the highest survival occurred with type II. Dogs show clear left coronary dominance; the RCA perfusion area increases with the number of its major branches.*

Keywords: *right coronary artery, dog, cardiac blood supply, right ventricle, anatomical variation, angiography, anastomoses, coronary artery ligation.*

Ввдение. Проблема ремоделирования сердечно-сосудистой системы при различных патологических состояниях, прежде всего при артериальной гипертензии (АГ), привлекает все большее внимание исследователей [1,2]. Результаты исследований последних лет продемонстрировали, что характер морфологических и функциональных изменений сердца определяется не только уровнем гемодинамической нагрузки, но и

существенно зависит от активации целого ряда нейрогуморальных систем, а также имеет генетическую предрасположенность [3,4].

Кровеносные сосуды сердца собаки являются объектом исследования многих экспериментаторов в связи с использованием этих животных для моделирования патологических состояний в сердечно-сосудистой системе. Увеличение частоты случаев «легочного» сердца и ишемических повреждений его правых отделов сделало актуальной задачу более тщательного морфологического изучения их кровоснабжения, бассейна ветвления правой венечной артерии (ПВА) и ее анастомозов с ветвями левой венечной артерии [5,6.] Обычно кровеносная система правых отделов сердца описывалась авторами при рассмотрении всей коронарной системы. Нам встретились только две работы, в которых предпринята попытка выделить варианты ветвления ПВА и связать их с характером реакции сердца на ее перевязку. Это работы выделил два типа ветвления ПВА: «нормальную анатомию ПВА», встречающуюся у большинства беспородных собак, и «анатомию борзых», встречающуюся реже. При первом типе ветвления конечный отдел ПВА делится на огибающую и краевую ветви. Передние желудочковые ветви выражены слабо. Второй тип характеризуется преобладанием передней желудочковой ветви над краевой. Собаки с таким типом ветвления ПВА гибнут после перевязки ПВА или ее желудочковой ветви от фибрилляции желудочков. Однако такое деление не включает всех существующих вариантов ПВА. R. Mital выбрал два признака для определения вариантов ПВА: преобладание в концевом отделе ПВА огибающей или краевой ветвей (выделено 3 типа) и характер развития передних желудочковых и красных ветвей ПВА (выделено 5 группи) [5,6].

Цель исследования. Выявить и систематизировать морфологические формы индивидуальной изменчивости ветвления правой венечной артерии у собаки в норме.

Материалы и методы исследования. В настоящей работе, изучая на 50 беспородных собаках кровоснабжение правых отделов сердца с помощью инъекции контрастными веществами с последующим изготовлением рентгеновских снимков, мы попытались воспользоваться классификацией R. N. Mital.

Результаты исследования. Мы разделили сердце на группы по количеству ветвей ПВА, отходящих к правому желудочку: 1 гр. -1 ветвь, 11 гр. - 2 ветви, 111 гр. - 3 ветви, 1Vгр. - 4 ветви и больше, V гр. - ПВА представлена двумя стволами. Нами подсчитывались только длинные ветви ПВА, составляющие по диаметру не менее половины диаметра ПВА, простирающиеся вдоль всей стенки правого желудочка от венечной борозды до ветвей левой венечной артерии в области передней межжелудочковой борозды. Подсчет начинался после отхождения от ПВА первой (по току крови) нисходящей ветви. В 1 группе сердец ПВА делится на огибающую и межжелудочковую (нисходящую) ветви, (8 сердец на 50/16%). При этом типе деления правый желудочек питается из одной нисходящей ветви, т. к. от

огибающей ветви отходят только тоненькие веточки к верхней части задней стенки правого желудочка. Краевая ветвь отсутсвует во всех случаях. В этой группе межсистемные анастомозы коронарных артерий образуются вторичными стволиками, отходящими от желудочковой ветви ПВА, и ветвями передней и задней межжелудочковых артерий из системы левой венечной артерии.

Во всех случаях в области задней стенки правого желудочка в се верхней части отмечается участок, снабжаемый одновременно из четырех взаимно перекрывающихся источников: из огибающей и нисходящей ветвей ПВА и из задней нисходя щей и огибающей левой венечной артерии. Здесь происходит перекрытие областей кровоснабжения.

Во 2-ой группе сердец от ПВА отходит 2 желудочковые ветви. (18 сердец из 50/36%). Краевая ветвь, идущая параллельно острому краю, отмечена на 8 из 18 рентгенограмм. В остальных 10 случаях к острому краю правого желудочка под углом подходит несколько ветвей, которые принимают участие в формировании межсистемных анастомозов, располагающихся в задней межжелудочковой борозде. И в этой группе в области задней стенки правого желудочка в се верхней части имеется участок, «зона перекрытия», ветретвей из системы правой и левой венечных артерий. В большинстве сердец этой группы наблюдаются длинные ветви, отходящие от передней нисходящей ветви левой венечной артерии в области передней межжелудочковой борозды.

В III группе сердец от ПВА отходит 3 желудочковые ветви, (13 сердец из 50/26%). Анастомозы в области задней борозды образуются между ветвями краевой ветви правой венечной артерии и задней межжелудочковой ветви левой венечной артерии. В области передней борозды область кровоснабжения за счет ветвей левой венечной артерии меньше, чем в предыдущей группе. В области задней стенки правого желудочка виден участок перекрытия областей кровоснабжения ветвей правой и левой венечных артерий. В IV группе сердец от ПВА отходит 4 и более ветвей. (Из 50 сердец - 8/16%). Краевая ветвь отмечена в длинные анастомозы между ветвями правой и левой венечных артерий в области передней борозды обнаружены в 2-х случаях. В области задней стенки правого желудочка в верхней части обнаруживается участок перекрытия областей кровоснабжения ветвей обеих артерий. В У группе сердец ПВА представлена двумя ветвями, отходящими от ПВА в области ее устья - огибающей и желудочковой (из 50 сердец - 3/6%). В одном случае огибающая ветвь имеет меньшую область распространения, чем нисходящая желудочковая и почти вся стенка правого желудочка снабжается за счет желудочковой артерии, которая и образует анастомозы с ветвями левой венечной артерии в области передней и задней межжелудочковых борозд. В другом случае - огибающая ветвь выражена так же, как и желудочковая. Она дает краевую ветвь и образует анастомозы с ветвями левой венечной артерии в области задней межжелудочковой борозды. В передней борозде анастомозы с передней межжелудочковой

ветвью левой венечной артерии в обоих случаях образует желудочковая ветвь ПВА. В третьем случае - огибающая артерия снабжает большую часть правого желудочка, а желудочковая артерия от уровня устья ПВА спускается вниз на переднюю стенку и снабжает кровью только переднюю часть правого желудочка. И в этой группе в области задней стенки правого желудочка, в ее верхней части обнаруживается участок перекрытия областей кровоснабжения правой и левой венечных артерий. По нашим данным самая большая площадь кровоснабжения правого желудочка ветвями ПВА отмечается в IV группе, где количество ветвей ПВА превышает четыре. Во всех случаях было отмечено преобладание в кровоснабжении сердца собаки левой венечной артерии. Во всех группах в области задней стенки правого желудочка можно определить участок, получающий питание из различных источников и потому находящийся в выгодных условиях после выключения одного из источников. В области передней межжелудочковой борозды узкая зона анастомозов тянется вдоль всей границы передней стенки правого желудочка с левым. Анастомозы между ветвями венечных артерий здесь тонкие, в норме выявляются в небольшом количестве. Правое предсердие во всех исследованных нами сердцах кровоснабжается однотипно за счет нескольких мелких ветвей от верхней поверхности ПВА и одной крупной, задней предсердной ветви, отходящей от дистальной части правой венечной артерии. В опытах с перевязкой ПВА на растоянии 1 см от ее артериального устья в условиях нагрузки на правый желудочек и без нее из 46 собак выжило 36. Очевидно, это не только наиболее распространенный тип ветвления ПВА у собак, но и наиболее выгодный для сердца в условиях прекращения кровотока в этой питающей магистрали.

Вывод. Таким образом, в кровоснабжении сердца собаки преобладает левая венечная артерия. Правая венечная артерия имеет варианты в характере ветвления, которые можно объединить в 5 группах по количеству отходящих к правому желудочку ветвей. Площадь кровоснабжения правого желудочка ветвями ПВА увеличивается с увеличением количества отходящих от нее ветвей. Тип ветвления ПВА, при котором к правому желудочку отходит 2 ветви, встречается чаще других. Собаки с таким типом ветвления ПВА лучше других переносят перевязку этой артерии.

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ФУНКЦИОНАЛЬНОЕ ЗОНИРОВАНИЕ ЗААМИНСКОГО НАЦИОНАЛЬНОГО ПРИРОДНОГО ПАРКА КАК ОСНОВА УСТОЙЧИВОГО ТУРИСТСКО-РЕКРЕАЦИОННОГО ПРИРОДОПОЛЬЗОВАНИЯ

Аннотация. *В статье обосновано функциональное зонирование Зааминского национального природного парка, необходимое для согласования природоохранных задач с развитием туризма и рекреации. Цель исследования состоит в территориальном разграничении режимов использования парка на основе природно-географических условий, устойчивости экосистем, размещения рекреационных объектов и характера антропогенной нагрузки. Применены полевой, картографический, сравнительно-географический и геоинформационный методы, а также анализ нормативных и фондовых материалов. В результате выделены заповедная, рекреационная и хозяйственная зоны, определены их пространственные особенности, допустимые виды деятельности и приоритетные меры управления. Установлено, что предложенная карта может служить пространственной основой для регулирования потоков посетителей, размещения инфраструктуры и организации мониторинга состояния природных комплексов.*

Ключевые слова: *национальный природный парк, функциональное зонирование, геоинформационные системы, рекреационная нагрузка, экотуризм, природоохранный режим, Заамин.*

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FUNCTIONAL ZONING OF ZAAMIN NATIONAL NATURE PARK AS A BASIS FOR SUSTAINABLE TOURISM AND RECREATIONAL NATURE MANAGEMENT

Abstract. *The article substantiates the functional zoning of Zaamin National Nature Park required to reconcile nature conservation with tourism and recreation development. The study aims to delimit territorial management regimes according to physical-geographical conditions, ecosystem resilience, the location of recreational facilities, and the intensity of human pressure. Field surveys,*

cartographic analysis, comparative geographical and GIS methods, as well as the examination of regulatory and archival materials, were applied. The resulting zoning distinguishes protected, recreational, and economic-use areas and defines their spatial characteristics, permitted activities, and management priorities. The proposed map provides a spatial basis for visitor-flow regulation, infrastructure siting, and environmental monitoring.

Keywords: *national nature park, functional zoning, geographic information systems, recreational pressure, ecotourism, conservation regime, Zaamin.*

Введение

Рост посещаемости горных природных территорий усиливает противоречие между экономическими выгодами туризма и необходимостью сохранять экосистемы. В национальных парках это противоречие проявляется особенно отчетливо: концентрация посетителей и инфраструктуры на доступных участках ведет к уплотнению почв, эрозии склонов, нарушению растительного покрова, накоплению отходов и беспокойству животных. Поэтому расширение туристского предложения без пространственного разграничения режимов использования способно снизить природную ценность территории, от которой непосредственно зависит ее рекреационная привлекательность.

Зааминский национальный природный парк расположен на северном склоне Туркестанского хребта в пределах Зааминского и Бахмальского районов Джизакской области. Площадь парка по паспорту на 2025 г. составляет 23 419,2 га; высотный диапазон изменяется примерно от 1200 до 4033 м. Значительная амплитуда высот обусловливает выраженную дифференциацию рельефа, климата, растительности, гидрографической сети и устойчивости ландшафтов. Территория включает естественные арчовые леса, речные долины, ущелья, участки с редкими видами, населенные пункты, дороги, объекты санаторно-курортной и туристской инфраструктуры. Совмещение охраняемых природных комплексов и освоенных участков требует территориально дифференцированного управления.

Правовой основой такого управления служат Закон Республики Узбекистан «Об охраняемых природных территориях», Указ Президента Республики Узбекистан от 6 апреля 2021 г. № УП-6201 и постановление Кабинета Министров Республики Узбекистан от 28 апреля 2021 г. № 254. Эти документы закрепляют необходимость охраны природных комплексов и одновременно определяют условия развития Зааминской туристско-рекреационной зоны [1-3]. Международные руководства IUCN рассматривают функциональное зонирование и управление потоками посетителей как взаимосвязанные инструменты устойчивого использования охраняемых территорий [4].

Цель исследования - разработать и научно обосновать схему функционального зонирования Зааминского национального природного парка, определив пространственное положение, назначение и режим

использования заповедной, рекреационной и хозяйственной зон. Для достижения цели решались задачи систематизации критериев зонирования, пространственного сопоставления природных и антропогенных факторов, интерпретации авторской карты и разработки дифференцированных управленческих мер.

Материалы и методы исследования

Исходную информационную базу составили паспорт Зааминского национального природного парка за 2025 г., полевые наблюдения автора, материалы учета природных и туристско-рекреационных объектов, топографическая основа, сведения о дорожной и поселковой сети, результаты анализа рекреационной нагрузки, а также нормативно-правовые и научные источники. Пространственная обработка и картографирование выполнялись в среде ArcGIS. Итоговая карта подготовлена в масштабе 1:100 000 и отражает территориальное распределение функциональных зон.

Методическая схема включала пять последовательных операций. На первом этапе анализировалась природно-географическая дифференциация: абсолютная высота, расчлененность и крутизна рельефа, состояние растительности, гидрографические объекты и проявление опасных процессов. На втором этапе учитывалась природоохранная ценность участков - сохранность экосистем, концентрация редких и эндемичных видов, значение местообитаний и потребность в ограничении доступа. На третьем этапе оценивалась рекреационная пригодность территории по доступности, пейзажной привлекательности, наличию маршрутов и устойчивости природных комплексов к посещениям. На четвертом этапе сопоставлялись поселения, дороги, санаторные, туристские и обслуживающие объекты как показатели хозяйственной освоенности. На пятом этапе тематические слои совмещались, а границы функциональных зон уточнялись с учетом целостности природных комплексов и практической управляемости.

При отнесении участка к определенной зоне использовался принцип приоритета наиболее строгого ограничения. Если высокая рекреационная привлекательность сочеталась с наличием уязвимого местообитания, приоритет отдавался охране, а посещение допускалось только в научных или строго регулируемых формах. Рекреационное использование концентрировалось на устойчивых и доступных территориях, тогда как хозяйственная функция закреплялась за уже преобразованными участками, где размещение обслуживания не требует освоения новых природных площадей.

Таблица 1 - Критерии функционального зонирования Зааминского национального природного парка

Группа критериев	Основные показатели	Управленческое значение
Природно-географические	Высота, крутизна и расчлененность склонов; гидросеть; растительный покров; эрозия, сели, оползни	Определение устойчивости, доступности и природных ограничений
Природоохранные	Сохранность экосистем; редкие и эндемичные виды; ценные местообитания	Выделение участков строгой охраны и научного мониторинга
Рекреационные	Пейзажность; доступность; существующие маршруты; устойчивость к вытаптыванию	Размещение регулируемого и активного посещения
Антропогенные	Дороги, поселения, санаторные и сервисные объекты; интенсивность посещений	Концентрация инфраструктуры на освоенных участках
Управленческие	Контролируемость доступа; связность границ; возможность мониторинга	Практическое обеспечение установленного режима

Результаты исследования

Картографический анализ позволил выделить три базовые функциональные зоны: заповедную, рекреационную и хозяйственную. На авторской карте заповедные участки показаны красным цветом, рекреационные - зеленым, хозяйственные - голубым. Пространственная конфигурация зон имеет мозаично-коридорный характер, что отражает сочетание горных природных комплексов, долинных путей доступа, населенных пунктов и локальных центров инфраструктуры.

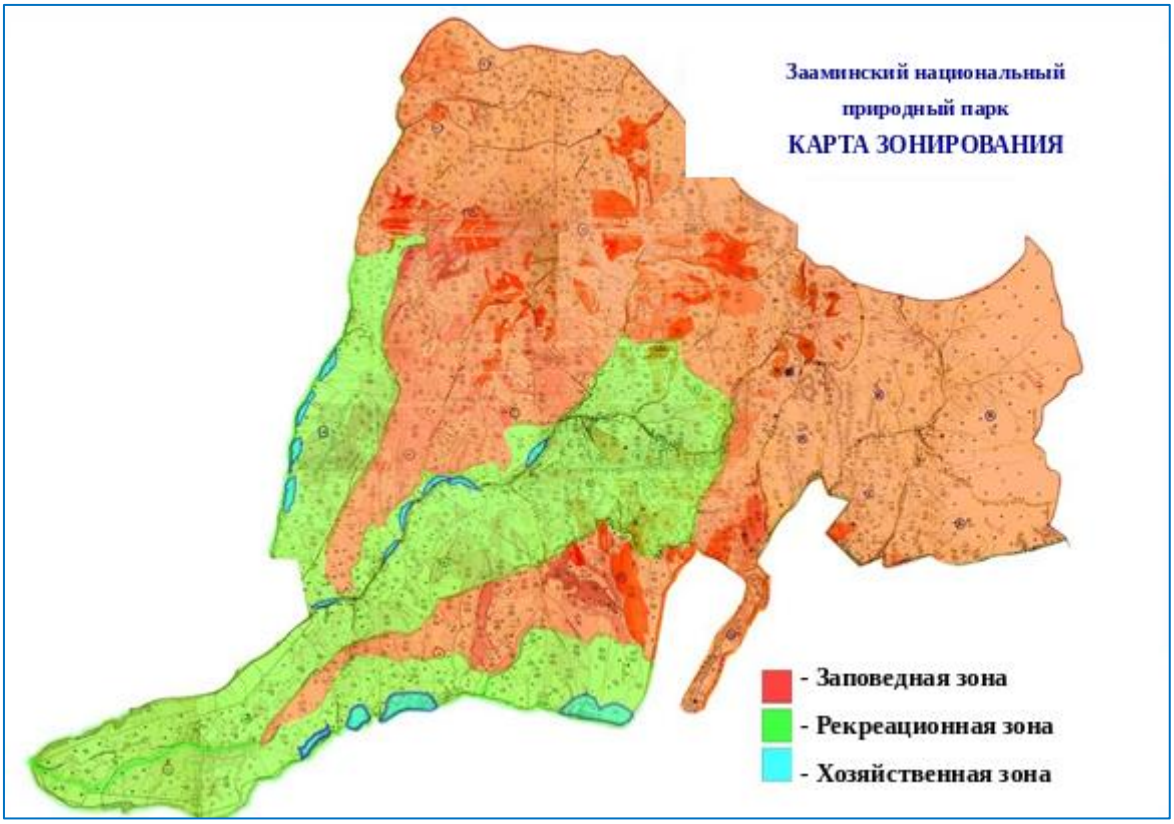


Рисунок 1 - Функциональное зонирование Зааминского национального природного парка

Примечание: красный цвет - заповедная зона; зеленый - рекреационная; голубой - хозяйственная. Составлено автором в ArcGIS по материалам исследования.

Заповедная зона представлена разобщенными участками преимущественно в северной, центральной и восточной частях парка. Такая конфигурация связана не с удобством туристского доступа, а с размещением наиболее ценных и уязвимых природных комплексов. В ее пределах сохраняются естественные процессы, арчовые экосистемы, местообитания редких видов и участки, чувствительные к вытаптыванию, дорожному строительству и шуму. Основная функция зоны - сохранение биоразнообразия и проведение научного мониторинга. Хозяйственная и массовая рекреационная деятельность исключается; вход возможен по специальному разрешению для исследований, охраны и восстановления природных комплексов.

Рекреационная зона образует наиболее связный пояс в западной, юго-западной и центральной частях, следуя доступным долинам, существующим путям и объектам посещения. Ее пространственная связность позволяет направлять основной поток по контролируемым маршрутам, не рассеивая посетителей по уязвимым участкам. Внутри этой зоны целесообразно различать участки ограниченной и активной рекреации. Ограниченная рекреация предусматривает пешие экотропы, наблюдательные площадки и посещения малыми группами по предварительно установленным квотам.

Активная рекреация допускается у сложившихся центров, включая район Зааминского санатория, при обязательном санитарном, техническом и экологическом контроле.

Хозяйственная зона на карте локализована небольшими участками, приуроченными к уже освоенным территориям. Ее назначение состоит в обеспечении функционирования парка и обслуживания посетителей без переноса инфраструктурной нагрузки на заповедные комплексы. Здесь могут размещаться административные и хозяйственные объекты, инженерные сети, парковки, пункты сбора отходов, объекты местного сервиса и иные сооружения, предусмотренные утвержденными планами. Новое строительство должно проходить экологическую оценку, соответствовать ландшафтно-архитектурным требованиям и использовать существующие транспортные коридоры.

Таблица 2 - Режим использования функциональных зон

Зона	Главная функция	Допустимые виды деятельности	Основные ограничения
Заповедная	Сохранение природных процессов, местообитаний и биоразнообразия	Научные исследования, мониторинг, охранные и восстановительные работы по разрешению	Запрет массового посещения, строительства, хозяйственного использования и движения вне служебных маршрутов
Рекреационная	Регулируемое знакомство с природой, отдых и экологическое просвещение	Экотропы, экскурсии, наблюдение, фото- и научный туризм; сервис на специально определенных площадках	Квоты, сезонные ограничения, движение только по маршрутам, запрет самовольных стоянок и костров
Хозяйственная	Административное и инфраструктурное обеспечение парка и посетителей	Управление, обслуживание, парковки, санитарные узлы, локальные инженерные объекты и услуги населения	Экологическая экспертиза, минимизация застройки, запрет расширения за счет ценных природных участков

Выделенные зоны образуют взаимодополняющую систему. Заповедная зона сохраняет экологическое ядро; рекреационная принимает и направляет посетителей; хозяйственная обеспечивает сервис и управление. Эффективность системы зависит не только от нанесения границ на карту, но и от юридического закрепления режимов, установки пограничных и информационных знаков, организации пропускных пунктов и регулярного обновления геоданных.

Обсуждение результатов

Предложенная схема соответствует концепции поляризации ландшафта Б.Б. Родомана, согласно которой интенсивно используемые и строго

охраняемые пространства должны быть территориально разведены и связаны буферными элементами [5]. Для Зааминского парка роль такого буфера выполняют участки регулируемой рекреации. Они обеспечивают доступ к природным достопримечательностям, но одновременно уменьшают прямое давление на заповедные ядра.

Результаты также согласуются с подходами LAC и VERP, в которых управление строится не вокруг формального максимального числа посетителей, а вокруг допустимого состояния природных ресурсов и качества опыта посетителей [6-8]. Поэтому границы рекреационной зоны не должны пониматься как безусловное разрешение на неограниченный поток. Для каждого маршрута необходимы индикаторы: ширина и размыв тропы, доля оголенной почвы, повреждение растительности, количество отходов, беспокойство животных и число посетителей в единицу времени. При достижении порогов маршрут временно закрывается, поток перераспределяется, а нарушенный участок восстанавливается.

Карта показывает, что транспортная и туристская активность может быть сосредоточена в связанном рекреационном коридоре. Это создает предпосылки для цифрового управления потоками. На входных постах целесообразно применять электронную регистрацию, а данные о посещениях связывать с геоинформационной базой. Оперативная панель должна отражать загрузку маршрутов, временные ограничения, пожарную и селевую опасность, состояние троп и санитарных объектов. Такой механизм позволяет перейти от неизменной схемы зонирования к адаптивному режиму управления.

Особое значение имеет высотная и сезонная изменчивость. На территории парка летние температуры могут достигать +23…+33 °C, зимние - снижаться до −19…−32 °C; среднегодовое количество осадков составляет около 295-405 мм, причем основная их часть приходится на весну. Сочетание крутых склонов, осадков и рыхлого материала повышает риск эрозии, селей, оползней и камнепадов. Следовательно, рекреационная пригодность не является постоянной: весной и после интенсивных осадков отдельные участки маршрутов должны переводиться в режим временного ограничения независимо от их базовой зональной принадлежности.

Функциональное зонирование создает также экономический эффект. Концентрация капиталоемких объектов в хозяйственной и активной рекреационной зонах уменьшает стоимость инженерного обеспечения и контроля, а участие жителей близлежащих поселений в работе гостевых домов, гидских служб, ремесленных и гастрономических сервисов распределяет доходы за пределы наиболее уязвимых природных участков. Подобный подход соответствует принципу вовлечения местных сообществ в устойчивый экотуризм [9, 10].

Ограничением исследования является отсутствие в исходной картографической композиции экспликации площадей каждой зоны. Поэтому в статье не приводятся расчетные доли зон: их определение по цветным

пикселям изображения дало бы методически ненадежный результат из-за совмещения зональных заливок с топографической основой. Следующий этап должен включать работу с исходными векторными полигонами, проверку топологии, расчет площадей и долей, а также полевую верификацию спорных границ. Это повысит воспроизводимость карты и позволит закрепить нормативы по каждому лесничеству и маршруту.

Практические рекомендации

Для внедрения карты в управление парком предлагается: 1) утвердить цифровые границы зон и режимы использования в документах территориального планирования; 2) разграничить внутри рекреационной зоны участки ограниченного и активного посещения; 3) создать единый реестр маршрутов и объектов с указанием сезонности, сложности и допустимой нагрузки; 4) установить на местности знаки и QR-коды с правилами поведения; 5) организовать мониторинг троп, растительности, почв, водных объектов, отходов и пожарной опасности; 6) размещать новую капитальную инфраструктуру только в хозяйственной либо активной рекреационной зоне после экологической оценки; 7) ежегодно уточнять геоинформационную базу по результатам полевых обследований и статистики посещений.

Заключение

Функциональное зонирование Зааминского национального природного парка является необходимым условием устойчивого сочетания природоохранной, рекреационной и хозяйственной функций. На основе природно-географических, природоохранных, рекреационных, антропогенных и управленческих критериев выделены три взаимосвязанные зоны. Заповедная зона обеспечивает сохранение наиболее ценных и уязвимых комплексов; рекреационная зона концентрирует регулируемые потоки и экологическое просвещение; хозяйственная зона принимает инфраструктуру и обслуживание на уже освоенных участках.

Главный практический результат исследования - авторская карта масштаба 1:100 000, которая переводит общие требования охраны природы в пространственно определенные режимы. Ее применение позволяет обосновывать размещение маршрутов и объектов, предотвращать проникновение массового туризма в уязвимые местообитания, распределять рекреационную нагрузку и организовать геоинформационный мониторинг.

Для перехода от проектной схемы к нормативному инструменту необходимы векторная инвентаризация границ, расчет площадей зон, полевое согласование спорных участков и закрепление измеримых индикаторов допустимых изменений. При регулярном обновлении данных функциональное зонирование может стать основой адаптивного управления Зааминским национальным природным парком и обеспечить сохранение его ландшафтного и биологического разнообразия при контролируемом развитии экотуризма.

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МОРФОМЕТРИЧЕСКИЕ ИЗМЕНЕНИЯ ГРУДНОЙ КЛЕТКИ У ДЕТЕЙ ШКОЛЬНОГО ВОЗРАСТА СО СКОЛИОЗОМ

Аннотация. *Изучены морфометрические параметры грудной клетки у детей школьного возраста со сколиозом в сравнении с контрольной группой. Проведено антропометрическое исследование детей 4-6 классов. Измерялись окружность грудной клетки, передне-задний и поперечный диаметры. Группа со сколиозом сравнивалась с контрольной группой здоровых детей.*

Выявлены статистически значимые различия в морфометрических показателях грудной клетки между группами. У детей со сколиозом отмечается уменьшение окружности грудной клетки в 4 классе и изменение диаметров в старших классах. Сколиоз оказывает значительное влияние на формирование грудной клетки у детей школьного возраста, что требует раннего выявления и коррекции деформации.

Ключевые слова: *сколиоз, грудная клетка, морфометрия, дети школьного возраста, деформация позвоночника.*

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MORPHOMETRIC CHANGES OF THE CHEST IN SCHOOL-AGE CHILDREN WITH SCOLIOSIS

Abstract. *Morphometric parameters of the chest in school-age children with scoliosis were studied in comparison with a control group. An anthropometric examination of children in grades 4–6 was conducted. Chest circumference, anteroposterior and transverse diameters were measured. The group with scoliosis was compared with a control group of healthy children.*

Statistically significant differences in the morphometric parameters of the chest between the groups were revealed. In children with scoliosis, a decrease in chest circumference is noted in the 4th grade and changes in diameters in the senior

grades. Scoliosis has a significant impact on the formation of the chest in school-age children, which requires early detection and correction of the deformity.

Keywords: *scoliosis, chest, morphometry, school-age children, spinal deformity.*

Введение. Идиопатический сколиоз является одной из наиболее распространенных деформаций позвоночника у детей и подростков, встречающейся в 2-4% популяции [1, 2]. Данное заболевание характеризуется не только искривлением позвоночника во фронтальной плоскости, но и ротационным компонентом, что приводит к формированию реберного горба и деформации грудной клетки [3, 4]. Морфометрические изменения грудной клетки при сколиозе имеют важное клиническое значение, поскольку они могут влиять на функцию дыхательной и сердечно-сосудистой систем [5, 6,8]. Раннее выявление этих изменений позволяет своевременно начать коррекционные мероприятия и предотвратить прогрессирование деформации [7,9,10].

Цель исследования - изучить морфометрические параметры грудной клетки у детей школьного возраста со сколиозом и сравнить их с показателями здоровых детей.

Материалы и методы. В исследование были включены дети 4-6 классов общеобразовательных школ. Основную группу составили 45 детей с диагностированным сколиозом I-II степени, контрольную группу - 52 здоровых ребенка того же возраста.

Проводились следующие антропометрические измерения:

- Окружность грудной клетки (см)
- Передне-задний диаметр грудной клетки (см)
- Поперечный диаметр грудной клетки (см)

Измерения выполнялись по стандартной методике с использованием сантиметровой ленты и толстотного циркуля. Статистическая обработка данных проводилась с использованием t-критерия Стьюдента. Различия считались статистически значимыми при $p<0,05$.

Результаты исследования. Результаты морфометрических измерений представлены в таблице 1.

Группа	**Класс**	**Окружность грудной клетки (см)**	**Передне-задний диаметр (см)**	**Поперечный диаметр (см)**
Контроль	4 класс	66,6±1,8	30,7±2,2	28,9±1,0
	5 класс	73,3±1,3	27,5±2,0	28,4±0,75
	6 класс	73,8±1,4	29,8±2,0	29,8±0,77
Сколиоз	4 класс	62,8±0,82*	25,6±1,1*	26,4±0,49*
	5 класс	69,9±2,6	23,9±2,7	27,8±1,3
	6 класс	70,5±1,7	38,6±0,78***	33,6±0,94**

Примечание: различия достоверны по сравнению с контрольной группой (-P<0,05; **-P<0,01; ***-P<0,001)*

Таблица 1. Морфометрические показатели грудной клетки у детей со сколиозом и контрольной группы (M±m)

У детей 4 класса со сколиозом окружность грудной клетки была достоверно меньше (62,8±0,82 см) по сравнению с контрольной группой (66,6±1,8 см, $p<0,05$). Это свидетельствует о раннем влиянии деформации позвоночника на развитие грудной клетки. В 5 и 6 классах различия в окружности грудной клетки между группами были менее выражены, что может быть связано с компенсаторными механизмами роста.

Наиболее выраженные изменения наблюдались в передне-заднем диаметре грудной клетки. У детей 4 класса со сколиозом этот показатель был значительно меньше (25,6±1,1 см против 30,7±2,2 см в контроле, $p<0,05$).

Особенно интересные результаты получены в 6 классе, где у детей со сколиозом передне-задний диаметр был достоверно больше (38,6±0,78 см против 29,8±2,0 см в контроле, $p<0,001$). Это может указывать на формирование компенсаторной деформации грудной клетки.

Поперечный диаметр грудной клетки у детей 4 класса со сколиозом был меньше контрольных значений (26,4±0,49 см против 28,9±1,0 см, $p<0,05$). В 6 классе наблюдалось достоверное увеличение этого показателя у детей со сколиозом (33,6±0,94 см против 29,8±0,77 см в контроле, $p<0,01$).

Обсуждение. Полученные результаты демонстрируют значительное влияние сколиоза на морфометрические параметры грудной клетки у детей школьного возраста. Выявленные изменения согласуются с данными литературы о том, что деформация позвоночника приводит к вторичным изменениям формы грудной клетки [8, 9]. Уменьшение всех измеряемых параметров у детей 4 класса со сколиозом может свидетельствовать о раннем негативном влиянии деформации на развитие грудной клетки. Это подчеркивает важность раннего выявления и лечения сколиоза [10]. Увеличение передне-заднего и поперечного диаметров у детей 6 класса со сколиозом может быть результатом компенсаторных механизмов, направленных на поддержание дыхательной функции при прогрессирующей деформации [11, 12]. Эти морфометрические изменения могут иметь клиническое значение, поскольку деформация грудной клетки может влиять на функцию легких и сердца [13, 14]. Раннее выявление таких изменений позволяет своевременно начать коррекционные мероприятия.

Выводы. Проведенное исследование морфометрических параметров грудной клетки у детей школьного возраста со сколиозом позволило установить, что у детей со сколиозом наблюдаются достоверные изменения морфометрических параметров грудной клетки по сравнению со здоровыми детьми. В младших классах (4 класс) отмечается уменьшение всех измеряемых параметров грудной клетки, что указывает на раннее влияние деформации позвоночника на формирование костно-мышечного каркаса туловища. В старших классах (6 класс) наблюдается компенсаторное увеличение передне-заднего и поперечного диаметров грудной клетки, что

может свидетельствовать о развитии адаптационных механизмов организма в ответ на прогрессирующую деформацию позвоночника.

Полученные данные подчеркивают необходимость раннего выявления и лечения сколиоза для предотвращения прогрессирования деформации грудной клетки и связанных с ней функциональных нарушений дыхательной и сердечно-сосудистой систем. Морфометрические исследования грудной клетки могут служить дополнительным критерием оценки тяжести сколиоза и эффективности проводимого лечения, что особенно важно для мониторинга состояния пациентов в динамике.

На основании полученных результатов рекомендуется включить морфометрические измерения грудной клетки в комплексное обследование детей со сколиозом как обязательный компонент диагностического алгоритма. Необходимо проводить регулярный мониторинг изменений формы грудной клетки у детей с деформациями позвоночника с целью своевременного выявления прогрессирования деформации и коррекции лечебных мероприятий. Целесообразно использовать полученные данные для раннего выявления детей группы риска по развитию дыхательных нарушений и формирования индивидуальных программ наблюдения и лечения. Важным направлением является разработка специализированных программ физической реабилитации с учетом выявленных морфометрических изменений, что позволит повысить эффективность консервативного лечения и улучшить качество жизни детей со сколиозом.

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ЗАРУБЕЖНЫЙ ОПЫТ ЭФФЕКТИВНОГО УПРАВЛЕНИЯ ПРЕДПРИЯТИЯМИ С ГОСУДАРСТВЕННЫМ УЧАСТИЕМ И ВОЗМОЖНОСТИ ЕГО ПРИМЕНЕНИЯ В РЕСПУБЛИКЕ УЗБЕКИСТАН

Аннотация. *В статье анализируется эффективное управление предприятиями с государственным участием на принципах профессионализации функции собственника, прозрачности, подотчётности, равных условий конкуренции, независимости советов директоров, качественной финансовой отчётности и недопущения политического вмешательства в операционную деятельность компаний. Раскрываются зарубежный опыт управления предприятиями с государственным участием. Анализ зарубежного опыта, позволило авторам выделить несколько направлений, которые могут быть применены в Республике Узбекистан.*

Ключевые слова: *Государственная собственность, управление активами, приватизация, предприятиям с государственным участием, реестр имущества, KPI (ключевые показатели эффективности) ESG (экологические, социальные и управленческие факторы), Агентства по управлению государственными активами.*

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INTERNATIONAL BEST PRACTICES IN THE EFFECTIVE MANAGEMENT OF STATE-OWNED ENTERPRISES AND THEIR POTENTIAL APPLICATION IN THE REPUBLIC OF UZBEKISTAN

Abstract. *This article analyzes the effective management of state-owned enterprises based on the principles of a professionalized ownership function, transparency, accountability, a level playing field for competition, board of directors independence, high-quality financial reporting, and the prevention of political interference in companies' operational activities. It also examines international experience in managing state-owned enterprises. The analysis of this international experience has allowed the authors to identify several areas for potential application in the Republic of Uzbekistan.*

Keywords: *State property, asset management, privatization, state-owned enterprises, property register, KPI (key performance indicators), ESG (environmental, social, and governance), State Assets Management Agency.*

1. Введение

В современных условиях предприятия с государственным участием сохраняют важное значение для обеспечения устойчивого экономического развития, национальной безопасности, энергетической стабильности, развития инфраструктуры и реализации социально значимых функций государства. При этом международная практика 2024-2026 годов показывает, что роль государства в экономике уже не сводится только к владению активами. Государство всё чаще выступает как профессиональный собственник, стратегический инвестор, регулятор и гарант устойчивого развития.

В отличие от подходов начала 2000-х годов, когда акцент делался преимущественно на приватизации и сокращении государственного сектора, современная модель управления государственными активами основывается на более сбалансированном подходе. Во многих странах государство сохраняет участие в стратегически важных секторах: энергетике, транспорте, водоснабжении, телекоммуникациях, оборонной промышленности, финансовой инфраструктуре, цифровых платформах, критической инфраструктуре и природных ресурсах.

Особое значение в 2024-2026 годах приобрели следующие направления:

во-первых, повышение эффективности предприятий с государственным участием через внедрение современных стандартов корпоративного управления;

во-вторых, разграничение функций государства как собственника, регулятора и заказчика общественно значимых услуг;

в-третьих, внедрение системы KPI (ключевые показатели эффективности), цифрового мониторинга и оценки результативности деятельности предприятий;

в-четвёртых, усиление требований к прозрачности, финансовой отчётности, внутреннему контролю и управлению рисками;

в-пятых, интеграция принципов ESG (экологические, социальные и управленческие факторы), устойчивого развития и климатической отчётности в систему управления государственными компаниями.

Согласно обновлённым подходам OECD (организация экономического сотрудничества и развития), эффективное управление предприятиями с государственным участием должно строиться на принципах профессионализации функции собственника, прозрачности, подотчётности, равных условий конкуренции, независимости советов директоров, качественной финансовой отчётности и недопущения политического вмешательства в операционную деятельность компаний.

В этой связи предприятия с государственным участием рассматриваются не только как инструмент государственного контроля, но и как механизм реализации долгосрочных национальных приоритетов: индустриализации, цифровизации, энергетического перехода, развития инфраструктуры, занятости населения и повышения инвестиционной привлекательности экономики.

2. Современные особенности управления предприятиями с государственным участием за рубежом

Международный опыт показывает, что универсальной модели управления предприятиями с государственным участием не существует. Однако в большинстве развитых и развивающихся стран можно выделить ряд общих тенденций.

2.1. Швеция: централизованная и профессиональная модель собственника [1].

Швеция считается одним из наиболее успешных примеров управления государственными компаниями. Основной особенностью шведской модели является концентрация прав собственника в специализированных государственных органах, которые действуют профессионально и ориентируются на коммерческую эффективность, устойчивое развитие и общественную пользу.

2.2. Норвегия: чёткая классификация целей государственного владения [2,3].

В Норвегии государственное участие в компаниях основывается на чётком понимании цели владения. Государство разделяет компании на группы в зависимости от того, преследуются ли в них преимущественно коммерческие цели либо одновременно реализуются общественно значимые задачи.

2.3. Сингапур: холдинговая модель Temasek [4].

Одной из наиболее известных моделей является сингапурская система управления через государственный инвестиционный холдинг «Temasek».

Temasek Holdings – это одна из государственных компаний в Азии и мире называет компанию со штаб-квартирой в Сингапуре, созданную в 1974

году. Она управляет многомиллиардными портфельными активами (более 400 миллиардов сингапурских долларов), инвестируя в различные сектора, включая финансовой, технологии и транспорт, действуя как коммерческая структура, независимая от прямого подчинения правительству. Данная модель основана на принципе отделения государства как собственника от операционного управления компаниями.

2.4. Франция: активная роль государства в стратегических секторах [5].

Французская модель отличается активной ролью государства в стратегически значимых отраслях: энергетике, транспорте, оборонной промышленности, инфраструктуре и высокотехнологичных секторах. Управление государственными долями осуществляется через специализированные структуры, включая Агентство по участию государства в капитале компаний.

2.5. Германия: правовая регламентация, контроль и финансовая дисциплина [6].

В Германии государственное участие в компаниях осуществляется на основе чётких правовых процедур, парламентского контроля, бюджетной дисциплины и требований к эффективности. Государство может владеть предприятиями полностью или частично, однако участие в капитале должно быть экономически и общественно обосновано.

2.6. Южная Корея: оценка эффективности и цифровой мониторинг [7].

Южная Корея активно применяет систему оценки деятельности государственных предприятий и публичных институтов. Управление строится на основе стратегических планов, ежегодной оценки эффективности, показателей результативности, финансового контроля и мониторинга долговой нагрузки.

2.7. Китай: стратегическое управление и реформирование государственных предприятий [8].

В Китае государственные предприятия играют ключевую роль в стратегических секторах экономики. Управление ими осуществляется через специализированные органы, включая SASAC – Комитет по контролю и управлению государственным имуществом.

Китайский опыт показывает, что государственные предприятия могут быть инструментом промышленной политики и технологической модернизации. Однако для эффективности такой модели необходимы жёсткая система KPI, контроль долговой нагрузки, профессиональный менеджмент и регулярная оценка результатов.

2.8. Казахстан: трансформация государственных холдингов [9].

Для Узбекистана особенно близким является опыт Казахстана, где значительная часть государственных активов сосредоточена в крупных национальных компаниях и холдингах, включая АО «Самрук-Казына». В последние годы Казахстан проводит реформы, направленные на повышение прозрачности, приватизацию отдельных активов, развитие IPO (первичное публичное размещение акций), совершенствование корпоративного

управления, внедрение KPI и повышение эффективности портфельных компаний.

3. Возможности применения зарубежного опыта в Республике Узбекистан

Анализ зарубежного опыта позволяет выделить несколько направлений, которые могут быть применены в Республике Узбекистан.

4.1. Классификация предприятий с государственным участием

Целесообразно разделить предприятия с государственным участием на несколько категорий:

стратегические предприятия, где государственный контроль должен сохраняться в целях национальной безопасности, энергетической устойчивости и экономического суверенитета;

инфраструктурные предприятия, выполняющие общественно значимые функции;

коммерческие предприятия, которые работают на конкурентном рынке и должны оцениваться по рыночным критериям эффективности;

предприятия, подлежащие приватизации, если участие государства в них не имеет стратегического значения;

предприятия, требующие реструктуризации, если их финансовое состояние, долговая нагрузка или управленческая модель не соответствуют современным требованиям.

4.2. Усиление роли Агентства по управлению государственными активами

В условиях Узбекистана особое значение имеет дальнейшее укрепление роли уполномоченного органа по управлению государственными активами. Агентство должно выступать не только как орган учёта и приватизации, но и как профессиональный центр управления государственным портфелем.

Для этого целесообразно развивать следующие функции: портфельный анализ государственных активов, цифровой мониторинг эффективности предприятий, оценка KPI руководителей, контроль дивидендной политики, анализ долговой нагрузки, мониторинг инвестиционных проектов, оценка деятельности наблюдательных советов, подготовка предприятий к приватизации, IPO и SPO (вторичное публичное размещение акций), внедрение ESG и стандартов устойчивого развития.

4.3. Повышение качества корпоративного управления

Зарубежный опыт показывает, что эффективность государственных предприятий во многом зависит от качества советов директоров и наблюдательных советов. В Узбекистане целесообразно усилить требования к кандидатам в наблюдательные советы предприятий с государственным участием.

При назначении членов наблюдательных советов необходимо учитывать: профессиональный опыт; специальность по диплому о высшем образования и соответствие ее отрасли; опыт работы на руководящих должностях; наличие базового образования в области корпоративного

управления; независимость суждений; отсутствие конфликта интересов; понимание стратегических задач предприятия.

Особое внимание следует уделить включению независимых директоров, специалистов по финансам, внутреннему аудиту, цифровизации, управлению рисками и ESG.

4.4. Развитие цифрового реестра государственных активов

Для повышения прозрачности управления государственными активами необходимо дальнейшее развитие цифрового реестра государственного имущества. Такой реестр должен обеспечивать актуальную информацию о составе активов, стоимости имущества, форме собственности, балансодержателях, эффективности использования, договорах аренды, судебных спорах, приватизационных процессах и инвестиционных обязательствах. Цифровизация учёта государственных активов позволит: снизить риск потери или неэффективного использования имущества; повысить прозрачность распоряжения активами; обеспечить межведомственный обмен данными; ускорить подготовку объектов к приватизации; повысить качество управленческих решений; усилить общественный и государственный контроль.

4.5. Совершенствование приватизации

Мировой опыт показывает, что приватизация не должна рассматриваться как самоцель. Её эффективность зависит от качества подготовки предприятия, прозрачности процедуры, наличия конкурентной среды, защиты прав собственности, оценки стоимости активов и последующего мониторинга инвестиционных обязательств.

Для Узбекистана важно придерживаться принципа: приватизировать не ради продажи, а ради повышения эффективности актива. Перед приватизацией необходимо проводить: финансовую диагностику предприятия; оценку активов; анализ долговой нагрузки; юридическую проверку имущества; оценку рыночной перспективы; реструктуризацию неэффективных обязательств; подготовку прозрачной информации для инвесторов; определение пост приватизационных обязательств.

После приватизации необходимо осуществлять мониторинг исполнения инвестиционных, социальных, производственных и экологических обязательств.

Выводы

Таким образом, для Республики Узбекистан на наш взгляд, целесообразно применять комбинированную модель управления предприятиями с государственным участием, основанную на международном опыте Швеции, Норвегии, Сингапура, Южной Кореи и Казахстана. Такая модель должна предусматривать сохранение государственного контроля над стратегически важными активами, внедрение KPI, цифрового мониторинга, ESG-отчётности, риск-ориентированного внутреннего контроля и повышение прозрачности приватизационных процессов.

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ДОРИВОР ЎСИМЛИК ХОМАШЁСИНИ СТАНДАРТЛАШТИРИШНИНГ ЗАМОНАВИЙ УСУЛЛАРИ

Аннотация:*Мазкур мақолада доривор ўсимлик хомашёсини стандартлаштиришнинг замонавий ёндашувлари, фармакогностик идентификация, физик-кимёвий ва фитокимёвий кўрсаткичларни аниқлаш ҳамда инструментал таҳлил усулларининг аҳамияти таҳлил қилинган. Доривор ўсимлик хомашёсининг сифати ўсимлик турининг ҳақиқийлиги, хомашёнинг морфологик ва анатомик белгилари, намлик, умумий кул, минерал аралашмалар, экстрактив моддалар, биологик фаол моддалар миқдори, микробиологик тозалик ва контаминантлар даражаси каби кўрсаткичлар билан белгиланади. Жаҳон соғлиқни сақлаш ташкилоти доривор ўсимлик материалларини сифат назоратида макроскопик, микроскопик, физик-кимёвий ва кимёвий усулларни комплекс қўллашни назарда тутади.Мақолада юпқа қатламли хроматография, юқори самарали суюқлик хроматографияси, газ хроматографияси-масс-спектрометрия, спектрофотометрия ва хроматографик «бармоқ изи» усулларининг имкониятлари ёритилган. Шунингдек, доривор ўсимлик хомашёсининг сифатини баҳолашда ботаник идентификация, маркер бирикмаларни танлаш, стандарт намуналардан фойдаланиш, контаминантларни назорат қилиш ва аналитик усулларни валидация қилишнинг аҳамияти кўрсатилган.*

Калит сўзлар: *доривор ўсимлик хомашёси, фармакогнозия, стандартлаштириш, сифат назорати, идентификация, фитокимёвий таҳлил, HPLC, GC-MS, спектрофотометрия, маркер бирикмалар.*

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MODERN METHODS FOR STANDARDIZATION OF MEDICINAL PLANT MATERIALS

Abstract:*The article analyzes modern approaches to the standardization of medicinal plant materials, including pharmacognostic identification, physicochemical evaluation, phytochemical analysis and instrumental quality-control methods. The quality of medicinal plant materials is determined by botanical identity, morphological and anatomical characteristics, moisture content, total ash, acid-insoluble ash, extractive values, biologically active constituents, microbiological quality and contaminants.Particular attention is paid to thin-layer chromatography, high-performance liquid chromatography, gas chromatography-mass spectrometry and spectrophotometric methods. Their role in identification, qualitative and quantitative determination of marker compounds and assessment of the chemical profile of herbal materials is discussed. The importance of controlling pesticides, toxic metals, microorganisms and other contaminants is also emphasized.A comprehensive approach combining macroscopic and microscopic identification with physicochemical, chromatographic and instrumental methods provides more reliable quality assessment of medicinal plant materials*

Keywords: *medicinal plant materials, pharmacognosy, standardization, quality control, identification, HPLC, GC-MS, chromatography, marker compounds, herbal medicines.*

Долзарблиги:Доривор ўсимликлар қадимдан инсон саломатлигини сақлаш ва касалликларни даволашда қўлланиб келинаётган табиий манбалардан бири ҳисобланади. Ҳозирги вақтда ҳам ўсимлик хомашёси фармацевтика саноати учун биологик фаол моддаларнинг муҳим манбаи бўлиб қолмоқда. Доривор ўсимликлар асосида тайёрланадиган дамламалар, қайнатмалар, экстрактлар, настойкалар, қуруқ экстрактлар ва бошқа

фитопрепаратларнинг сифати, хавфсизлиги ва барқарорлиги биринчи навбатда бошланғич хомашёнинг сифат кўрсаткичларига боғлиқ.

Доривор ўсимлик хомашёси кимёвий таркибининг мураккаблиги билан синтетик фаол моддалардан фарқ қилади. Бир ўсимлик таркибида ўнлаб ва ҳатто юзлаб турли кимёвий бирикмалар учраши мумкин. Уларнинг миқдори ўсимлик тури, нав хусусиятлари, ўсиш жойи, иқлим, тупроқ, вегетация босқичи, йиғиш муддати, қуритиш технологияси ва сақлаш шароитига боғлиқ равишда ўзгариб туради.

Шунинг учун доривор ўсимлик хомашёсини фақат ташқи белгилар асосида баҳолаш етарли эмас. Хомашёнинг ҳақиқийлигини тасдиқлаш, фаол ва маркер бирикмаларни аниқлаш, намлик ва кул миқдорини белгилаш, ёт аралашмалар ва контаминантларни назорат қилиш ҳамда зарур ҳолларда инструментал усуллардан фойдаланиш талаб этилади.

Жаҳон соғлиқни сақлаш ташкилоти доривор ўсимлик материалларининг сифатини баҳолаш учун махсус сифат назорати усулларини ишлаб чиққан. Уларда идентификация, тозалик, намлик, кул, экстрактив моддалар, микробиологик кўрсаткичлар ва бошқа параметрларни баҳолашга ёндашувлар келтирилган.

Европа дори воситалари агентлигининг доривор ўсимлик препаратлари бўйича амалдаги ҳужжатларида ҳам хомашё ва ўсимлик препаратлари учун спецификациялар, тест усуллари ва қабул мезонларини белгилашга алоҳида эътибор қаратилган.

Бу талаблар доривор ўсимлик хомашёсини стандартлаштиришда анъанавий фармакогностик усуллар билан бир қаторда замонавий инструментал усулларни комплекс қўллаш зарурлигини кўрсатади.

ТАДҚИҚОТНИНГ МАҚСАДИ:Доривор ўсимлик хомашёсини стандартлаштиришда қўлланиладиган замонавий фармакогностик, физик-кимёвий, фитокимёвий ва инструментал усулларни таҳлил қилиш ҳамда уларнинг хомашё сифатини баҳолашдаги аҳамиятини асослаш.

Тадқиқот вазифалари

Қўйилган мақсадга эришиш учун қуйидаги вазифалар белгиланди:

Доривор ўсимлик хомашёсини стандартлаштириш тушунчасини ёритиш.

Хомашёни идентификациялаш усулларини таҳлил қилиш.

Макроскопик ва микроскопик таҳлилнинг аҳамиятини аниқлаш.

Физик-кимёвий сифат кўрсаткичларини ўрганиш.

Биологик фаол ва маркер бирикмаларни аниқлаш усулларини таҳлил қилиш.

HPLC, GC-MS, спектрофотометрия ва бошқа замонавий усулларнинг имкониятларини кўрсатиш.

МАТЕРИАЛЛАР ВА ТАДҚИҚОТ УСУЛЛАРИ

Тадқиқотнинг назарий асосини фармакогнозия, фармацевтик таҳлил, фитокимё ва доривор ўсимлик хомашёсини сифат назоратига оид илмий

адабиётлар ҳамда халқаро ташкилотларнинг методик ҳужжатлари ташкил этди.

Адабиётлар таҳлилида қуйидаги усуллар ўрганилди:

Макроскопик идентификация;микроскопик таҳлил;сифат реакциялари;юпқа қатламли хроматография;спектрофотометрия;юқори самарали суюқлик хроматографияси;

Газ хроматографияси;GC-MS;хроматографик «бармоқ изи» таҳлили;намлик ва кулни аниқлаш;

Экстрактив моддалар миқдорини аниқлаш;микробиологик назорат;

Пестицидлар ва оғир металларни назорат қилиш.

ДОРИВОР ЎСИМЛИК ХОМАШЁСИНИ СТАНДАРТЛАШТИРИШ ТУШУНЧАСИ

Стандартлаштириш — доривор ўсимлик хомашёсининг ҳақиқийлиги, тозалиги, сифати ва белгиланган талабларга мувофиқлигини баҳолаш учун меъёрий кўрсаткичлар тизимини белгилаш жараёнидир.

Стандартлаштиришнинг асосий вазифаси хомашёнинг бир партиясидан иккинчи партиясигача бўлган сифат барқарорлигини таъминлашдан иборат.

Доривор ўсимлик хомашёсини стандартлаштириш қуйидаги асосий босқичларни қамраб олади:

ЕМА ҳужжатларида спецификациялар маҳсулотнинг чиқарилиш вақтида ва сақлаш муддати давомида сифатини таъминлаш учун қўлланиладиган тестлар, аналитик процедуралар ва қабул мезонларидан ташкил топиши таъкидланган.

МАКРОСКОПИК ТАҲЛИЛ

Макроскопик таҳлил доривор ўсимлик хомашёсини идентификациялашнинг биринчи босқичларидан биридир.

Бунда хомашёнинг:ташқи кўриниши;шакли;ранги;ҳиди;таъми;ўлчами;юзаси;консистенцияси;

Ўзига хос морфологик белгилариўрганилади.

МИКРОСКОПИК ТАҲЛИЛ

Микроскопик таҳлил доривор ўсимлик хомашёсининг анатомик диагностик белгиларини аниқлаш имконини беради.

Бунда:

Эпидермис;оғизчалар;трихомалар;секретор безлар;эфир мойи каналлари;механик тўқималар;

Ўтказувчи тўқималар;крахмал доналари;кальций оксалат кристаллари;толалар;склереидлар

Каби тузилмалар ўрганилади.

ФИЗИК-КИМЁВИЙ КЎРСАТКИЧЛАР:Доривор ўсимлик хомашёсининг сифатини баҳолашда физик-кимёвий кўрсаткичлар муҳим ўрин тутади.

1. Намлик

Намлик хомашёнинг сақланиш барқарорлигига бевосита таъсир қилади. Ортиқча намлик микробиологик жараёнларнинг кучайиши, қолип пайдо

бўлиши ва биологик фаол моддаларнинг парчаланишига олиб келиши мумкин.

2. Умумий кул

Умумий кул хомашё ёқилгандан кейин қоладиган минерал моддалар миқдорини тавсифлайди. Унинг меъёрдан юқори бўлиши минерал аралашмалар ёки хомашёни тайёрлаш жараёнидаги ифлосланиш билан боғлиқ бўлиши мумкин.

3. 10% хлорид кислотада эримайдиган кул

Бу кўрсаткич асосан тупроқ, қум ва силикатли минерал аралашмаларни баҳолашда аҳамиятли.

4. Экстрактив моддалар

Экстрактив моддалар хомашёдан белгиланган эритувчи ёрдамида ажратиб олиниши мумкин бўлган моддалар миқдорини кўрсатади. Ушбу кўрсаткич хомашёнинг умумий кимёвий қийматини баҳолашда қўлланилиши мумкин.

БИОЛОГИК ФАОЛ МОДДАЛАРНИ АНИҚЛАШ:Доривор ўсимликларнинг фармакологик қиймати кўп жиҳатдан улар таркибидаги биологик фаол моддаларга боғлиқ.

Асосий гуруҳларга:алкалоидлар;флавоноидлар;сапонинлар;ошловчи моддалар;эфир мойлари;

Кумаринлар;антрахинонлар;юрак гликозидлари;полисахаридлар;иридоидлар;фенол бирикмалари киради.

Замонавий стандартлаштиришда ҳар доим ҳам барча компонентларни аниқлаш талаб этилмайди. Кўп ҳолатларда хомашёнинг сифатини баҳолаш учун характерли ёки маркер бирикмалар танланади.

ЮПҚА ҚАТЛАМЛИ ХРОМАТОГРАФИЯ:Юпқа қатламли хроматография (ЮҚХ) доривор ўсимлик хомашёсини идентификациялаш ва сифат таҳлилида кенг қўлланилади.

Усулнинг асосий афзаллиги:

Содда;нисбатан арзон;бир вақтда бир нечта намунани таҳлил қилиш имкони;

Стандарт намуна билан солиштириш;бир нечта компонентларни ажратиш имконияти.

Хроматографик профиль хомашёнинг ўзига хос «кимёвий бармоқ изи» сифатида ҳам қўлланилиши мумкин.

ЮҚОРИ САМАРАЛИ СУЮҚЛИК ХРОМАТОГРАФИЯСИ:Юқори самарали суюқлик хроматографияси — HPLC — доривор ўсимлик хомашёсининг индивидуал компонентларини аниқлаш ва миқдорий баҳолашда замонавий ва юқори селектив аналитик усуллардан биридир.

HPLC ёрдамида:флавоноидлар;фенол кислоталар;алкалоидлар;кумаринлар;сапонинлар;

Органик кислоталар;бошқа маркер бирикмаларианиқланиши мумкин.

HPLC усулининг муҳим афзаллиги — мураккаб ўсимлик экстракти таркибидаги алоҳида компонентларни ажратиб, уларнинг миқдорини аниқлаш имкониятидир.

ГАЗ ХРОМАТОГРАФИЯСИ ВА GC-MS:Эфир мойлари ва бошқа учувчан компонентларни таҳлил қилишда газ хроматографияси муҳим аҳамиятга эга.

Газ хроматографияси ёрдамида эфир мойининг компонентлари ажратилади ва уларнинг нисбий миқдори аниқланади.GC-MS — газ хроматографияси-масс-спектрометрия — компонентларнинг масс-спектрлари асосида уларни идентификациялаш имконини беради.

Ушбу усул айниқса:Mentha;Salvia;Thymus;Origanum;Melissa;Lavandulaкаби эфир мойи сақловчи ўсимликларни ўрганишда муҳимдир.

СПЕКТРОФОТОМЕТРИЯ:Спектрофотометрия доривор ўсимлик хомашёсининг айрим биологик фаол моддалари ёки уларнинг умумий гуруҳларини миқдорий баҳолашда қўлланилади.Масалан:умумий флавоноидлар;умумий фенол бирикмалари;айрим пигментлар;

Хромофор гуруҳга эга бирикмалар спектрофотометрия асосида баҳоланиши мумкин.

НАТИЖАЛАР ВА МУҲОКАМА:Адабиётлар таҳлили шуни кўрсатдики, доривор ўсимлик хомашёсини стандартлаштириш биргина таҳлил усулига асосланиши мумкин эмас. Ўсимлик хомашёсининг кўп компонентли табиати комплекс ёндашувни талаб қилади.

Макроскопик ва микроскопик усуллар ботаник ҳақиқийликни тасдиқлашда муҳим бўлса, физик-кимёвий кўрсаткичлар хомашёнинг умумий сифатини баҳолаш имконини беради.

Фитокимёвий таҳлил эса хомашёнинг биологик фаол моддаларини аниқлашга қаратилган. Бунда ЮҚХ скрининг ва идентификация учун қулай бўлса, HPLC муайян маркер моддаларни миқдорий баҳолашда юқори имкониятларга эга.

Эфир мойи сақловчи хомашёларда GC ва GC-MS усуллари алоҳида аҳамият касб этади. Спектрофотометрия эса айрим умумий гуруҳларни тезкор баҳолашда фойдали.

Замонавий стандартлаштиришда контаминантларни назорат қилиш ҳам сифат тизимининг ажралмас қисми ҳисобланади. ЖССТ доривор ўсимлик материаллари учун сифат назорати бўйича махсус методик базани шакллантирган бўлиб, у миллий сифат назорати лабораториялари учун ҳам асосий манбалардан бири ҳисобланади.

Eманинг амалдаги спецификация бўйича йўриқномасида тест процедуралари ва қабул мезонлари нафақат маҳсулот чиқарилишида, балки унинг сақлаш муддати давомида сифатини таъминлаш учун белгиланиши қайд этилган.

ХУЛОСА:Доривор ўсимлик хомашёсини стандартлаштириш фармацевтик сифат назоратининг муҳим қисми бўлиб, хомашёнинг ҳақиқийлиги, тозалиги, сифати ва барқарорлигини таъминлашга қаратилган.

Макроскопик ва микроскопик усуллар хомашёни ботаник идентификациялашда асосий фармакогностик усуллар ҳисобланади.

Намлик, умумий кул, кислотада эримайдиган кул, экстрактив моддалар ва майдаланиш даражаси каби физик-кимёвий кўрсаткичлар хомашёнинг сифатини комплекс баҳолаш имконини беради.Биологик фаол моддалар ва маркер бирикмаларни аниқлаш доривор ўсимлик хомашёсининг фармакогностик ва фармацевтик қийматини баҳолашда муҳим аҳамиятга эга.ЮҚХ, HPLC, GC-MS ва спектрофотометрия каби замонавий аналитик усуллар стандартлаштириш жараёнининг ишончлилигини оширади.

ФОЙДАЛАНИЛГАН АДАБИЁТЛАР

Ҳа, тўғри. ОАК мақола учун адабиётлар рўйхатини **GOST стандартида** бир хил услубда расмийлаштириш мақбул. Қуйида юқоридаги мақолага мослаб, манбаларни **ГОСТ Р 7.0.100–2018** услубига яқин шаклда қайта расмийлаштирдим.

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ДОРИВОР ЎСИМЛИКЛАР ТАРКИБИДАГИ ФЛАВОНОИДЛАРНИНГ ФАРМАКОЛОГИК АҲАМИЯТИ

Аннотация:*Мақолада доривор ўсимликлар таркибида кенг тарқалган флавоноидларнинг фармакогностик ва фармакологик аҳамияти замонавий илмий адабиётлар асосида таҳлил қилинган. Флавоноидлар ўсимликларнинг иккиламчи метаболитлари таркибига кирувчи полифенол бирикмалар бўлиб, улар ўсимликларни ташқи муҳит таъсирларидан ҳимоя қилишда иштирок этади ҳамда инсон организми учун биологик фаол моддалар манбаи ҳисобланади. Мақолада флавоноидларнинг асосий синфлари, доривор ўсимликларда тарқалиши, антиоксидант, яллиғланишга қарши, антимикроб, кардиопротектор, гепатопротектор ва нейропротектор хусусиятлари ёритилган. Шунингдек, флавоноидларнинг биологик таъсир механизмлари, уларнинг тузилиши ва фаоллиги ўртасидаги боғлиқлик ҳамда доривор ўсимлик хомашёсини стандартлаштиришдаги аҳамияти таҳлил қилинган. Замонавий тадқиқотларда флавоноидларнинг кўплаб фармакологик хусусиятлари асосан in vitro ва in vivo моделларда ўрганилгани, клиник далиллар эса айрим ҳолатларда ҳали чеклангани кўрсатилган. Ўзбекистон флорасида учрайдиган флавоноидларга бой доривор ўсимликларни чуқур фармакогностик ва фитокимёвий ўрганиш маҳаллий фитопрепаратлар учун истиқболли йўналиши сифатида баҳоланади.*

Калит сўзлар*: фармакогнозия, доривор ўсимликлар, флавоноидлар, полифеноллар, кверцетин, рутин, антиоксидант, яллиғланишга қарши таъсир, фитопрепарат, стандартлаштириш.*

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THE PHARMACOLOGICAL SIGNIFICANCE OF FLAVONOIDS IN MEDICINAL PLANTS

The article analyzes the pharmacognostic and pharmacological significance of flavonoids found in medicinal plants. Flavonoids are a large group of polyphenolic secondary metabolites that participate in plant defense mechanisms and possess various biological activities. Their antioxidant, anti-inflammatory, antimicrobial, cardioprotective, hepatoprotective and neuroprotective properties have been extensively investigated. The article discusses the main classes of flavonoids, their distribution in medicinal plants, mechanisms of biological action, and their importance in pharmaceutical quality control. Modern analytical approaches, including spectrophotometry, thin-layer chromatography and high-performance liquid chromatography, are considered for the identification and standardization of flavonoid-containing medicinal plant materials. The analysis demonstrates that flavonoid-rich medicinal plants represent a promising source of biologically active substances. Further pharmacognostic and phytochemical investigation of local medicinal plants may contribute to the development and standardization of herbal pharmaceutical preparations.

Keywords*: flavonoids, medicinal plants, pharmacognosy, polyphenols, antioxidant activity, anti-inflammatory activity, phytopharmaceuticals, standardization.*

Долзарблиги:Доривор ўсимликлар фармацевтика соҳасида биологик фаол моддаларнинг муҳим табиий манбаи ҳисобланади. Ўсимликлар таркибида алкалоидлар, гликозидлар, эфир мойлари, таннинлар, сапонинлар, витаминлар, органик кислоталар ва полифеноллар каби кўплаб биологик фаол бирикмалар мавжуд. Улар орасида флавоноидлар ўзининг кенг тарқалганлиги ва кўп йўналишли биологик фаоллиги билан алоҳида аҳамиятга эга.

Флавоноидлар полифенол бирикмаларнинг катта гуруҳини ташкил этади. Улар мева, барг, гул, илдиз, пўстлоқ ва уруғларда учрайди. Флавоноидларнинг ўсимлик организмидаги вазифалари фотопротекция, пигментация, патогенлардан ҳимояланиш ва ташқи муҳит стрессларига жавоб реакцияларини ўз ичига олади.

Флавоноидларга қизиқишнинг асосий сабабларидан бири уларнинг турли биологик нишонларга таъсир қила олиши ҳисобланади. Илмий адабиётларда уларнинг антиоксидант, яллиғланишга қарши, антимикроб, вирусларга қарши, кардиопротектор ва бошқа хусусиятлари ўрганилган

Флавоноидларнинг кимёвий тузилиши уларнинг биологик фаоллигига катта таъсир кўрсатади. Хусусан, гидроксил гуруҳларининг сони ва жойлашиши, С ҳалқанинг тузилиши, гликозидланиш даражаси ва бошқа структура хусусиятлари антиоксидант ҳамда бошқа таъсирларни белгилаши мумкин.

Шу нуқтаи назардан доривор ўсимликларда флавоноидларнинг тарқалиши ва уларнинг фармакологик хусусиятларини ўрганиш фармакогнозия ва фармацевтик технология учун муҳим илмий йўналишлардан бири ҳисобланади.

ТАДҚИҚОТНИНГ МАҚСАДИ:Доривор ўсимликлар таркибидаги асосий флавоноид бирикмаларнинг фармакогностик ва фармакологик аҳамиятини замонавий илмий адабиётлар асосида таҳлил қилиш, уларнинг биологик таъсир механизмларини ёритиш ҳамда флавоноидларга бой доривор ўсимлик хомашёсини стандартлаштириш истиқболларини баҳолаш.

Тадқиқот вазифалари:

Флавоноидларнинг кимёвий таснифини ўрганиш.

Флавоноидларнинг доривор ўсимликларда тарқалишини таҳлил қилиш.

Асосий флавоноидларнинг фармакологик хусусиятларини умумлаштириш.

Флавоноидларнинг антиоксидант ва яллиғланишга қарши таъсир механизмларини ёритиш.

Флавоноидларни аниқлаш ва стандартлаштириш усулларини таҳлил қилиш.

Ўзбекистондаги доривор ўсимликлар асосида флавоноидларни тадқиқ этиш истиқболларини белгилаш.

МАТЕРИАЛЛАР ВА ТАДҚИҚОТ УСУЛЛАРИ

Тадқиқот объекти сифатида доривор ўсимликлар таркибида учрайдиган флавоноидлар ва уларни сақловчи доривор ўсимлик хомашёси ҳақидаги илмий маълумотлар олинди.

Тадқиқотда фармакогнозия, фармакология, фитокимё ва фармацевтик таҳлил соҳаларидаги илмий мақолалар, илмий шарҳлар ва электрон маълумотлар базалари таҳлил қилинди.

Адабиётларни танлашда флавоноидларнинг кимёвий тузилиши, биосинтези, фармакологик хусусиятлари, антиоксидант ва яллиғланишга қарши фаоллиги, доривор ўсимликларда тарқалиши ҳамда аналитик стандартлаштириш усулларига оид тадқиқотларга асосий эътибор қаратилди.

ФЛАВОНОИДЛАРНИНГ КИМЁВИЙ ТАСНИФИ

Флавоноидларнинг умумий скелети С6–С3–С6 тузилишга эга бўлиб, икки ароматик ҳалқа ва кислород сақловчи марказий ҳалқадан ташкил топган.

Уларнинг кимёвий тузилишидаги фарқлар асосида бир нечта асосий синфлар ажратилади.

1-жадвал. Флавоноидларнинг асосий синфлари

Флавоноид синфи	Асосий вакиллари	Доривор ўсимликларда учраши
Флавонлар	Апигенин, лютеолин	Мойчечак, ялпиз ва бошқалар
Флавоноллар	Кверцетин, кемпферол	Доривор ўсимликларнинг кўп турларида
Флаванонлар	Нарингенин, гесперетин	Цитрус ўсимликлари
Изофлавоноидлар	Генистеин, дайдзеин	Dukkakdoshlar
Антоцианлар	Цианидин, дельфинидин	Мева ва гулларда
Катехинлар	Катехин, эпикатехин	Чой ва бошқа ўсимликлар

2023 йилги илмий шарҳларда флавоноидларнинг таснифи, биосинтези ва биологик фаоллиги кенг таҳлил қилинган. Флавоноидларнинг антиоксидант хусусияти уларнинг молекуляр тузилиши ва гидроксил гуруҳларининг жойлашуви билан боғлиқлиги таъкидланган.

ДОРИВОР ЎСИМЛИКЛАРДА ФЛАВОНОИДЛАРНИНГ ТАРҚАЛИШИ

Флавоноидлар ўсимликларнинг турли органларида тўпланиши мумкин. Баргларда фотосинтез жараёни билан боғлиқ бирикмалар сифатида, гулларда пигментлар таркибида, мева ва уруғларда эса ҳимоя функцияларини бажарувчи бирикмалар сифатида учрайди.

Флавоноидларга бой доривор ўсимликларга мойчечак, ялпиз, дўлана, наъматак, далачой, арслонқуйруқ, қоқиўт, қичитқиўт ва бошқа кўплаб турларни киритиш мумкин.

Флавоноидларнинг миқдори ўсимлик тури билан бир қаторда географик тарқалиш, тупроқ-иқлим шароити, ўсимликнинг ривожланиш босқичи, йиғиш муддати ва қуритиш технологиясига ҳам боғлиқ бўлади. Ўсимликда флавоноидларнинг тўпланиши ички генетик омиллар ҳамда ташқи муҳит омиллари билан бошқарилиши ҳақида замонавий тадқиқотлар мавжудШу сабабли бир хил ботаник тургa мансуб хомашёнинг турли ҳудудларда тайёрланган намуналарида флавоноидлар миқдори бир хил бўлмаслиги мумкин. Бу ҳолат фармакогностик стандартлаштиришда муҳим аҳамият касб этад

ФЛАВОНОИДЛАРНИНГ АНТИОКСИДАНТ ХУСУСИЯТЛАРИ

Антиоксидант фаоллик флавоноидларнинг энг кўп ўрганилган хусусиятларидан биридир. Организмда реактив кислород турларининг ҳаддан ташқари тўпланиши оксидловчи стресснинг кучайишига олиб келиши мумкин.

Флавоноидлар эркин радикалларни тутиш, электрон ёки водород атомини бериш, айрим металл ионларини хелатлаш ва ҳужайранинг антиоксидант тизими билан ўзаро таъсир қилиш орқали антиоксидант хусусият намоён қилиши мумкин.

Антиоксидант таъсирнинг даражаси флавоноиднинг кимёвий тузилишига боғлиқ. Хусусан, В ҳалқадаги гидроксил гуруҳларининг

мавжудлиги ва уларнинг жойлашуви радикалларни нейтраллаш қобилиятига таъсир қилиши мумкин.

Шу билан бирга, in vitro антиоксидант фаолликни инсон организмидаги клиник самара билан тўғридан-тўғри тенглаштириш мумкин эмас. Биокираолиш, метаболизм ва тўқималарга етиб бориш даражаси ҳам муҳим аҳамиятга эга.

ФЛАВОНОИДЛАРНИНГ ЯЛЛИҒЛАНИШГА ҚАРШИ ТАЪСИРИ

Яллиғланиш организмнинг ҳимоя механизмларидан бири бўлса-да, унинг узоқ давом этиши турли патологик жараёнлар билан боғлиқ бўлиши мумкин.

Флавоноидлар яллиғланиш жараёнларида иштирок этувчи айрим молекуляр механизмларга таъсир қилиши мумкин. Илмий тадқиқотларда кверцетин, апигенин, кемпферол ва бошқа флавоноидларнинг NF-κB, COX-2, липооксигеназа ҳамда яллиғланиш цитокинлари билан боғлиқ жараёнларга таъсири ўрганилган. Айрим тадқиқотларда флавоноидлар TNF-α, IL-1β ва IL-6 каби яллиғланиш медиаторларининг экспрессиясини пасайтириши мумкинлиги кўрсатилган. Бироқ ушбу маълумотларнинг катта қисми экспериментал моделларга асосланган сабабли клиник амалиётда флавоноидларнинг самарадорлигини баҳолаш учун қўшимча юқори сифатли тадқиқотлар зарур.

ФЛАВОНОИДЛАРНИНГ КАРДИОПРОТЕКТОР АҲАМИЯТИ

Флавоноидларнинг юрак-қон томир тизимига таъсири ҳам сўнгги йилларда фаол ўрганилмоқда.

2024 йилдаги илмий шарҳларда флавоноидларнинг антиоксидант ва яллиғланишга қарши таъсирлари, шунингдек, TLR4/NF-κB, PI3K/AKT ва Nrf2/HO-1 каби сигнал йўллари билан боғлиқ эҳтимолий механизмлари муҳокама қилинган.

Флавоноидларнинг қон томир эндотелийси функцияси, оксидловчи стресс ва яллиғланиш жараёнларига таъсири уларни кардиоваскуляр фармакология учун қизиқарли табиий бирикмалар қаторига киритади.

Бироқ озиқ-овқат орқали флавоноидларни қабул қилиш ва муайян клиник натижалар ўртасидаги боғлиқлик бўйича далиллар барча ҳолатларда бир хил эмас. 2024 йилги umbrella review 32 та мақолани қамраб олган бўлиб, флавоноидларнинг соғлиқ натижаларига таъсири бўйича далилларнинг айрим йўналишларда ҳали етарлича аниқ эмаслигини кўрсатган.

ФЛАВОНОИДЛАРНИНГ БОШҚА ФАРМАКОЛОГИК ХУСУСИЯТЛАРИ

Флавоноидларнинг биологик фаоллиги фақат антиоксидант ва яллиғланишга қарши таъсир билан чекланмайди.

2-жадвал. Флавоноидларнинг асосий фармакологик хусусиятлари

Таъсир тури	Эҳтимолий механизм/аҳамияти
Антиоксидант	ROS ни нейтраллаштириш ва оксидловчи стрессни камайтириш
Яллиғланишга қарши	NF-κB, COX-2 ва цитокинларга таъсир

Таъсир тури	Эҳтимолий механизм/аҳамияти
Антимикроб	Микроорганизмларнинг айрим ҳужайравий жараёнларига таъсир
Кардиопротектор	Эндотелий функцияси ва оксидловчи стресс билан боғлиқ механизмлар
Нейропротектор	Оксидловчи стресс ва яллиғланиш жараёнларини модуллаш
Гепатопротектор	Жигар ҳужайраларини оксидловчи стрессдан ҳимоялаш потенциали
Антивирус	Айрим вируслар билан боғлиқ молекуляр нишонларга таъсир
Антиаллергик	Айрим яллиғланиш медиаторларининг фаоллигини модуллаш

2024 йилги илмий шарҳлар флавоноидларнинг антимикроб, антиоксидант, яллиғланишга қарши, кардиопротектор ва нейропротектор хусусиятларини қамраб олган. Шу билан бирга, муаллифлар клиник тадқиқотлар сони айрим йўналишларда чекланганлигини таъкидлайди.

ФЛАВОНОИДЛАРНИ СТАНДАРТЛАШТИРИШ

Фармакогнозияда доривор ўсимлик хомашёсининг сифатини баҳолашда флавоноидлар муҳим диагностик ва миқдорий кўрсаткич бўлиши мумкин.

Флавоноидларни таҳлил қилишда қуйидаги усуллардан фойдаланилади:

Сифат реакциялари.

Айрим флавоноидларни аниқлашда рангли реакциялардан фойдаланилади. Улар хомашё таркибида флавоноидлар мавжудлигини дастлабки баҳолаш имконини беради.

Юпқа қатламли хроматография.

Флавоноидларни идентификация қилишда нисбатан қулай усул ҳисобланади. Хомашё экстрактидаги бирикмалар стандарт намуналар билан солиштирилади.

Спектрофотометрия.

Умумий флавоноидлар миқдорини баҳолашда қўлланилиши мумкин.

Юқори самарали суюқлик хроматографияси (HPLC). Кверцетин, рутин, апигенин, лютеолин ва бошқа муайян флавоноидларни аниқлаш ва миқдорий баҳолашда юқори селективликка эга.

Замонавий тадқиқотларда флавоноидларни идентификациялаш ва миқдорий баҳолаш учун хроматографик ва спектрометрик ёндашувларни биргаликда қўллаш доривор ўсимликларнинг кимёвий профилини янада тўлиқ тавсифлаш имконини бериши таъкидланган.

ЎЗБЕКИСТОН ШАРОИТИДА ТАДҚИҚОТ ИСТИҚБОЛЛАРИ

Ўзбекистон флораси доривор ва биологик фаол моддаларга бой ўсимликларнинг турли хиллиги билан ажралиб туради. Маҳаллий ўсимлик хомашёсини фармакогностик жиҳатдан ўрганиш нафақат илмий, балки амалий аҳамиятга ҳам эга.

Флавоноидларга бой маҳаллий ўсимликларни тадқиқ қилишда қуйидаги йўналишларга эътибор қаратиш мумкин:

Ўсимлик турини ботаник идентификация қилиш.

Макроскопик ва микроскопик диагностик белгиларни аниқлаш.

Флавоноидларнинг сифат таркибини ўрганиш.

Умумий флавоноидлар миқдорини аниқлаш.

Индивидуал флавоноидларни HPLC усулида аниқлаш.

Турли ҳудудларда етиштирилган хомашёни таққослаш.

Йиғиш муддатининг флавоноидлар миқдорига таъсирини ўрганиш.

Қуритиш ва сақлаш шароитларининг флавоноидлар барқарорлигига таъсирини баҳолаш.

Стандартлаштириш меъёрларини ишлаб чиқиш.

Флавоноидларга бой маҳаллий хомашё асосида фитопрепаратлар яратиш имкониятларини ўрганиш.

Ўсимликларда флавоноидлар тўпланиши генетик омиллардан ташқари ўсиш шароити, ташқи стресслар ва агротехник тадбирларга ҳам боғлиқ бўлиши мумкин. Шунинг учун маҳаллий хомашёнинг кимёвий профилини ҳудудлар кесимида ўрганиш илмий жиҳатдан муҳимдир.

НАТИЖАЛАР ВА МУҲОКАМА

Адабиётлар таҳлили натижасида флавоноидлар доривор ўсимликларнинг фармакологик потенциалини белгилайдиган муҳим полифенол бирикмалардан бири эканлиги аниқланди.

Флавоноидларнинг биологик таъсири уларнинг кимёвий тузилиши билан чамбарчас боғлиқ. Бир хил синфга мансуб бирикмаларнинг ҳам биологик таъсири бир-биридан фарқ қилиши мумкин. Бу ҳолат флавоноидларни алоҳида бирикмалар даражасида ўрганиш зарурлигини кўрсатади.

Адабиётларда кверцетин, кемпферол, апигенин, лютеолин, нарингенин, катехин ва бошқа бирикмаларнинг турли биологик фаолликлари келтирилган.

Шу билан бирга, флавоноидларнинг фармакологик потенциали ҳақидаги натижаларнинг катта қисми лаборатория ва экспериментал моделларга таянади. Шу сабабли уларни янги фитопрепаратлар учун илмий асос сифатида баҳолашда биокираолиш, фармакокинетика, хавфсизлик ва клиник самарадорлик масалалари алоҳида ўрганилиши керак. 2024 йилги замонавий шарҳ ҳам клиник далилларнинг айрим йўналишларда чекланганлигини кўрсатади.

Фармакогнозия нуқтаи назаридан эса флавоноидлар доривор ўсимлик хомашёсининг идентификацияси, сифатини баҳолаш ва стандартлаштиришда муҳим кўрсаткич бўлиб қолмоқда.

ХУЛОСА:Флавоноидлар доривор ўсимликлар таркибида кенг тарқалган полифенол бирикмалар бўлиб, улар фармакогнозияда муҳим биологик фаол моддалар гуруҳи ҳисобланади.

Флавоноидларнинг асосий синфларига флавонлар, флавоноллар, флаванонлар, изофлавоноидлар, антоцианлар ва катехинлар киради.

Замонавий илмий тадқиқотлар флавоноидларнинг антиоксидант, яллиғланишга қарши, антимикроб, кардиопротектор, нейропротектор ва бошқа биологик хусусиятларини кўрсатади. Флавоноидларнинг

фармакологик таъсири уларнинг молекуляр тузилиши, гидроксил гуруҳларининг жойлашиши ва бошқа структура хусусиятлари билан боғлиқ.

Доривор ўсимлик хомашёсини стандартлаштиришда флавоноидларни сифат ва миқдор жиҳатдан аниқлаш муҳим аҳамиятга эга.

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ХИМИЧЕСКИЙ СОСТАВ ПЛОДОВ РАСТЕНИЯ УНАБИ И ИХ ПРИМЕНЕНИЕ ПРИ ЛЕЧЕНИИ ОПУХОЛЕЙ

Аннотация*: Растение Ziziphus jujuba, в народе называемое унаби, является питательным и лечебным. Его используют в народной медицине с давних времен. К сожалению, рак становится одним из самых распространенных заболеваний. В последние годы в плодах унаби были обнаружены вещества, используемые при лечении рака. Они относятся к классу тритерпеновых органических кислот. В статье анализируются исследования противоракового действия этих веществ.*

Ключевые слова*: унаби, Ziziphus jujuba, белок, углевод, сахар, микроэлементы, органические кислоты, онкология, опухоли, тритерпеновые кислоты, урсолин, олеаниол, бетулин.*

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THE CHEMICAL COMPOSITION OF UNABI PLANT FRUITS AND THEIR APPLICATION IN THE TREATMENT OF TUMORS

Abstract: *The plant Ziziphus jujuba, popularly called unabi, is nutritious and medicinal. It has been used in folk medicine since ancient times. Unfortunately, cancer is becoming one of the most common diseases. In recent years, substances used in the treatment of cancer have been found in unabi fruits. They belong to the class of triterpene organic acids. The article analyzes studies of the anticancer effects of these substances.*

Key words: *unabi, Ziziphus jujuba, protein, carbohydrate, sugar, microelements, organic acids, oncology, tumors, triterpene acids, ursoline, oleaniol, betulin.*

Введение. Плоды растения зизифуса, известного в узбекском народе как чилонжийда, по химическому составу богаты биологически активными веществами, среди которых большое значение имеют тритерпеновые органические кислоты в связи с их применением при различных формах рака [1].

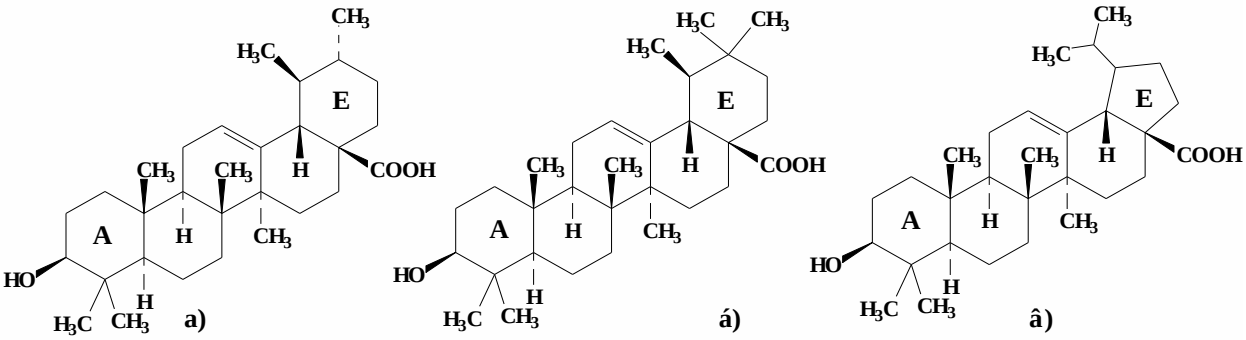
К сожалению, в наши дни рак становится одним из самых распространенных заболеваний. По данным Всемирной организации здравоохранения, ежегодно в мире регистрируется более 10 миллионов

случаев рака. Химиотерапия остается основным методом лечения рака, несмотря на множество побочных эффектов. Предложенные учеными методы недороги, имеют мало побочных эффектов, эффективны благодаря использованию растений и указывают на то, что они являются перспективным методом лечения рака. Органические кислоты тритерпеновой природы существуют в виде свободных кислот или гликонов. Их физиологические эффекты широки и, как и сапонины, обладают противовоспалительным, антимикробным, гепатопротекторным и антиоксидантным действием. В последние годы их способность бороться с опухолями привлекла внимание ученых [2].



1-рисунок. Растения унаби: *Ziziphus jujuba* и его плоды.

Обсуждения результатов исследований. В 2009 г. Гуо и др. выделили из сушеных плодов унаби 10 органических кислот тритерпеновой природы: сеанотин, альфит, зизибераналь, зизибераналин, эписеанотин, сеанотен, бетулин, олеанолин, урсолин и зизибереналиновую кислоты. Среди них 3 органические кислоты – урсолиновая (2-рисунок, а), олеанолиновая (2-рисунок, б) и бетулиновая (2-рисунок, в) кислоты активно участвуют при апоптозе. Дефекты апоптоза или запрограммированной гибели клеток играют важную роль в различных физиологических и патологических процессах и тесно связаны с многостадийным процессом роста и развития опухоли. Таким образом, одним из важных механизмов противоопухолевых свойств биологически активных веществ является модуляция апоптоза.



2-рисунок. Противораковые вещества плодов унаби: а) урсолиновая кислота, б) олеанолевая кислота в) бетулиновая кислота.

Группа иранских ученых также отметили, что унаби может эффективно использоваться при лечении опухолевых заболеваний. Исследования показали, что тритерпеновые органические кислоты, такие как урсолин, олеанолин и бетулин, содержащиеся в плодах унаби, проникают в опухолевые клетки и выделяют токсичные вещества, останавливая рост и развитие опухолей и приводит в дальнейшему их гибелью [3].

Китайские ученые обнаружили, что урсоловая кислота вызывает процесс гибели клеток – апоптоз. Ими доказано, что активность апоптоза и снижение жизнеспособности клеток гепатобластов HepG2 в организме человека зависят от концентрации урсоловой кислоты и времени. Фрагментация ДНК и активация фермента каспазы-3 наблюдались при введении урсоловой кислоты в концентрации 30 мкм (микромоль/л).

Другая группа ученых изучали влияние урсоловой кислоты на опухолевые клетки молочной железы как in vivo, так и in vitro. Мышам в постменопаузе (период от последней менструации до полного прекращения функции яичников, т. е. начало старения длительностью 5 лет) в течение 8 недель вводили 0,05%, 0,10% и 0,25% раствор урсоловой кислоты, давали смешанный корм. Через 3 недели после начала эксперимента мышам вводили специальные опухолевые клетки молочной железы, отмеченные MMTV-Wnt-1.

Кроме того, параллельно in vitro наблюдалось, что ингибирующее свойство урсоловой кислоты в отношении роста особых опухолевых клеток молочных желез с маркировкой WA4 увеличивается с течением времени. При этом концентрации урсоловой кислоты 25 мкм и 50 мкм оказались наиболее эффективными в ингибировании деления и размножения опухолевых клеток WA4, что полностью подтвердило результаты экспериментов, проведенных in vivo на мышах.

В эксперименте in vivo все дозы урсоловой кислоты были эффективны в ингибировании пролиферации опухолевых клеток, но образец с концентрацией 0,10% оказался более эффективным в уменьшении конечного размера опухолевых клеток. В заключение можно сказать, что модуляция ферментов фосфатидилинозитол-3-киназы и митоген-активируемых протеинкиназ в клеточных сигнальных путях, присутствующих в структуре урсоловой кислоты, влияет на выживаемость клеток и апоптоз. То есть при строении этих ферментов в структуре урсолиновой кислоты появляются активные группы со склонностью к реакции, функция ферментов по воспроизводству опухолевых клеток снижается, и опухолевые клетки начинают погибать.

И урсолиновая, и олеонолиновая кислоты представляют собой органические кислоты тритерпенового типа, которые довольно распространены в природных объектах и считаются очень схожими по строению, различаясь лишь расположением метильных групп в группе Е.

Китайский профессор Дж. Ли и его коллеги изучали действие тритерпеновых кислот - урсолиновой и олеанолиновой кислот на рост

опухолевых клеток в толстой кишке человека. Исследования показали, что при обработке опухолей толстой кишки растворами урсоловой и олеаноловой кислот с концентрацией 60 мкм/л в течение 24–72 часов количество мертвых клеток резко увеличивалось, а деление опухолевых клеток снижалось до 30 мкм/л. Анализ клеточных популяций методом проточной цитометрии показал, что концентрация урсоловой кислоты 30 мкм/л и концентрация олеаноловой кислоты 60 мкм/л накапливались в опухолевых клетках толстой кишки в течение 36 и 72 часов соответственно, а позже их концентрация снижалась, а эффект усиливался [4].

Также в 2010 году М.Х.Шу и соавторы подтвердили в своих экспериментах, что урсолиновая и олеанолиновая кислоты подавляют рост опухолевых клеток печени человека. По их словам, эффективное воздействие оказывают образцы кислот с концентрацией 100 мкм/л и 75 мкм/л соответственно. Урсолиновая и олеанолиновая кислоты увеличивают проницаемость пор в митохондриях, что создают условие перехода в цитоплазму таких активаторов, как цитохром С, который активирует фермент каспазу, а затем активировать ферменты каспазу-3 и каспазу-9. В результате опухолевые клетки погибают – апоптоз. По мнению ряда другиех ученых урсолиновая и олеаноловая кислоты эффективны в отношении лейкозных клеток HL-60, опухолевых клеток меланомы B16F10 и опухолевых клеток молочной железы MCF-7. Они обладают свойствами, индуцирующими апоптоз в клетках опухоли простаты.

Другая пентациклическая тритерпеновая кислота - бетулиновая кислота (2-рисунок, в), которая избирательно токсична на мышиных моделях опухолей меланомы человека (кожа с низким содержанием меланина) и в нейроэктодермальных опухолевых клетках (голова, шея, нос). Она ингибирует апоптоз-индуцирующий эффект в нейроэктодермальных клетках за счет активации фермента каспазы.

В исследованиях ученых под руководством Э.Зельцера бетулиновая кислота вызывала апоптоз опухолевых клеток меланомы человека. Установлено, что данный эффект бетулиновой кислоты аддитивно сочетается с эффектом лучевой терапии больного. Однако механизм действия этих двух методов различен. По мнения ученых, эффект бетулиновой кислоты был более выражен в клетках меланомы человека, чем в здоровых клетках. Эти же ученые также установили, что токсическое действие бетулиновой кислоты на клетки меланомы усиливается в присутствии винкристина, то есть бетулиновая кислота является синергистом лекарственного препарата винкристина.

Результаты несколько других исследований показали, что бетулиновая кислота, как и урсолиновая и олеанолиновая кислоты, обладает противоопухолевой активностью при лейкемии, раке толстой кишки, легких, простаты, головного мозга и шеи, а также раке матки. А.А.Дамле и др. изучали действие бетулиновой кислоты на опухоли молочных желез у мышей. Они заявили, что у мышей, получавших бетулиновую кислоту в дозе 50 мг/кг и 100

мг/кг, наблюдалось уменьшение размера опухолевых клеток на 52% и 77% соответственно. Ученые связывают этот эффект с замедлением ангиогенеза (процесса образования новых кровеносных сосудов, происходящего при раке), пролиферации (деление клеток) и инвазии (повреждение клеток инородным веществом) у мышей после введения бетулиновой кислоты [5].

Заключение. Плоды унаби содержат сравнительно большое количество ненасыщенных жирных кислот и их эфиров, биогенных элементов, таких как Mg, P, Ca, K, Si, Sr, Fe, Mn, B, Cu, имеющих большое значение для организма. Учитывая наличие противоопухолевых тритерпеновых органических кислот, таких как урсолиновой, олеанолиновой и бетулиновой кислот, предложено разработать и внедрить в практику пищевую добавку, предотвращающую и помогающую в лечении рака, на основе плодов унаби.

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ВОЗРАСТНЫЕ ОСОБЕННОСТИ РАСПРЕДЕЛЕНИЯ ЛИМФОИДНЫХ ОБРАЗОВАНИЙ В СТЕНКЕ ПИЩЕВОДА ЗДОРОВЫХ КРЫС

Аннотация. *Данная работа посвящена морфофункциональному исследованию лимфатических сосудов как ключевого звена лимфатического русла и иммунной системы организма. В исследовании рассматриваются анатомические и гистологические особенности строения стенок лимфатических капиляров, сосудов и протоков, а также механизмы лимфообразования и транспортная функция лимфы в норме.*

Ключевые слова: *Лимфатические сосуды, лимфатическая система, лимфатические капилляры, лимфатические протоки, морфофункциональное исследование, гистология, лимфообразование, транспортная функция лимфы, иммунная система.*

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AGE-RELATED CHARACTERISTICS OF LYMPHOID STRUCTURE DISTRIBUTION IN THE ESOPHAGEAL WALL OF HEALTHY RATS

Abstract. *This study focuses on a morphofunctional investigation of lymphatic vessels as a key component of the lymphatic bed and the immune system. The paper examines the anatomical and histological structural features of the walls of lymphatic capillaries, vessels, and ducts, as well as the mechanisms of lymph formation and the normal transport function of lymph.*

Keywords: *Lymphatic vessels, lymphatic system, lymphatic capillaries, lymphatic ducts, morphofunctional study, histology, lymph formation, lymph transport function, immune system*

Ввдение. Проблема хирургического лечения рака пищевода в целом далека от окончательного решения и сохраняет свою актуальность и значимость [1,2]. Среди множества патологий, встречающихся у людей, значительная часть приходится на болезни желудочно-кишечного тракта. Большой удельный вес среди них занимают заболевания пищевода. Несмотря на большое количество научных работ по пищеводу целый ряд вопросов остался неосвещенным [3,4]. Лимфоидные образования пищевода привлекли внимание исследователей в последние годы, однако, и здесь изучены лишь лимфоидные образования пищевода человека, но неосвещены их взаимоотношения с сосудами и другими структурами, отсутствует характеристика интраэпителиальных лимфоцитов пищевода [5,6].

Цель исследования: изучить возрастные особенности морфологии и пространственного распределения лимфоидных образований в стенке пищевода здоровых крыс в динамике постнатального онтогенеза.

Материал и методы исследования. Исследование проведено на 19 белых беспородных крысах (контрольная включавшие возрастные периоды: новорожденные, 6, 11, 16, 22 суток). Контрольные животные получали 1 мл воды. Материал фиксировали в растворе Буэна (24 ч) и делили пищевод на шейный, грудный и брюшной отделы. Изготовленные серийные срезы (8–10 мкм) окрашивали гематоксилином-эозином, по ван Гизону, Вейгерту, а также импрегнировали серебром по Футу (в модификации Н.А. Юриной).

Морфометрический анализ включал измерение толщины слоев стенки пищевода, параметров внутриорганных сосудов, определение количества интраэпителиальных лимфоцитов и клеток в лимфоидных скоплениях (на 100 эпителиоцитов). Статистическую обработку данных проводили методами вариационной статистики.

Результаты исследования. Количество больших лимфоцитов в шейной части составляет 18,4%, уменьшается в грудной до 16,1% и вновь возрастает в брюшной, составляя 19,3%. Содержание средних лимфоцитов незначительно отличается на протяжении органа, составив 59,8% в шейной, 61,3% - в грудной и 60% - в брюшной частях пищевода. Малые лимфоциты встречаются чаще больших. Больше всего их в грудной части 22,6%. В других частях пищевода количество их незначительно меньше и составляет 21,8% в шейной части и 20,7% в брюшной. Лимфоидные образования подслизистой основы представлены трехрядными цепочками малых лимфоцитов, находящихся на некотором расстоянии от собственной пластинки слизистой оболочки **[рис. 1]**.

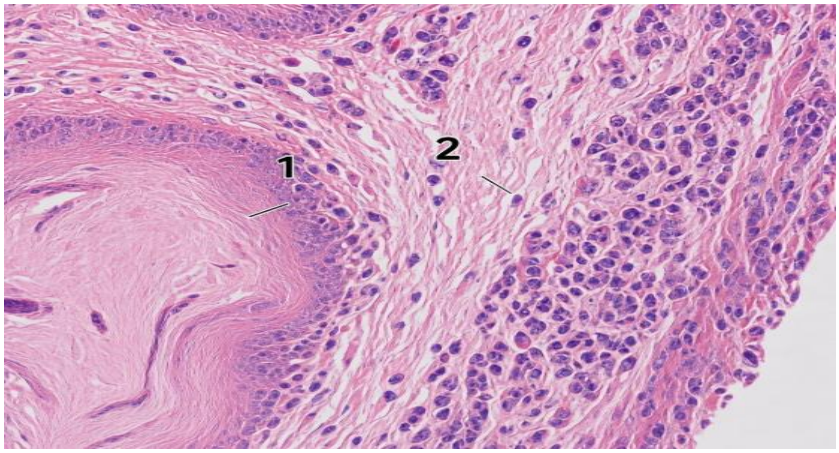


Рис.1. Лимфоидные образования подслизистой основы пищевода 6-ти дневной крысы контрольной группы. 1 - лимфоциты в виде двухрядной цепочки; 2 - подслизистая основа. Окраска гематоксилином-эозином. Об. 40 х ок. 7.

Лимфоциты в цепочках расположены на некотором расстоянии друг от друга. Цепочки лимфоцитов проходят внутрь складок слизистой оболочки и доходят до их вершины. На всем протяжении подслизистой основы большое количество одиночно расположенных средних и малых лимфоцитов.

Шейной части средние лимфоциты составляют 50,3%, большие 26%, а малые - 23,6%. В грудной части средних лимфоцитов 53,6%, больших и малых по 23,2%. В брюшной части средние лимфоциты составили 51,6%, большие 25%, малые 23,4%. Лимфоидные образования подслизистой основы представляют собой двух- а местами трехрядную цепочку лимфоцитов, расположенную на небольшом расстоянии от собственной пластинки слизистой оболочки. Клетки в этой цепочке не прилегают плотно друг к другу и представлены малыми лимфоцитами. По всей площади подслизистой основы до границы с мышечной расположено большое количество средних и малых лимфоцитов, образующих одиночные скопления, количество клеток в которых колеблется от 6 до 11. Центр этих скоплений разрежен, а лимфоциты расположены преимущественно по периферии.

Вывод. Впервые установлено, что лимфоидные структуры пищевода у новорожденных крысят представлены двух-, трехрядной цепочками. С началом формирования лимфоидного узелка (11 сутки), количество рядов в цепочке уменьшается. В экспериментальной группе процесс формирования узелка начинается раньше (6 сутки). Выявлено, что во все сроки эксперимента количество рядов лимфоцитов больше, чем в контроле, а количество лифоцитов в скоплениях - меньше. Впервые дана интраэпителиальных лимфоцитов количественная характеристика пищевода в зависимости от возраста в норме и эксперименте.

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СМЫСЛОВОЕ ЧТЕНИЕ В 1–4 КЛАССАХ: КАК НАУЧИТЬ РЕБЁНКА ПОНИМАТЬ ТЕКСТ, А НЕ ПРОСТО СКЛАДЫВАТЬ БУКВЫ

Аннотация*: в статье рассматривается проблема формирования навыка смыслового чтения у обучающихся начальной школы. Автор анализирует сущность смыслового чтения как метапредметного универсального учебного действия, описывает трёхэтапную технологию работы с текстом (до чтения, во время чтения, после чтения) и представляет систему конкретных приёмов, адаптированных к возрастным особенностям каждого класса с 1-го по 4-й. Особое внимание уделяется практическим стратегиям, таким как «Ассоциативный куст», «Чтение с остановками», «Чтение с пометками», «Синквейн», «Ромашка Блума». Статья адресована учителям начальных классов, педагогам-психологам и родителям, заинтересованным в развитии читательской грамотности детей.*

Ключевые слова: *смысловое чтение, начальная школа, читательская грамотность, универсальные учебные действия, стратегии работы с текстом, ФГОС НОО, понимание текста.*

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MEANINGFUL READING IN GRADES 1–4: HOW TO TEACH A CHILD TO UNDERSTAND TEXT, NOT JUST TO PUT LETTERS TOGETHER

Annotation. *The article examines the problem of forming the skill of meaningful reading in primary school students. The author analyses the essence of meaningful reading as a meta-subject universal learning activity, describes a three-stage technology of working with a text (before reading, during reading, after reading) and presents a system of specific techniques adapted to the age characteristics of each grade from 1st to 4th. Special attention is paid to practical strategies such as "Association Cluster", "Reading with Stops", "Reading with Marks", "Cinquain", "Bloom's Daisy". The article is addressed to primary school teachers, educational psychologists and parents interested in developing children's reading literacy.*

Keywords: *meaningful reading, primary school, reading literacy, universal learning activities, text work strategies, FSES PE, text comprehension.*

Современная начальная школа ставит перед учителем принципиально новую задачу: не просто научить ребёнка бегло и безошибочно читать, а сформировать у него способность понимать, анализировать и использовать прочитанную информацию. Смысловое чтение, закреплённое в обновлённом ФГОС НОО как одно из важнейших метапредметных универсальных учебных действий, лежит в основе всей последующей учебной деятельности ученика [1][2]. Без него невозможно полноценное освоение ни одного школьного предмета — от литературного чтения до математики и окружающего мира.

Проблема, однако, в том, что многие дети, формально овладев техникой чтения, так и не переходят к его осмысленному варианту. Они складывают буквы в слова, слова — в предложения, но смысл написанного ускользает. Ребёнок не может пересказать прочитанное, ответить на вопросы по тексту, выделить главное. Именно поэтому формирование смыслового чтения должно стать не эпизодическим, а системным элементом работы учителя на каждом уроке, начиная с первого класса [3][5].

Смысловое чтение — это вид чтения, нацеленный на максимально точное и полное понимание содержания текста: его информационной, смысловой и идейной сторон [1][3]. Цель смыслового чтения — не просто прочесть, а дать оценку информации, откликнуться на содержание, соотнести прочитанное с собственным опытом и знаниями [1][5]. В концепции универсальных учебных действий смысловое чтение связано с тремя группами действий [1][12]:осмысление цели чтения и выбор вида чтения в зависимости от коммуникативной задачи (ознакомительное, изучающее, поисковое);определение основной и второстепенной информации, формулирование проблемы и главной идеи текста;оценка информации и соотнесение её с личным опытом. Поскольку чтение — метапредметный

навык, его составляющие пронизывают все универсальные учебные действия: мотивация чтения и отношение к учению входят в личностные УУД, произвольная регуляция деятельности — в регулятивные, а логическое мышление, оперативная память, внимание и словарный запас — в познавательные [1][12].

Технология смыслового (продуктивного) чтения включает три последовательных этапа, каждый из которых решает свои задачи и предполагает определённый набор приёмов [2][3][6].

I этап. Работа с текстом до чтения (предтекстовые стратегии)

Цель этапа — настроить ребёнка на чтение, актуализировать имеющиеся знания, создать мотивацию и сформировать читательскую установку [3][6].

Основные приёмы: антиципация — предвосхищение содержания текста по заглавию, имени автора, ключевым словам, иллюстрации. Учитель просит детей предположить, о чём будет текст, какие события могут произойти [2][3]; «Ассоциативный куст» — учитель записывает на доске ключевое слово или заголовок, дети по очереди называют ассоциации, которые учитель фиксирует вокруг. Это активизирует познавательную деятельность и помогает настроиться на тему [3][6][11]; «Верите ли вы…» — учитель предлагает ряд утверждений по теме, с которыми дети соглашаются или не соглашаются до чтения. После прочтения они возвращаются к этим утверждениям и проверяют, подтвердились ли их предположения [5][13]; «Глоссарий» — актуализация словаря, связанного с темой текста. Ученикам предлагается отметить слова, которые, по их мнению, встретятся в тексте [3][13]; «Рассечение вопроса» — анализ заглавия: дети разбивают его на смысловые группы и предполагают, о чём пойдёт речь [13]; с писателем — краткий рассказ об авторе, беседа о его личности, работа с материалами учебника [3][8].

II этап. Работа с текстом во время чтения (текстовые стратегии)

Цель — сформировать умение самостоятельно работать с печатной информацией, вдумчиво читать, задавать вопросы и контролировать понимание [2][6].

Основные приёмы:

- «Чтение с остановками» — текст делится на смысловые фрагменты. После прочтения каждой части учитель задаёт вопросы, охватывающие разные уровни понимания (от простого воспроизведения фактов до прогнозирования развития сюжета). Обязателен вопрос: «Что будет дальше и почему?» [3][6][7].
- «Чтение с пометками» (ИНСЕРТ) — ученики маркируют текст значками: «V» — уже знал, «+» — новое, «–» — думал иначе, «?» — не понял, есть вопросы. Затем заполняют таблицу, систематизируя материал [5][6][11].
- «Чтение в кружок» — дети по очереди читают текст по абзацам вслух. Задача слушающих — задавать чтецу вопросы, чтобы проверить, понимает ли он читаемое. Если ответ неверен, слушающие поправляют [7][13].

• «Читаем и спрашиваем» — ученики читают текст про себя, объединяются в пары, выделяют ключевые слова, формулируют вопросы по ним и отвечают друг другу [3][6][11].

• «Дневник двойных записей» — тетрадь делится на две части. В левой ученик записывает моменты, которые поразили, удивили, вызвали ассоциации; в правой — лаконичный комментарий: почему именно это удивило, на какие мысли натолкнуло [1][11][12].

• «Чтение в парах — обобщение в парах» — каждый ученик поочерёдно выполняет две роли: докладчик (читает и обобщает содержание в виде одного тезиса) и респондент (слушает и задаёт два вопроса по существу). Затем роли меняются [11][12].

III этап. Работа с текстом после чтения (послетекстовые стратегии)

Цель — осмысление и оценка прочитанного, выражение собственного отношения, закрепление понимания [2][6].

Основные приёмы:

• «Толстые и тонкие вопросы» — «тонкие» вопросы требуют однозначного ответа (Кто? Что? Когда?), «толстые» — развёрнутого рассуждения (Почему? В чём различие? Что, если…?). Сначала учитель задаёт вопросы, затем дети учатся составлять их сами [7][10].

• «Ромашка Блума» — шесть типов вопросов: простые, уточняющие, объясняющие (интерпретационные), творческие, оценочные, практические. Каждый тип направлен на определённый уровень понимания: от воспроизведения фактов до оценки и применения информации в жизни [5][8][12].

• «Синквейн» — пятистрочное стихотворение по алгоритму: 1) существительное (тема), 2) два прилагательных, 3) три глагола, 4) фраза из четырёх слов, выражающая главную мысль, 5) одно слово-синоним. Развивает умение выделять ключевые понятия и синтезировать полученные знания [5][6].

• «Кластер» — графическая организация материала: в центре листа записывается тема, по сторонам — связанные с ней понятия и идеи. Помогает систематизировать информацию и увидеть связи [5][6].

• Концептуальная беседа — коллективное обсуждение прочитанного, дискуссия, соотнесение читательских интерпретаций с авторской позицией, формулирование основной идеи [3][6].

• Творческие задания — инсценировка эпизодов, рисование иллюстраций, написание продолжения, составление кроссворда по тексту [3][6].

Возрастная специфика: от 1-го к 4-му классу

Формирование смыслового чтения — постепенный процесс, и задачи каждого класса должны соответствовать возрастным возможностям обучающихся [3][7][8].

1 класс: учимся понимать прочитанное

На первом этапе главная задача — научить ребёнка отличать текст от набора предложений, видеть структуру (начало, концовку), последовательность событий [3][7][8].

Доступные приёмы: выделение смысловых частей под руководством учителя; озаглавливание текста (подбор заголовков); составление схематического или картинного плана; ответы на простые вопросы по содержанию; подбор пословиц к тексту с опорой на иллюстрации [7][8].

2 класс: учимся работать с текстом

Расширяется спектр операций: дети учатся находить в тексте конкретную информацию, подбирать синонимы и антонимы, восстанавливать пропущенные слова, составлять план [3][8].

Доступные приёмы: «Читаем и спрашиваем» в парах; «Верные и неверные утверждения»; восстановление логической последовательности событий составление вопросов к тексту с помощью учителя [5][8].

3 класс: учимся интерпретировать

Дети переходят к самостоятельному выделению главной мысли, нахождению информации в тексте на поставленные вопросы в прямой и косвенной форме, прогнозированию содержания по заглавию и иллюстрациям [3][7][8].

Доступные приёмы: «Чтение с остановками» с прогнозированием; «Чтение с пометками» (ИНСЕРТ); «Дневник двойных записей»; «Толстые и тонкие вопросы»; «Кластер» [5][6][7].

4 класс: учимся анализировать и оценивать

Заключительный этап: самостоятельное формулирование вопросов по тексту, сравнение текстов разных жанров и стилей, выявление жизненных позиций героев и соотнесение их с собственными убеждениями, оценка прочитанного [3][7][8].

Доступные приёмы:«Ромашка Блума» (все шесть типов вопросов); «Синквейн»; составление собственных заданий для одноклассников по тексту; сравнение текстов разных стилей с похожим содержанием; написание творческих работ на основе прочитанного [5][8].

Опираясь на практический опыт, можно сформулировать несколько принципов, которые делают работу по формированию смыслового чтения эффективной:

1. Системность. Приёмы смыслового чтения не должны использоваться эпизодически — они должны применяться на каждом уроке, независимо от предмета. Смысловое чтение — метапредметный навык, и его формирование не может быть задачей только уроков литературного чтения [1][3].

2. Постепенность. От простого к сложному: в 1-м классе — ответы на вопросы учителя и картинный план, в 4-м — самостоятельная интерпретация и оценка. Нельзя перепрыгивать ступени: навык формируется поэтапно [3][7].

3. Вовлечение каждого. Парные и групповые формы работы («Читаем и спрашиваем», «Чтение в парах») обеспечивают активность всех учеников, а не только тех, кто поднял руку [6][11].

4. Связь с жизнью. Вопросы практического типа («Где вы в жизни могли это наблюдать?», «Как бы вы поступили на месте героя?») помогают ребёнку соотнести прочитанное с личным опытом и делают чтение личностно значимым [5][12].

5. Частота, а не длительность. Короткие, но регулярные упражнения эффективнее, чем редкие длинные занятия. Ежеурочные пятиминутки чтения, зрительные диктанты, жужжащее чтение дают устойчивый результат [9].

В заключении, можно сказать, что смысловое чтение — не дополнительный навык, а фундамент всей учебной деятельности. Научить ребёнка понимать текст — значит дать ему инструмент, которым он будет пользоваться всю жизнь: и в школе, и за её пределами. Трёхэтапная технология работы с текстом, разнообразие приёмов для каждого возраста и системность их применения позволяют учителю начальных классов планомерно вести ученика от механического складывания букв к осознанному, критическому и творческому чтению. Главное — помнить, что чтение без понимания — это просто движение глаз по строкам. Настоящее чтение начинается там, где начинается мысль.

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СРАВНИТЕЛЬНЫЙ АНАЛИЗ ДАННЫХ SENTINEL-2 И LANDSAT 9 ДЛЯ РЕШЕНИЯ ПРИКЛАДНЫХ ЗАДАЧ ДИСТАНЦИОННОГО ЗОНДИРОВАНИЯ ЗЕМЛИ

Аннотация. *В статье выполнено сравнение двух наиболее востребованных открытых источников мультиспектральных космических снимков спутниковой группировки Sentinel-2 (EKA, программа Copernicus) и спутника Landsat 9 (NASA/USGS). Сопоставлены спектральные, пространственные, временные и радиометрические характеристики систем. На основе анализа литературы и модельных расчётов определено, для каких прикладных задач предпочтительны данные каждой системы. Показано, что Sentinel-2 выигрывает в задачах, требующих высокой детальности и частоты съёмки, а Landsat 9 незаменим при оценке температуры поверхности и анализе многолетних рядов. Обоснована целесообразность совместного использования данных в виде гармонизированного продукта HLS.*

Ключевые слова: *дистанционное зондирование Земли, Sentinel-2, Landsat 9, мультиспектральные снимки, пространственное разрешение, мониторинг сельскохозяйственных угодий, температура поверхности, HLS.*

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COMPARATIVE ANALYSIS OF SENTINEL-2 AND LANDSAT 9 DATA FOR APPLIED EARTH REMOTE SENSING TASKS

Abstract. *The article compares the two most widely used open sources of multispectral satellite imagery: the Sentinel-2 constellation (ESA, Copernicus programme) and the Landsat 9 satellite (NASA/USGS). The spectral, spatial, temporal and radiometric characteristics of the systems are compared. Based on a literature review and model calculations, the applied tasks for which each system is preferable are identified. It is shown that Sentinel-2 performs better in tasks requiring high spatial detail and frequent observations, while Landsat 9 is indispensable for land surface temperature retrieval and long-term time-series analysis. The expediency of joint use of the data in the form of the harmonized HLS product is substantiated.*

Keywords: *Earth remote sensing, Sentinel-2, Landsat 9, multispectral imagery, spatial resolution, agricultural monitoring, land surface temperature, HLS.*

Введение

Данные дистанционного зондирования Земли (ДЗЗ) стали одним из основных источников информации для управления природными ресурсами, сельским хозяйством, водным хозяйством и городской средой. Особую роль играют системы, предоставляющие снимки на открытой и бесплатной основе: это снижает барьер доступа к космической информации для научных организаций, государственных органов и частного бизнеса, в том числе в странах Центральной Азии [4].

На сегодняшний день наибольшее распространение среди открытых мультиспектральных данных среднего разрешения получили снимки европейской группировки Sentinel-2 и американской программы Landsat, последним спутником которой является Landsat 9, выведенный на орбиту 27 сентября 2021 г. [2, 12]. Обе системы работают в сходных спектральных диапазонах, однако заметно различаются по пространственному разрешению, частоте повторной съёмки, набору каналов и длительности архива. Поэтому перед специалистом, решающим конкретную прикладную задачу, закономерно возникает вопрос: данные какой системы выбрать?

Цель работы — провести сравнительный анализ характеристик Sentinel-2 и Landsat 9 и определить, в каких прикладных задачах целесообразно использовать данные каждой из систем, а в каких — их совместно.

Материалы и методы

В качестве исходных материалов использованы официальные технические описания миссий ЕКА и USGS [12, 13], а также публикации, посвящённые калибровке, сопоставлению и совместному использованию данных [1–3, 5–8, 10]. Сравнение проводилось по четырём группам параметров: спектральным (число, положение и ширина каналов), пространственным (размер пикселя, ширина полосы обзора), временным (периодичность съёмки) и радиометрическим (разрядность, точность калибровки).

Для наглядной оценки влияния пространственного разрешения построена модельная сцена сельскохозяйственного ландшафта размером 600×600 м с исходным шагом 1 м, которая затем была загрублена путём усреднения до 10 и 30 м. Частота получения безоблачных наблюдений рассчитывалась по формуле:

$$N = (365 / T) \cdot p,$$

где T — период повторной съёмки, сут.; p — вероятность безоблачной сцены (для засушливых районов Центральной Азии в вегетационный период принято $p = 0{,}7$). Пригодность систем для прикладных задач оценивалась экспертно по пятибалльной шкале с учётом требований каждой задачи к разрешению, спектральному набору и частоте съёмки.

Результаты и обсуждение

1. Основные технические характеристики. Сводные характеристики систем приведены в таблице 1.

Таблица 1 – Сравнение основных характеристик Sentinel-2 и Landsat 9

Параметр	**Sentinel-2 (MSI)**	**Landsat 9 (OLI-2 / TIRS-2)**
Оператор	ЕКА / Copernicus	NASA / USGS
Запуск	2A – 2015, 2B – 2017, 2C – 2024	27.09.2021
Высота орбиты	786 км	705 км
Время пересечения экватора	10:30	10:00
Число спектральных каналов	13	9 (OLI-2) + 2 тепловых (TIRS-2)
Пространственное разрешение	10 / 20 / 60 м	30 м; 15 м (панхром.); 100 м (тепловые)
Ширина полосы обзора	290 км	185 км
Период повторной съёмки	10 сут. (1 КА); 5 сут. (2 КА)	16 сут.; 8 сут. совместно с Landsat 8
Радиометрическое разрешение	12 бит	14 бит
Каналы red-edge	3 (B5, B6, B7)	нет
Тепловые каналы	нет	2 (10,6–11,2 и 11,5–12,5 мкм)
Архив программы	с 2015 г.	с 1972 г. (вся программа Landsat)
Стандартные продукты	L1C, L2A (отражение у поверхности)	Collection 2 Level-2 (отражение и температура поверхности)
Доступ к данным	Copernicus Data Space Ecosystem, бесплатно	USGS EarthExplorer, бесплатно

Из таблицы видно, что по большинству «оптических» параметров — разрешению, ширине полосы обзора и частоте съёмки — преимущество имеет Sentinel-2. Landsat 9, в свою очередь, обладает двумя уникальными возможностями: тепловыми каналами и преемственностью с более чем

полувековым архивом Landsat. Отметим, что в январе 2025 г. спутник Sentinel-2C заменил Sentinel-2A в основной группировке, а Sentinel-2A продолжил работу в рамках расширенной кампании, что временно увеличило частоту съёмки ряда районов [13].

2. Спектральные возможности. Расположение каналов обеих систем показано на рис. 1. Каналы видимого, ближнего (NIR) и коротковолнового инфракрасного (SWIR) диапазонов в целом совпадают, что и позволяет использовать снимки совместно [6]. Ключевые различия заключаются в следующем.

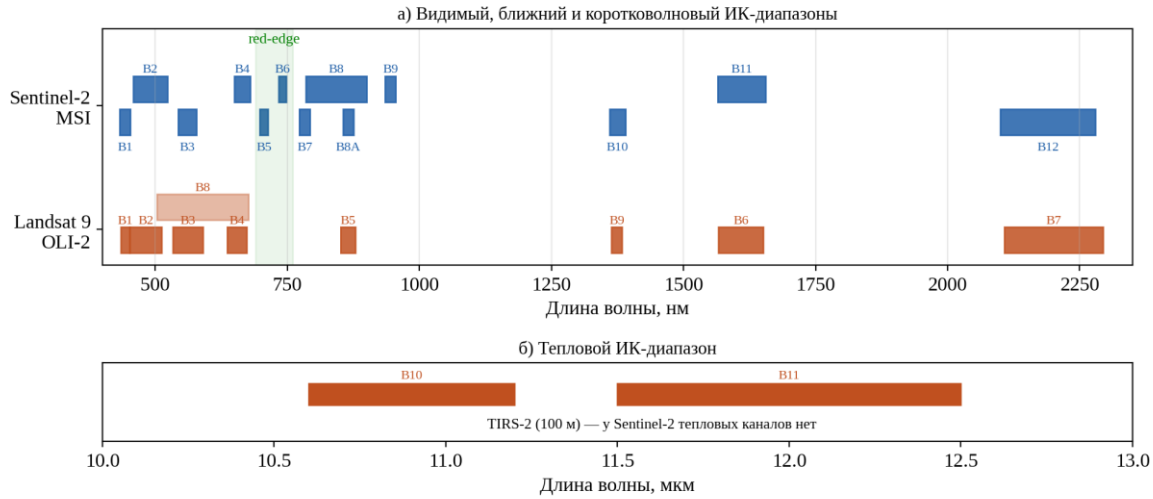


Рис. 1 – Спектральные каналы Sentinel-2 MSI и Landsat 9 OLI-2/TIRS-2 (составлено автором по [12, 13])

Во-первых, Sentinel-2 имеет три канала в области «красного края» (red-edge, 705–783 нм), где отражательная способность растительности резко возрастает. Положение и крутизна этого перехода чувствительны к содержанию хлорофилла и азота в листьях (рис. 2), поэтому индексы на основе red-edge (NDRE, CIre, MTCI) позволяют выявлять стресс растений раньше, чем классический NDVI [7]. У Landsat 9 таких каналов нет.

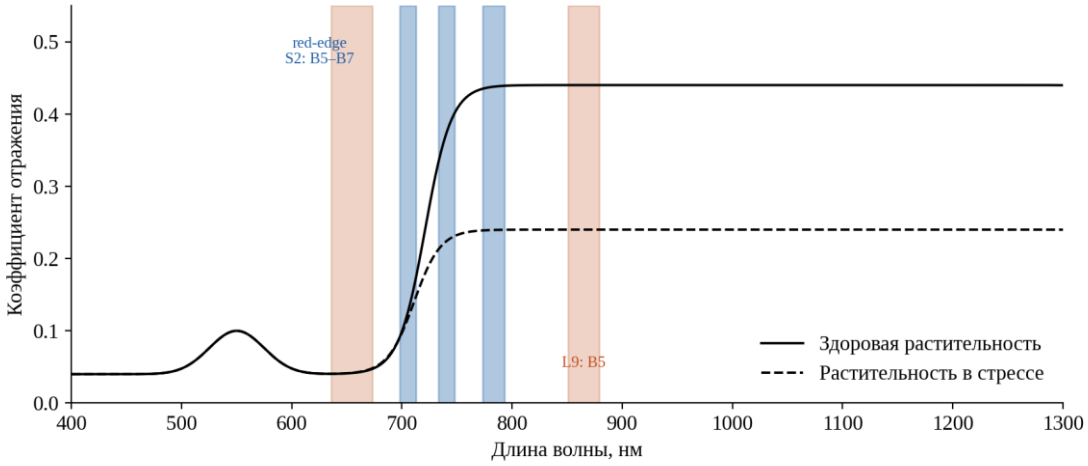


Рис. 2 – Типичные спектральные кривые растительности и положение каналов red-edge Sentinel-2 и каналов Red/NIR Landsat 9 (модельные кривые)

Во-вторых, Landsat 9 оснащён тепловым радиометром TIRS-2 с двумя каналами в окне прозрачности атмосферы 10–12,5 мкм. Это позволяет рассчитывать температуру поверхности суши (LST), а через неё — эвапотранспирацию и индексы водного стресса [9]. Sentinel-2 тепловых каналов не имеет вовсе, и для этих задач он непригоден. Кроме того, радиометрическая разрядность OLI-2 (14 бит) выше, чем у MSI (12 бит), что даёт лучшее разделение слабых сигналов над тёмными объектами — водой и густыми лесами [2].

3. Пространственное разрешение. Основные каналы Sentinel-2 (синий, зелёный, красный, NIR) имеют разрешение 10 м, т. е. на один пиксель Landsat 9 (30 м) приходится девять пикселей Sentinel-2. Результат моделирования приведён на рис. 3.

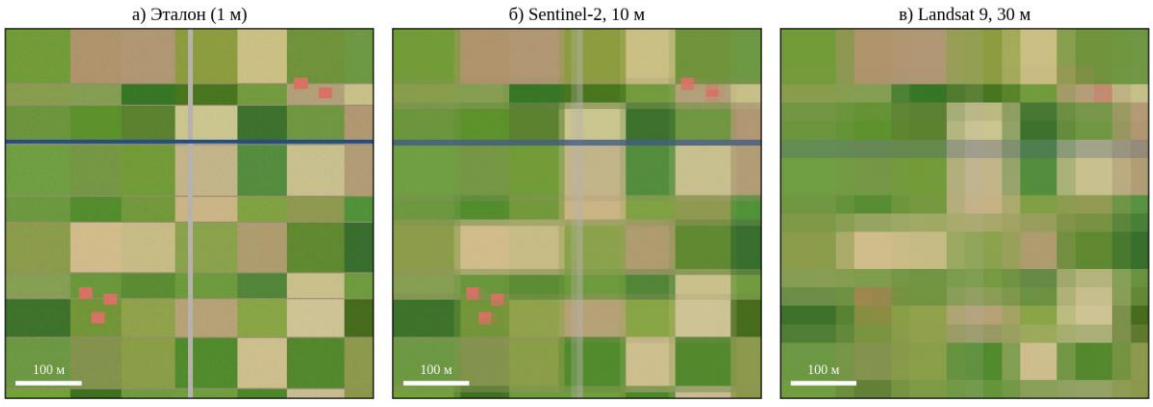


Рис. 3 – Модельная сцена сельскохозяйственного ландшафта: а) эталон 1 м; б) загрубление до 10 м (Sentinel-2); в) загрубление до 30 м (Landsat 9)

На изображении с разрешением 10 м сохраняются границы полей, оросительный канал шириной 6 м и отдельные постройки, тогда как при

разрешении 30 м узкие линейные объекты «растворяются», а доля смешанных пикселей на границах полей резко возрастает. Для территорий с мелкоконтурным землепользованием, характерным для орошаемых районов Узбекистана (Ферганская долина, Ташкентский и Самаркандский оазисы), это различие особенно существенно: при средней площади контура в 1–3 га данные 30 м дают лишь несколько «чистых» пикселей на поле.

4. Временное разрешение. Результаты расчёта числа наблюдений в год представлены на рис. 4.

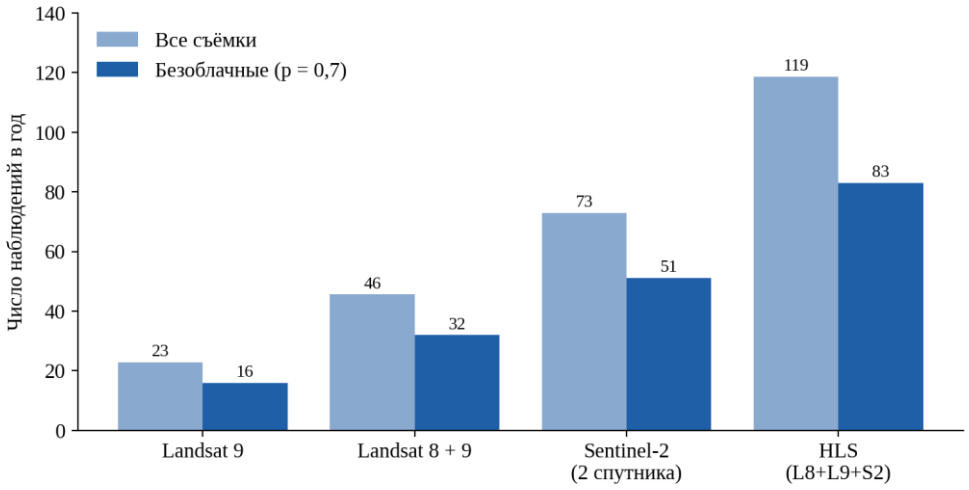


Рис. 4 – Расчётное число наблюдений в год для разных систем и их комбинаций

Один Landsat 9 даёт около 23 снимков в год, из которых безоблачными окажутся примерно 16, т. е. в среднем один пригодный снимок за 3 недели. Для отслеживания фенологии сельскохозяйственных культур этого недостаточно: критические фазы (всходы, цветение, налив) могут быть пропущены. Группировка из двух спутников Sentinel-2 обеспечивает около 73 съёмок в год (≈51 безоблачная). Наибольшую плотность ряда даёт совместное использование Landsat 8, Landsat 9 и Sentinel-2 — свыше 80 безоблачных наблюдений в год, т. е. пригодный снимок в среднем каждые 4–5 дней [5].

5. Сравнение по прикладным задачам. Сводная оценка пригодности систем приведена в таблице 2 и на рис. 5.

Таблица 2 – Предпочтительная система для различных прикладных задач

Задача	**Предпочтительно**	**Обоснование**
Мониторинг посевов, фенология, прогноз урожайности	Sentinel-2	10 м, red-edge, съёмка каждые 5 сут.
Детальное картографирование растительного покрова и землепользования	Sentinel-2	Меньше смешанных пикселей, больше спектральных признаков
Точное земледелие, зонирование полей	Sentinel-2	Разрешение 10 м позволяет выделять зоны внутри поля
Водные объекты, береговые линии, мелкие водоёмы	Sentinel-2	Выделение объектов шириной от 10–20 м
Температура поверхности (LST)	Landsat 9	Наличие тепловых каналов TIRS-2
Эвапотранспирация, водный стресс, засуха	Landsat 9	Энергобалансовые модели требуют LST
Городские острова тепла	Landsat 9	Тепловые каналы; архив для анализа динамики
Многолетние изменения (опустынивание, Аральское море, рост городов)	Landsat 9	Сопоставимый ряд данных с 1972 г.
Оперативный мониторинг пожаров и паводков	Оба / HLS	Важна частота съёмки; SWIR есть у обеих систем
Снежный покров и ледники	Оба	SWIR-каналы обеих систем; Sentinel-2 детальнее, Landsat 9 точнее радиометрически

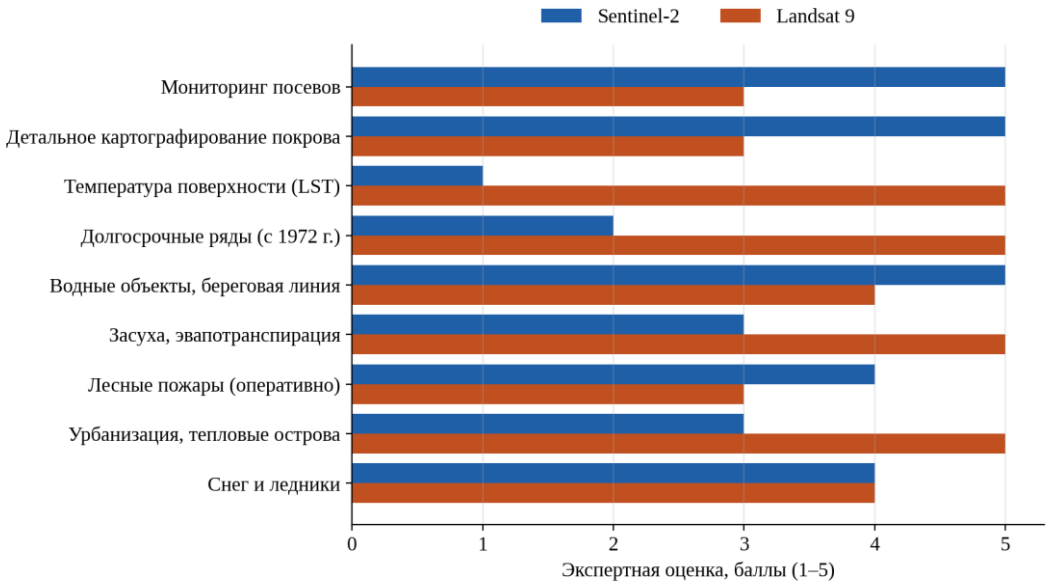


Рис. 5 – Экспертная оценка пригодности Sentinel-2 и Landsat 9 для прикладных задач

Как видно из таблицы 2 и рис. 5, специализация систем достаточно чёткая. Sentinel-2 предпочтителен там, где решающими являются детальность и частота съёмки: сельское хозяйство, картографирование, мониторинг водных объектов. Landsat 9 выигрывает в задачах, связанных с тепловым режимом поверхности и водным балансом, а также в ретроспективных исследованиях. Последнее особенно актуально для региона: оценка усыхания Аральского моря, деградации орошаемых земель и расширения городов возможна только на основе архива Landsat, начинающегося с 1970-х гг. [4, 14, 15].

6. Совместное использование данных. Поскольку системы дополняют друг друга, наиболее эффективным является их комплексное применение. NASA выпускает гармонизированный продукт HLS (Harmonized Landsat and Sentinel-2), в котором снимки Sentinel-2 приведены к сетке 30 м, выполнена коррекция различий в спектральных характеристиках каналов и эффектов двунаправленного отражения [3]. HLS обеспечивает единый ряд наблюдений с интервалом 2–3 сут., однако ценой потери преимущества Sentinel-2 в разрешении. Поэтому для задач, требующих 10 м, рекомендуется использовать исходные данные Sentinel-2, а Landsat 9 привлекать для заполнения пропусков и получения тепловой информации.

Заключение

Проведённый сравнительный анализ показал, что Sentinel-2 и Landsat 9 не являются взаимозаменяемыми, а дополняют друг друга. Sentinel-2 превосходит Landsat 9 по пространственному (10 м против 30 м) и временному (5 сут. против 16 сут.) разрешению, ширине полосы обзора и наличию каналов red-edge, что делает его основным источником данных для мониторинга сельскохозяйственных угодий, детального картографирования и наблюдения

за водными объектами. Landsat 9 имеет преимущества в радиометрической разрядности, наличии тепловых каналов и преемственности с полувековым архивом, что определяет его незаменимость при оценке температуры поверхности, эвапотранспирации, городских островов тепла и долгосрочных изменений природной среды.

Для условий Узбекистана с мелкоконтурным орошаемым земледелием и острыми проблемами водопользования рекомендуется комбинированный подход: Sentinel-2 — для оперативного мониторинга посевов, Landsat 9 — для оценки водного стресса и ретроспективного анализа, продукт HLS — для построения плотных временных рядов.

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ЗДРАВООХРАНЕНИЕ В ОБЩЕСТВЕ

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RAXIT BILAN KASALLANGAN BOLALARDA KALSIY-FOSFOR ALMASHINUVINI KORREKSIYA QILISHNING KLINIK VA LABORATOR SAMARADORLIGI

Annotatsiya. *Mazkur tadqiqotda raxit bilan kasallangan bolalarda Kalsiy-D3 Nikomed preparatining klinik va laborator samaradorligi baholandi. Tadqiqotga raxit tashxisi qo‘yilgan 64 nafar bola va 30 nafar sog‘lom bola jalb qilindi. Asosiy guruhdagi bemorlarga 1,5–2 oy davomida Kalsiy-D3 Nikomed preparati yoshga mos terapevtik dozalarda buyurildi. Davolash samaradorligi klinik belgilar hamda qon zardobidagi umumiy kalsiy, noorganik fosfor, ishqoriy fosfataza va 25(OH)D ko‘rsatkichlari asosida baholandi. Davolash natijasida bemorlarning klinik holati sezilarli yaxshilandi, umumiy kalsiy, noorganik fosfor va 25(OH)D darajalari ishonchli oshdi, ishqoriy fosfataza faolligi esa kamaydi ($p<0,05–0,01$). Olingan natijalar Kalsiy-D3 Nikomed preparatining raxit bilan kasallangan bolalarda D vitamini tanqisligini bartaraf etish, kalsiy-fosfor almashinuvini normallashtirish va davolash samaradorligini oshirishda yuqori klinik hamda metabolik samaradorlikka ega ekanligini ko‘rsatdi.*

Kalit so‘zlar: *raxit, bolalar, D vitamini, Kalsiy-D3 Nikomed, 25(OH)D, kalsiy, fosfor, davolash.*

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CLINICAL AND LABORATORY EFFICACY OF CALCIUM–PHOSPHORUS METABOLISM CORRECTION IN CHILDREN WITH RICKETS

Abstract. *This study aimed to evaluate the clinical and laboratory efficacy of Calcium-D3 Nycomed in children diagnosed with rickets. The study included 64 children diagnosed with rickets and 30 apparently healthy children in the control group. Patients in the main group received age-appropriate therapeutic doses of* ***Calcium-D3 Nycomed*** *for 1.5–2 months. Treatment efficacy was assessed based on clinical manifestations and changes in serum total calcium, inorganic phosphorus, alkaline phosphatase, and 25-hydroxyvitamin D [25(OH)D] levels. Following treatment, significant improvement in clinical condition was observed, accompanied by increased serum total calcium, inorganic phosphorus, and*

*25(OH)D levels, as well as a significant reduction in alkaline phosphatase activity ($p<0.05–0.01$). The findings demonstrate the high clinical and metabolic efficacy of **Calcium-D3 Nycomed** in the treatment of rickets in children.*

Keywords: *rickets, children, vitamin D, Calcium-D3 Nycomed, 25(OH)D, calcium, phosphorus, treatment.*

Mavzuning dolzarbligi. Raxit bolalar yoshida uchraydigan metabolik suyak kasalliklari orasida eng dolzarb patologiyalardan biri bo‘lib, o‘sayotgan organizmda suyak to‘qimasining mineralizatsiyasi buzilishi, epifiz o‘sish plastinkasi faoliyatining izdan chiqishi hamda skelet deformatsiyalarining rivojlanishi bilan tavsiflanadi. Kasallikning asosini kalsiy-fosfor almashinuvining buzilishi tashkil etadi. Ushbu jarayon D vitamini yetishmovchiligi, uning metabolizmi yoki retseptorlari faoliyatidagi irsiy nuqsonlar, fosfat almashinuvining buzilishi, surunkali buyrak kasalliklari va boshqa metabolik omillar bilan bog‘liq uzviy bog`liq [1–3].

So‘nggi o‘n yilliklarda D vitamini profilaktikasi dasturlarining joriy etilishi natijasida klassik raxitning uchrash chastotasi kamaygan bo‘lsa-da, D vitamini tanqisligi va raxit dunyoning ko‘plab mamlakatlarida, jumladan iqtisodiy rivojlangan davlatlarda ham dolzarb muammo bo‘lib qolmoqda. Jahon sog‘liqni saqlash tashkiloti hamda xalqaro pediatriya va endokrinologiya jamiyatlari ma'lumotlariga ko‘ra, D vitamini tanqisligi bolalar orasida eng ko‘p uchraydigan mikronutrient yetishmovchiliklaridan biri bo‘lib, u raxit rivojlanishining asosiy xavf omili hisoblanadi [1,4].

Epidemiologik tadqiqotlar Osiyo, Afrika va Yaqin Sharq mamlakatlari bilan bir qatorda Yevropa hamda Shimoliy Amerikada ham raxit holatlarining qayta ortib borayotganini ko‘rsatmoqda. Bunga urbanizatsiya, ovqatlanish xususiyatlarining o‘zgarishi, quyosh nuri ta'sirining kamayishi, migratsiya jarayonlari, homilador ayollar va emizikli onalarda D vitamini tanqisligi, shuningdek, faqat ko‘krak suti bilan oziqlanayotgan chaqaloqlarda profilaktik tadbirlarning yetarli darajada olib borilmasligi sabab bo‘lmoqda [2,5].

O‘zbekiston Respublikasida ham D vitamini tanqisligi va raxit bolalar salomatligining muhim muammolaridan biri bo‘lib qolmoqda. Mamlakatimiz iqlim sharoiti quyosh nurlaridan yetarli foydalanish imkonini bersa-da, bolalarning quyosh ta'sirida kam bo‘lishi, ovqatlanishdagi nomutanosibliklar, homilador ayollarda D vitamini tanqisligi, erta tug‘ilgan chaqaloqlar sonining ortishi va profilaktik tavsiyalarga to‘liq amal qilinmasligi kasallik rivojlanishiga zamin yaratadi. Mahalliy tadqiqotlar bolalarda D vitamini tanqisligi yuqori uchrashini hamda bu holat raxit rivojlanish xavfini oshirishini ko‘rsatmoqda [6].

Hozirgi kunda raxitning etiologiyasi ancha keng talqin qilinmoqda. Kasallik faqat D vitamini tanqisligi bilan bog‘liq emas, balki D vitamini almashinuvining irsiy buzilishlari, vitamin D retseptori nuqsonlari, buyrak naychalarida fosfat reabsorbsiyasining pasayishi, fibroblast o‘sish omili-23 (FO`O23) ning ortiqcha sekretsiyasi hamda boshqa genetik va metabolik buzilishlar natijasida ham

rivojlanishi mumkin [3,7]. Shu sababli raxit bugungi kunda turli etiopatogenetik mexanizmlarga ega bo‘lgan geterogen kasalliklar guruhi sifatida qaralmoqda.

Patogenezga oid zamonaviy qarashlarning rivojlanishi kasallikni tashxislash va davolash yondashuvlarini tubdan o‘zgartirdi. Kalsiy-fosfor almashinuvi, paratgormon, FO’O23, Klotho oqsili hamda D vitamini metabolizmini boshqaruvchi fermentlarning o‘zaro ta'siri haqidagi yangi ma'lumotlar raxitning molekulyar asoslarini chuqurroq tushunish imkonini berdi. Natijada laborator diagnostikada 25(OH)D, 1,25(OH)$_2$D, paratgormon, ishqoriy fosfataza, FO’O23 kabi biomarkerlardan foydalanish, molekulyar-genetik tekshiruvlarni amaliyotga joriy etish va kasallikning irsiy shakllarini erta aniqlash imkoniyatlari kengaydi [7,8].

Maqolaning maqsadi. Bolalarda raxitning klinik xususiyatlari, zamonaviy diagnostikasi, profilaktikasi va davolash tamoyillarini tavsiflash.

Tadqiqot obyekti. Tadqiqot 2025-yil 1-yanvardan 2026-yil 28-fevralgacha o'tkazildi. Tadqiqotga raxit tashxisi qo'yilgan 2 oylikdan 2 yoshgacha bo'lgan 64 nafar bola jalb qilindi. Nazorat guruhini yosh va jinsi bo'yicha moslashtirilgan 30 nafar amalda sog'lom bola tashkil etdi.

Material va metodlar. Barcha bolalarda klinik tekshiruv o'tkazilib, anamnez ma'lumotlari, klinik belgilar va antropometrik ko'rsatkichlar baholandi. Laborator tekshiruvlar davomida qon zardobida umumiy kalsiy, noorganik fosfor va ishqoriy fosfataza (ALP) miqdori biokimyoviy usullar yordamida aniqlandi. D vitamini bilan ta'minlanganlik darajasini baholash maqsadida 25-gidroksivitamin D [25(OH)D] miqdori ferment bilan bog'langan immunosorbent tahlil (**ELISA/IFA**) usulida aniqlandi.

Olingan natijalar statistik jihatdan qayta ishlandi. Miqdoriy ko'rsatkichlar o'rtacha arifmetik qiymat (**M**) va standart og'ish (**SD**) ko'rinishida ifodalandi. Guruhlar o'rtasidagi farqlar statistik usullar yordamida baholanib, $\mathbf{p < 0,05}$ qiymati statistik ahamiyatlilik mezoni sifatida qabul qilindi.

Tadqiqot natijalari. Mazkur tadqiqotda 2 oylikdan 2 yoshgacha bo‘lgan raxit tashxisi qo‘yilgan 64 nafar bola hamda 30 nafar amalda sog‘lom boladan iborat nazorat guruhi klinik, antropometrik, laborator va anamnestik ko‘rsatkichlar bo‘yicha kompleks tekshirildi. Olingan natijalar raxitning klinik namoyon bo‘lishi organizmda D vitamini yetishmovchiligi va mineral almashinuvi buzilishlari bilan chambarchas bog‘liqligini ko‘rsatdi.

Klinik tekshiruv natijalariga ko‘ra, bemor bolalarda kasallikning dastlabki belgilaridan biri sifatida vegetativ nerv tizimi faoliyatidagi o‘zgarishlar ustunlik qildi. Jumladan, ko‘p terlash, bezovtalik, uyquning buzilishi va qo‘zg‘aluvchanlik 56 nafar (87,5%) bolada qayd etildi. Mazkur belgilar D vitamini tanqisligi oqibatida nerv-mushak qo‘zg‘aluvchanligining ortishi hamda kalsiy-fosfor almashinuvi izdan chiqishi bilan izohlanadi. Ushbu natijalar raxitning erta klinik diagnostikasida vegetativ simptomlarning muhim diagnostik ahamiyatga ega ekanligini ko‘rsatadi.

Suyak tizimiga xos klinik o‘zgarishlar ham bemorlarning aksariyatida kuzatildi. Xususan, ensa suyagining yumshashi (kraniotabes) 27 nafar (42,2%) bolada, qovurg‘alar bo‘ylab raxitik "tasbehsimon" bo‘rtmalar 16 nafar (25%)

bolada, bilak metafizlarining kengayishi ("raxitik bilaguzuk") 20 nafar (31,3%) bolada hamda katta liqildoqning fiziologik muddatdan kech yopilishi 44 nafar (68,8%) bolada aniqlandi. Ushbu morfologik o‘zgarishlar suyak to‘qimasida osteoid moddaning yetarlicha minerallashmasligi hamda osteomalatsiya jarayonining rivojlanishini aks ettiradi.

Antropometrik ko‘rsatkichlarni tahlil qilish raxit bilan kasallangan bolalarda jismoniy rivojlanish sur'atlari nazorat guruhiga nisbatan sustlashganligini ko‘rsatdi. Ayniqsa tana vazni ortishining sekinlashuvi, mushak tonusining pasayishi hamda yoshga mos psixomotor rivojlanish bosqichlari, jumladan o‘tirish, emaklash va mustaqil yurish ko‘nikmalarining kechikishi kuzatildi. Mazkur holatlar suyak-mushak tizimining yetarli darajada shakllanmaganligi va mineral almashinuvining buzilishi bilan bog‘liq bo‘lib, kasallikning klinik og‘irligini tavsiflaydi.

Kasallikning metabolik asoslarini aniqlash maqsadida kalsiy-fosfor almashinuvi hamda organizmning D vitamini bilan ta'minlanganlik darajasi baholandi. Biokimyoviy va immunoferment tekshiruv natijalari raxit bilan kasallangan bolalarda mineral almashinuvi sezilarli darajada izdan chiqqanligini ko‘rsatdi.

1-JADVAL.

TADQIQOT GURUHLARIDAGI BOLALARNING LABORATOR KO‘RSATKICHLARI (M±SD)

Ko‘rsatkich	Asosiy guruh (n=64)	Nazorat guruhi (n=30)	p
Umumiy kalsiy, mmol/l	1,92±0,15	2,41±0,12	<0,05
Noorganik fosfor, mmol/l	1,04±0,11	1,65±0,14	<0,05
Ishqoriy fosfataza, U/L	620,4±75,8	245,2±30,5	<0,01
25(OH)D, ng/ml	14,2±3,6	32,4±4,8	<0,01

Izoh: *p<0,05 – guruhlar o‘rtasidagi farq statistik jihatdan ishonchli.*

Laborator natijalar tahlili asosiy guruh bolalarida umumiy kalsiy va noorganik fosfor miqdori nazorat guruhiga nisbatan statistik jihatdan ishonchli darajada pasayganligini ko‘rsatdi ($p<0,05$). Ayniqsa, gipofosfatemiya raxit patogenezining asosiy laborator belgilaridan biri sifatida namoyon bo‘ldi. D vitamini tanqisligi natijasida ichakda kalsiyning so‘rilishi kamayadi, bu esa ikkilamchi giperparatireoz rivojlanishiga olib keladi. Paratgormon sekresiyasining kuchayishi natijasida buyrak naychalarida fosfatlarning qayta so‘rilishi kamayadi va giperfosfaturiya yuzaga keladi. Natijada qon zardobida fosfor miqdori pasayib, suyak mineralizatsiyasi izdan chiqadi.

Ishqoriy fosfataza fermenti faolligi asosiy guruhda 620,4±75,8 U/L ni tashkil etib, nazorat guruhidagi ko‘rsatkichga nisbatan qariyb 2,5 baravar yuqori bo‘ldi ($p<0,01$). Mazkur holat osteoblastlar faoliyatining kompensator ravishda kuchayganligini va osteoid to‘qima hosil bo‘lish jarayonining jadallashganligini ko‘rsatadi. Shu bilan birga, ALP darajasining ortishi suyak mineralizatsiyasi

buzilishining eng sezgir laborator markerlaridan biri sifatida raxitning faol bosqichini aks ettiradi.

25-gidroksivitamin D [25(OH)D] miqdorini immunoferment tahlil usulida aniqlash natijasida asosiy guruh bolalarida ushbu ko‘rsatkich o‘rtacha 14,2±3,6 ng/ml ni tashkil etdi, nazorat guruhida esa 32,4±4,8 ng/ml bo‘ldi ($p<0,01$). Olingan natijalar bemor bolalarda yaqqol D vitamini tanqisligi mavjudligini tasdiqladi.

64 nafar bemorda D vitamini statusi batafsil baholanganda 15 nafar (23,4%) bolada og‘ir tanqislik (<10 ng/ml), 40 nafar (62,5%) bolada yetishmovchilik (10–20 ng/ml) hamda 9 nafar (14,1%) bolada suboptimal daraja (21–29 ng/ml) aniqlandi. Demak, tekshirilgan bolalarning 85,9% ida D vitamini tanqisligi yoki yetishmovchiligi mavjud bo‘lib, bu raxit rivojlanishida D gipovitaminozining yetakchi etiologik omil ekanligini yana bir bor tasdiqlaydi.

Anamnestik ma'lumotlar tahlili kasallik rivojlanishida bir qator modifikatsiyalanuvchi xavf omillari muhim o‘rin tutishini ko‘rsatdi. Tabiiy quyosh nurlaridan yetarli foydalanmaslik 68,8% bolada, homiladorlik davrida onalarda ekstragenital kasalliklar va preeklampsiya 51,5% holatda hamda sun'iy oziqlantirish 43,8% bolada qayd etildi. Ushbu omillar prenatal va postnatal davrda D vitamini almashinuvining buzilishiga zamin yaratishi bilan ahamiyatlidir.

Tadqiqotning ikkinchi bosqichida raxit tashxisi tasdiqlangan asosiy guruhdagi 64 nafar bolaga kalsiy va D vitamini tanqisligini bartaraf etishga qaratilgan kompleks patogenetik davolash o‘tkazildi. Barcha bemorlarga yoshiga mos terapevtik dozalarda **Kalsiy-D3 Nikomed** preparati buyurildi. Davolash samaradorligi terapiya boshlanganidan 1,5–2 oy o‘tgach klinik belgilar hamda laborator ko‘rsatkichlarning dinamikasi asosida baholandi.

Davolash fonida bemorlarning umumiy holati sezilarli darajada yaxshilandi. Terapiyaning 2–3-haftasiga kelib vegetativ nerv tizimi bilan bog‘liq klinik belgilar regressiyasi kuzatildi. Xususan, ko‘p terlash, bezovtalik, uyqu buzilishi va yuqori qo‘zg‘aluvchanlik kabi shikoyatlar aksariyat bemorlarda bartaraf etildi. Shuningdek, mushak gipotoniyasi kamaydi, bolalarning motor faolligi yaxshilandi hamda kraniotabes, raxitik tasbehlar va raxitik bilaguzuklarning progressiv rivojlanishi to‘xtadi.

Laborator tekshiruvlar natijalari mineral almashinuvining sezilarli yaxshilanganligini ko‘rsatdi.

2-JADVAL.

ASOSIY GURUHDAGI BOLALARDA KALSIY-D3 NIKOMED PREPARATI BILAN DAVOLASHDAN OLDINGI VA KEYINGI LABORATOR KO‘RSATKICHLAR DINAMIKASI (M±SD)

Ko‘rsatkich	Davolashdan oldin (n=64)	Davolashdan keyin (n=64)	O‘zgarish (%)	Nazorat guruhi (n=30)	p
Umumiy kalsiy, mmol/l	1,92±0,15	2,35±0,11	+22,4	2,41±0,12	<0,05
Noorganik fosfor, mmol/l	1,04±0,11	1,52±0,13	+46,2	1,65±0,14	<0,05
Ishqoriy fosfataza, U/L	620,4±75,8	285,6±34,2	−53,9	245,2±30,5	<0,01
25(OH)D, ng/ml	14,2±3,6	29,8±4,1	+109,9	32,4±4,8	<0,01

Izoh: *Ma'lumotlar* **M±SD** *ko‘rinishida keltirilgan. Statistik tahlilda Studentning juftlangan t-testidan foydalanildi. p<0,05 – statistik jihatdan ishonchli farq.*

2-jadval ma'lumotlariga ko‘ra, davolashdan so‘ng umumiy kalsiy miqdori 22,4 % ga, noorganik fosfor 46,2 % ga va 25(OH)D konsentratsiyasi 109,9 % ga oshdi. Aksincha, ishqoriy fosfataza faolligi 53,9 % ga kamaydi. Davolash yakunida 50 nafar (78,1 %) bolada D vitaminining normal yoki suboptimal darajasi qayd etildi, og‘ir tanqislik holatlari esa aniqlanmadi.

Olingan natijalar Kalsiy-D3 Nikomed preparati raxit bilan kasallangan bolalarda klinik simptomlarni bartaraf etish va kalsiy-fosfor almashinuvini tiklashda yuqori samaradorlikka ega ekanligini ko‘rsatdi. Davolash fonida kuzatilgan umumiy kalsiy va noorganik fosfor miqdorining oshishi hamda ishqoriy fosfataza faolligining kamayishi suyak to‘qimasida mineralizatsiya jarayonlari faollashganligini ko‘rsatadi.

25(OH)D konsentratsiyasining ikki martadan ortiq oshishi organizmning D vitamini bilan ta'minlanganligi yaxshilanganligini tasdiqlaydi. Bu holat ichakda kalsiy so‘rilishining ortishi, ikkilamchi giperparatireozning kamayishi va suyak matriksining mineralizatsiyasi tiklanishi bilan izohlanadi.

Bizning natijalarimiz raxitni davolash bo‘yicha zamonaviy klinik tavsiyalar va boshqa tadqiqotchilar ma'lumotlari bilan mos keladi. Adabiyotlarda D vitamini va kalsiy preparatlarining kompleks qo‘llanilishi klinik simptomlarning tez regressiyasiga, ishqoriy fosfataza faolligining pasayishiga va 25(OH)D darajasining normallashuviga olib kelishi qayd etilgan.

Klinik belgilar va laborator ko‘rsatkichlarning parallel ravishda yaxshilanishi preparatning nafaqat simptomatik, balki patogenetik ta'sirga ham ega ekanligini ko‘rsatadi. Ayniqsa, vegetativ simptomlarning keskin kamayishi va motor faolligining yaxshilanishi davolashning amaliy klinik samaradorligini tasdiqlaydi.

Xulosa. O‘tkazilgan tadqiqot natijalari raxit bilan kasallangan bolalarda kasallikning kuz va qish mavsumlarida ko‘proq uchrashini, klinik jihatdan ko‘p terlash, bezovtalik, uyqu buzilishi, mushak gipotoniyasi hamda suyak tizimidagi o‘zgarishlar bilan namoyon bo‘lishini ko‘rsatdi. Laborator tekshiruvlarda umumiy kalsiy, noorganik fosfor va 25(OH)D darajalarining pasayishi, ishqoriy fosfataza

faolligining esa sezilarli oshishi aniqlanib, bu kalsiy-fosfor almashinuvi buzilishi va D vitamini tanqisligini tasdiqladi.

Raxit bilan kasallangan bolalarda 1,5–2 oy davomida olib borilgan kompleks patogenetik davolash natijasida klinik simptomlarning sezilarli regressiyasi kuzatildi. Davolashdan so‘ng umumiy kalsiy, noorganik fosfor va 25(OH)D ko‘rsatkichlari statistik jihatdan ishonchli ravishda oshdi ($p<0,05$), ishqoriy fosfataza faolligi esa sezilarli darajada kamaydi ($p<0,01$). Davolash yakunida bolalarning 78,1 % ida D vitaminining normal yoki suboptimal darajasiga erishildi.

Shunday qilib, raxit bilan kasallangan bolalarda kalsiy-fosfor almashinuvini korreksiya qilish mineral almashinuvining tiklanishi, suyak to‘qimasi mineralizatsiyasining yaxshilanishi hamda klinik simptomlarning regressiyasiga olib keladi. Olingan natijalar kompleks patogenetik davolashning yuqori klinik va laborator samaradorligini tasdiqlaydi hamda uni raxitni davolash amaliyotida keng qo‘llash maqsadga muvofiqligini ko‘rsatadi.

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BOLALARDA TUBULOINTERSTITSIAL NEFRIT: KLINIK-LABORATOR VA INSTRUMENTAL DIAGNOSTIKANING KOMPLEKS BAHOSI

Annotatsiya. *Tubulointerstitsial nefrit (TIN) bolalarda buyrakning tubulyar va interstitsial tuzilmalari zararlanishi bilan kechib, klinik va laborator ko‘rinishlarining xilma-xilligi bilan tavsiflanadi. Tadqiqotning maqsadi bolalarda TINning klinik-laborator xususiyatlari hamda buyrakdagi strukturaviy va gemodinamik o‘zgarishlarni zamonaviy instrumental usullar yordamida kompleks baholashdan iborat. Tadqiqotda klinik-laborator ko‘rsatkichlar, siydik sindromi, buyrak funksiyasi, ultratovush tekshiruvi, renal Doppler va shear-wave elastografiya natijalari tahlil qilindi. TINda siydik nisbiy zichligining pasayishi, leykotsituriya va proteinuriya, shuningdek, kreatinin va mochevina miqdorining oshishi hamda eGFR pasayishi kuzatildi. Instrumental tekshiruvlarda buyrak parenximasidagi o‘zgarishlar, renal rezistiv indeks va parenxima qattiqligining oshishi aniqlandi. Olingan natijalar TINda klinik-laborator tekshiruvlarni ultratovush, Doppler va shear-wave elastografiya bilan birgalikda qo‘llash buyrak zararlanishining funksional va strukturaviy xususiyatlarini kompleks baholash imkonini berishini ko‘rsatadi.*

Kalit so‘zlar: *tubulointerstitsial nefrit, bolalar, buyrak funksiyasi, siydik sindromi, ultratovush tekshiruvi, Doppler ultrasonografiya, rezistiv indeks, shear-wave elastografiya.*

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TUBULOINTERSTITIAL NEPHRITIS IN CHILDREN: COMPREHENSIVE ASSESSMENT OF CLINICAL, LABORATORY, AND INSTRUMENTAL DIAGNOSTICS

Abstract. *Tubulointerstitial nephritis (TIN) in children is characterized by injury to the renal tubular and interstitial structures and presents with diverse clinical and laboratory manifestations. The aim of the study was to comprehensively assess the clinical and laboratory features of TIN and structural and hemodynamic renal changes using modern instrumental methods. Clinical and laboratory parameters, urinary syndrome, renal function, ultrasonography, renal Doppler ultrasonography, and shear-wave elastography findings were evaluated. In children with TIN, decreased urine specific gravity, leukocyturia and proteinuria, increased serum creatinine and urea levels, and reduced estimated glomerular filtration rate were observed. Instrumental assessment revealed changes in the renal parenchyma, increased renal resistive index, and increased parenchymal stiffness. The findings indicate that the combined use of clinical and laboratory assessment with modern*

non-invasive instrumental methods provides a comprehensive evaluation of functional and structural renal changes in children with TIN.

Keywords: *tubulointerstitial nephritis, children, renal function, urinary syndrome, ultrasonography, Doppler ultrasonography, resistive index, shear-wave elastography.*

Dolzarbligi. Tubulointerstitsial nefrit (tin) bolalik davrida buyrakning kanalcha va interstitsial komponentlarini zararlovchi yallig‘lanish jarayoni bo‘lib, uning klinik ahamiyati faqat o‘tkir buyrak funksiyasi buzilishi bilan cheklanmaydi. Yallig‘lanish jarayoni o‘z vaqtida aniqlanib, sababchi omil bartaraf etilmasa, interstitsial to‘qimada strukturaviy qayta qurilish, kanalchalar atrofiyasi va fibrotik o‘zgarishlar shakllanishi mumkin. Shu sababli tinning dastlabki bosqichlarini aniqlash va jarayonning buyrak funksiyasiga ta’sirini to‘g‘ri baholash bolalar nefrologiyasida muhim diagnostik vazifa bo‘lib qolmoqda. Zamonaviy pediatrik ma’lumotlarda ham tinning klinik va laborator ko‘rinishlari ko‘pincha o‘ziga xos bo‘lmagani sababli tashxis kechikishi mumkinligi qayd etilgan [1].

Tinning pediatrik shakllari yagona etiologik mexanizm bilan izohlanmaydi. Dori vositalariga bog‘liq immun-yallig‘lanish reaksiyalari, infeksion omillar, tizimli va autoimmun jarayonlar hamda etiologiyasi aniqlanmaydigan holatlar kasallikning turli klinik variantlarini yuzaga keltirishi mumkin. So‘nggi yillardagi tadqiqotlar, ayniqsa, bolalarda infeksiyalar bilan bog‘liq tubulointerstitsial zararlanishlarni ham alohida diagnostik muammo sifatida ko‘rsatmoqda [1,2]. Bu holat tinga shubha qilingan bemorni baholashda anamnestik ma’lumotlarni, infeksiyalar, dori vositalari ta’sirini va tizimli kasalliklar mavjudligini birgalikda hisobga olish zarurligini ko‘rsatadi.

Kasallikning klinik diagnostikasini murakkablashtiradigan jihat shundaki, tin ko‘pincha ma’lum bir organga xos simptomlar bilan emas, balki umumiy va nospetsifik shikoyatlar bilan boshlanadi. Holsizlik, ishtaha pasayishi, ko‘ngil aynishi, qusish, tana haroratining ko‘tarilishi, qorin yoki bel sohasidagi og‘riq kabi belgilar turli pediatrik kasalliklarda kuzatilishi mumkin. Natijada dastlabki klinik bosqichda tinni boshqa buyrak yoki tizimli patologiyalardan ajratish qiyinlashadi. Pediatrik kogortlarda klassik klinik belgilar kombinatsiyasining kam uchrashi ham ushbu diagnostik muammoning amaliy ahamiyatini ko‘rsatadi [1,3].

Muammoning yana bir muhim jihati — buyrak funksiyasi ko‘rsatkichlari va parenximadagi patologik jarayon o‘rtasidagi munosabatning har doim ham bir xil bo‘lmasligidir. Glomerulyar filtratsiyaning pasayishi buyrakning umumiy funksional zararlanishini ko‘rsatadi, biroq uning o‘zi yallig‘lanish jarayonining tubulointerstitsial lokalizatsiyasini aniqlamaydi. Shu sababli tinda diagnostik yondashuv faqat funksional ko‘rsatkichlarni aniqlash bilan chegaralanmasdan, buyrak parenximasining strukturaviy holatini ham baholashga yo‘naltirilishi kerak [1,4,5].

Buyrak biopsiyasi tubulointerstitsial zararlanishning morfologik xususiyatlarini bevosita aniqlash imkonini beradigan muhim usul bo‘lib qolmoqda. Biroq uning invazivligi, qon ketish kabi asoratlar xavfi va pediatrik bemorlarda

qo‘llash uchun klinik asos zarurligi uni barcha holatlar uchun universal skrining usuliga aylantirmaydi. Bundan tashqari, biopsiya natijasini kutish ayrim vaziyatlarda davolash taktikasini belgilashni kechiktirishi mumkin. Shu sababli klinik amaliyot uchun xavfsiz, takroran qo‘llash mumkin bo‘lgan va buyrakdagi patologik jarayon haqida qo‘shimcha ma’lumot beruvchi noinvaziv usullarning ahamiyati ortib bormoqda [4,5].

Elastografiyaning rivojlanishi buyrak to‘qimasining mexanik xususiyatlarini noinvaziv ravishda miqdoriy baholash imkoniyatini kengaytirmoqda. Pediatriyada ultratovush elastografiyasidan foydalanish bo‘yicha 2026-yilgi zamonaviy sharhlar ushbu texnologiyaning istiqbolli ekanini, biroq uning klinik qo‘llanilishi turli kasalliklarda bir xil darajada standartlashtirilmaganini ko‘rsatadi [6]. Ayniqsa, tinda elastografik parametrlarning yallig‘lanish faolligi, parenxima o‘zgarishlari va keyingi fibrotik jarayonlar bilan munosabatini aniqlash uchun qo‘shimcha klinik tadqiqotlar talab etiladi.

Shu sababli bolalarda tubulointerstitsial nefritni kompleks diagnostik baholashga qaratilgan tadqiqot o‘tkazish nafaqat mavjud klinik va laborator mezonlarning diagnostik imkoniyatlarini aniqlashtirish, balki noinvaziv instrumental tekshiruvlarning ushbu kasallikdagi real amaliy qiymatini baholash nuqtayi nazaridan ham dolzarbdir. Bunday yondashuv tinni erta aniqlash, differensial diagnostika jarayonini takomillashtirish va kelgusida pediatrik bemorlar uchun yanada asoslangan diagnostik algoritmlarni ishlab chiqishga xizmat qilishi mumkin.

Tadqiqotning maqsadi — bolalarda tubulointerstitsial nefritning klinik-laborator va instrumental diagnostik xususiyatlarini kompleks baholash.

Materiallar va tadqiqot usullari. Tadqiqotga 5–17 yoshdagi 92 nafar bola jalb qilindi. Asosiy guruhni tubulointerstitsial nefrit tashxisi qo‘yilgan 73 nafar bemor, nazorat guruhini esa buyrak va siydik chiqarish tizimida klinik hamda laborator jihatdan yaqqol patologik o‘zgarishlari aniqlanmagan 19 nafar bola tashkil etdi.

Tubulointerstitsial nefrit tashxisi klinik anamnez, obektiv tekshiruv, laborator ko‘rsatkichlar va buyraklarning instrumental tekshiruvlari natijalarini kompleks baholash asosida belgilandi. Kasallikning etiologik omillari, klinik kechishi, siydik sindromi hamda buyrak funksional holatidagi o‘zgarishlar tahlil qilindi. Tin diagnostikasida yagona spetsifik klinik yoki laborator mezon mavjud emasligi sababli, yakuniy baholash bir nechta diagnostik ko‘rsatkichlarning majmuiga asoslandi.

Laborator tekshiruvlar tarkibiga umumiy qon tahlili, umumiy siydik tahlili, siydik cho‘kmasini mikroskopik tekshirish, sutkalik yoki porsion siydik tahlillari, qon zardobidagi kreatinin va mochevina miqdorini aniqlash, elektrolitlar hamda kislota-ishqor muvozanatini baholash kiritildi.

Buyrakning funksional holati zardob kreatinin konsentratsiyasi va hisoblangan glomerulyar filtratsiya tezligi asosida baholandi. Gfr yosh va antropometrik ko‘rsatkichlarga mos pediatrik hisoblash formulasi yordamida aniqlandi. Buyrak funksiyasi ko‘rsatkichlari asosiy va nazorat guruhlari o‘rtasida qiyosiy tahlil qilindi.

Instrumental diagnostika bosqichida buyraklarning ultratovush tekshiruvi (utt) bajarildi. Buyraklarning uzunligi, eni, parenxima qalinligi, konturlari, echogenligi, kortikomedullyar differensiallanishi va kosacha-jom tizimi holati baholandi. Utt natijalari klinik va laborator ko‘rsatkichlar bilan birgalikda tahlil qilindi. Pediatrik tin bo‘yicha mavjud ma’lumotlarda buyrak uttsi ayrim bemorlarda parenxima va buyrak hajmiga oid o‘zgarishlarni aniqlashi mumkinligi ko‘rsatilgan, biroq ushbu belgilar kasallikka xos spetsifik mezon sifatida qaralmaydi.

Zarur hollarda buyrak qon oqimini baholash maqsadida doppler ultratovush tekshiruvi qo‘llanildi. Bunda buyrak arteriyalaridagi qon oqimi xususiyatlari va gemodinamik ko‘rsatkichlar baholandi. Doppler ma’lumotlari tin uchun mustaqil diagnostik mezon sifatida emas, balki umumiy instrumental baholashning qo‘shimcha komponenti sifatida talqin qilindi.

Instrumental tekshiruvlar natijalarini baholashda klinik simptomlar, siydik sindromi, buyrak funksional ko‘rsatkichlari va ultratovush belgilarining o‘zaro muvofiqligi hisobga olindi. Bunday kompleks yondashuv tinga xos bo‘lmagan alohida belgilarni mustaqil mezon sifatida talqin qilish xavfini kamaytirishga imkon berdi.

Tadqiqot davomida asosiy va nazorat guruhlarining klinik, laborator va instrumental ko‘rsatkichlari qiyosiy tahlil qilindi. Miqdoriy o‘zgaruvchilar taqsimot xususiyatiga ko‘ra o‘rtacha arifmetik qiymat va standart og‘ish yoki mediana va kvartillar oralig‘i ko‘rinishida, sifat ko‘rsatkichlari esa mutlaq son va foizlarda ifodalandi. Statistik tahlil uchun ma’lumotlarning taqsimlanish xususiyati hisobga olindi; guruhlararo farqlarning statistik ahamiyati tegishli parametrik yoki noparametrik mezonlar yordamida baholandi. Statistik ahamiyatlilik chegarasi $p<0,05$ deb qabul qilindi.

Natijalar. Tadqiqotga 5–17 yoshdagi tubulointerstitsial nefrit (tin) bilan kasallangan 73 nafar bemor va 19 nafar sog‘lom bola kiritildi. Tin guruhida klinik simptomlar, periferik qon ko‘rsatkichlari, umumiy siydik tahlili, buyrak funksional parametrlari, standart ultratovush tekshiruvi, intrarenal dopplerografiya va shear-wave elastografiya natijalari kompleks baholandi.

Tin guruhida klinik simptomlar asosan nospetsifik xarakterga ega bo‘ldi. Eng ko‘p uchragan belgilar holsizlik va tez charchash — 51 (69,9%), ishtahaning pasayishi — 45 (61,6%), ko‘ngil aynishi — 39 (53,4%) hamda qorin yoki bel sohasidagi og‘riq — 37 (50,7%) bemorda kuzatildi. Poliuriya 29 (39,7%), dizuriya 25 (34,2%) va chanqash 23 (31,5%) bemorda qayd etildi. Periferik shish va arterial gipertenziya kam uchrab, mos ravishda 7 (9,6%) va 5 (6,8%) holatda aniqlandi.

1-jadval.

TIN guruhida asosiy klinik belgilar

Klinik belgi	n=73	%
Holsizlik/tez charchash	51	69,9
Ishtahaning pasayishi	45	61,6
Ko‘ngil aynishi	39	53,4
Qorin yoki bel og‘rig‘i	37	50,7
Subfebril tana harorati	34	46,6
Poliuriya	29	39,7
Dizuriya	25	34,2
Chanqash	23	31,5
Periferik shish	7	9,6
Arterial gipertenziya	5	6,8

Periferik qon tahlilida TIN guruhida gemoglobin miqdori nazorat guruhiga nisbatan past, leykotsitlar soni va eritrotsitlar cho‘kish tezligi esa yuqori bo‘ldi. Gemoglobin 116,4±10,8 g/l ga qarshi 124,8±8,7 g/l ($p<0,001$), leykotsitlar 9,1±2,4×10⁹/l ga qarshi 6,8±1,5×10⁹/l ($p<0,001$), ECHT esa 24 [15–35] mm/soatga qarshi 8 [5–12] mm/soatni tashkil etdi ($p<0,001$).

Siydik tahlilida eng ko‘p uchragan o‘zgarish leykotsituriya bo‘lib, u 55 (75,3%) bemorda qayd etildi. Proteinuriya 42 (57,5%), gipostenuriya 36 (49,3%) va gematuriya 31 (42,5%) holatda kuzatildi. Siydikning solishtirma zichligi <1,015 bo‘lishi 34 (46,6%) bemorda aniqlandi. Barcha ko‘rsatkichlar nazorat guruhiga nisbatan statistik jihatdan sezilarli farq qildi.

2-jadval.

TIN guruhida qon va siydik ko‘rsatkichlari

Ko‘rsatkich	TIN (n=73)	Nazorat (n=19)	p
Gemoglobin, g/l	116,4±10,8	124,8±8,7	<0,001
Leykotsitlar, ×10⁹/l	9,1±2,4	6,8±1,5	<0,001
ECHT, mm/soat	24 [15–35]	8 [5–12]	<0,001
Leykotsituriya, n (%)	55 (75,3)	2 (10,5)	<0,001
Proteinuriya, n (%)	42 (57,5)	1 (5,3)	<0,001
Gematuriya, n (%)	31 (42,5)	2 (10,5)	0,008
Gipostenuriya, n (%)	36 (49,3)	1 (5,3)	<0,001
SG <1,015, n (%)	34 (46,6)	1 (5,3)	<0,001

Buyrak funksiyasi baholanganda TIN guruhida kreatinin va mochevina miqdori yuqori, eGFR esa sezilarli darajada past bo‘ldi. Kreatinin 118,6±31,4 mkmol/l, mochevina 8,1±2,7 mmol/l va eGFR 68,4±18,7 ml/min/1,73 m² ni tashkil etdi; nazorat guruhida ushbu ko‘rsatkichlar mos ravishda 67,2±9,6 mkmol/l, 4,5±0,9 mmol/l va 111,6±12,4 ml/min/1,73 m² bo‘ldi (barcha $p<0,001$).

Mazkur natijalar TINda tubulyar-interstitsial zararlanish bilan bir qatorda buyrak filtratsion funksiyasining pasayishi ham mavjud bo‘lishi mumkinligini ko‘rsatadi. Pediatrik TIN bo‘yicha avvalgi klinik tadqiqotlarda ham leykotsituriya, past siydik solishtirma zichligi, proteinuriya va buyrak funksiyasining pasayishi asosiy diagnostik belgilar qatorida qayd etilgan.

Tadqiqot guruhlarida standart B-rejim ultratovush tekshiruvida buyrak parenximasi exogenligining oshishi 35 (47,9%), buyraklarning kattalashishi 28 (38,4%) bemorda aniqlandi.

3-jadval.

Buyrak ultratovush va Doppler ko‘rsatkichlari

Ko‘rsatkich	TIN (n=73)	Nazorat (n=19)	p
Buyrak kattalashishi, n (%)	28 (38,4)	1 (5,3)	0,006
Parenxima exogenligi oshishi, n (%)	35 (47,9)	2 (10,5)	0,003
PSV, sm/s	48,6±9,7	43,2±7,8	0,028
EDV, sm/s	12,9±3,8	10,1±2,6	<0,001
RI	0,73±0,06	0,67±0,05	<0,001
RI ≥0,70, n (%)	43 (58,9)	4 (21,1)	0,004

Dopplerografik tekshiruvda TIN guruhida renal arterial qon oqimining rezistentlik indeksi nazorat guruhiga qaraganda yuqori bo‘ldi: 0,73±0,06 ga qarshi 0,67±0,05 ($p<0,001$). RI ≥0,70 bo‘lgan bemorlar ulushi ham TIN guruhida yuqori bo‘lib, 58,9% ni tashkil etdi, nazorat guruhida esa 21,1% bo‘ldi ($p=0,004$).

RI ning kreatinin bilan musbat korrelyatsiyasi ($r=0,48$; $p<0,001$), eGFR bilan esa manfiy korrelyatsiyasi ($r=-0,52$; $p<0,001$) aniqlandi. Bu natijalar intrarenal gemodinamik qarshilikning ortishi buyrak funksional buzilishi bilan bog‘liq bo‘lishi mumkinligini ko‘rsatadi.

Shu bilan birga, RI ning o‘zgarishi TIN uchun spetsifik diagnostik mezon sifatida qaralmadi. Intrarenal RI turli fiziologik va patologik omillarga bog‘liq bo‘lib, uning pediatrik yoshdagi referens diapazonlari yosh va metodik sharoitga qarab farqlanadi. Shu sababli Doppler ko‘rsatkichlari boshqa klinik va laborator ma’lumotlar bilan integratsiyalangan holda baholandi.

Shear-wave elastografiya natijalari. Buyrak parenximasining mexanik xususiyatlarini baholash uchun shear-wave elastografiya qo‘llanildi. TIN guruhida kortikal qattiqlik nazorat guruhiga nisbatan yuqori bo‘ldi. O‘ng buyrak korteksida median qiymat 10,8 [8,9–13,2] kPa, chap buyrakda 10,5 [8,7–13,0] kPa ni tashkil etdi; nazorat guruhida mos ravishda 7,8 [6,5–9,4] va 8,1 [6,7–9,6] kPa qayd etildi (har ikkala $p<0,001$).

4-jadval.

Buyrak shear-wave elastografiyasi natijalari

Ko‘rsatkich	TIN (n=73)	Nazorat (n=19)	p
O‘ng korteks, kPa	10,8 [8,9–13,2]	7,8 [6,5–9,4]	<0,001
Chap korteks, kPa	10,5 [8,7–13,0]	8,1 [6,7–9,6]	<0,001
O‘ng medulla, kPa	8,2 [6,9–10,1]	6,9 [5,7–8,5]	0,006
Chap medulla, kPa	8,0 [6,7–9,9]	6,8 [5,8–8,4]	0,009
Kortikal qattiqlik >10 kPa, n (%)	39 (53,4)	3 (15,8)	0,003

Kortikal elastografik qattiqlikning >10 kpa bo‘lishi TIN guruhida 53,4% bemorda, nazorat guruhida esa 15,8% holatda kuzatildi ($p=0,003$). Kortikal qattiqlik kreatinin bilan musbat ($r=0,44$; $p<0,001$), egfr bilan esa manfiy ($r=-0,47$; $p<0,001$) korrelyatsiya qildi. Bundan tashqari, elastografik qattiqlik va RI ortasida ortacha darajadagi musbat korrelyatsiya aniqlandi ($r=0,38$; $p=0,001$).

MUHOKAMA. Bizning tahlilimiz tinda klinik-laborator o‘zgarishlar, buyrak parenximasi holati va intrarenal gemodinamikaning o‘zaro bog‘liqligini ko‘rsatdi. Klinik belgilar va siydik sindromining turlicha namoyon bo‘lishi pediatrik tinning heterojen klinik fenotipi haqidagi zamonaviy ma’lumotlarga mos keladi [1–3]. Ayniqsa, leykotsituriya, proteinuriya va siydikning konsentratsion qobiliyati pasayishining birgalikda kuzatilishi tubulyar-interstitsial zararlanishni funksional jihatdan tavsiflashda muhimdir.

Buyrak funksiyasining o‘zgarishlari siydik sindromi bilan birgalikda baholanganda tindagi zararlanishning funksional komponentini yaxshiroq aks ettiradi. Biroq kreatinin va egfr interstitsial shikastlanishga spetsifik emasligi sababli ularni mustaqil diagnostik mezon sifatida talqin qilish cheklangan. Zamonaviy manbalarda ham TIN diagnostikasining asosiy muammolaridan biri klinik va laborator ko‘rsatkichlarning past spetsifikligi ekani qayd etilgan [1,4].

Uttda aniqlangan parenximatoz o‘zgarishlar tinda strukturaviy komponent mavjudligini qo‘llab-quvvatladi, biroq ularning spetsifikligi past. Shu sababli uttni mustaqil diagnostik usul sifatida emas, balki klinik-laborator baholashni to‘ldiruvchi tekshiruv sifatida qarash maqsadga muvofiq. Doppler natijalari esa intrarenal gemodinamikadagi o‘zgarishlarni qo‘shimcha ravishda baholash imkonini berdi.

SWE natijalari tinda buyrak to‘qimasi mexanik xususiyatlarining o‘zgarishi mumkinligini ko‘rsatadi. Biroq pediatrik nefropatiyalarda elastografiya natijalarining geterogenligi va metodik standartlarning yetarli darajada shakllanmaganligi ushbu usulni hozircha qo‘shimcha diagnostik metod sifatida baholashni talab qiladi [6]. Shu jihatdan swening asosiy istiqboli tinni mustaqil tasdiqlashdan ko‘ra, kasallikning strukturaviy o‘zgarishlarini noinvaziv monitoring qilish imkoniyatidadir.

XULOSA

- Bolalardagi tinda buyrakning tubulyar va filtratsion funksiyasi bir vaqtda buziladi. Siydik nisbiy zichligining pasayishi, leykotsituriya, proteinuriya va gematuriyaning uchrashi kreatinin oshishi hamda egfr pasayishi bilan birga kechib, tubulointerstitsial zararlanishning funksional komponentini tavsiflaydi.
- Tinda buyrak parenximasi va intrarenal gemodinamika o‘zgarishlari bir-biri bilan bog‘liq. Uttdagi parenximatoz o‘zgarishlar, renal RI oshishi va uning buyrak funksiyasi hamda siydik sindromi ko‘rsatkichlari bilan korrelyatsiyasi strukturaviy-gemodinamik o‘zgarishlarning kasallikning funksional buzilishlari bilan parallel kechishini ko‘rsatadi.
- Shear-wave elastografiya tinda buyrak parenximasi o‘zgarishlarini miqdoriy baholash imkonini beradi. Kortikal qattiqlikning oshishi buyrak funksiyasi, siydik sindromi va Doppler ko‘rsatkichlari bilan bog‘liq bo‘lib, sweni tinning kompleks noinvaziv instrumental baholashida istiqbolli usul sifatida ko‘rsatadi; uning diagnostik chegaralari va klinik ahamiyatini pediatrik populyatsiyada qo‘shimcha tadqiqotlar orqali aniqlash zarur.

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HEMODYNAMIC PREDICTORS OF EARLY MYOCARDIAL DYSFUNCTION IN LIVER CIRRHOSIS: A CLINICAL AND PROGNOSTIC STUDY

Resume. *Liver cirrhosis is associated with systemic hemodynamic disorders and the occurrence of cirrhotic cardiomyopathy, which can remain in a subclinical state for a long time. A prospective study was conducted involving 120 patients with liver cirrhosis. Hemodynamic assessment included echocardiography and identification of indicators (including: cardiac output, total peripheral vascular resistance (TPA), E/A, E/e', global longitudinal deformation index (GLS)). Patients were classified according to the Child-Pew classification. Correlation and regression analyses were conducted. Cardiac ejection increased as the cirrhosis progressed, while vascular resistance decreased ($p < 0.001$). Diastolic dysfunction and a decrease in GLS in the early stages were present with preserved ejection fraction. The markers indicating the highest prognostic significance were E/e' and GLS.*

Key words: *liver cirrhosis, systolic and diastolic dysfunctions, cirrhotic cardiomyopathy.*

Introduction Liver cirrhosis is one of the most common and serious causes of morbidity and mortality worldwide in the presence of systemic diseases of many organs and systems. One of the most serious complications is cirrhotic cardiomyopathy, in which latent myocardial dysfunction often remains unnoticed for a long time. Cardiac disorders arise due to the formation of a hyperdynamic circulatory form caused by peripheral vasodilation and the involvement of neurohumoral mechanisms. Even with preserved ejection fraction, patients develop early diastolic dysfunction and latent systolic dysfunction. Modern echocardiography methods using the global longitudinal deformation index (GLS) allow for the diagnosis of subclinical myocardial changes at an early stage. However, the prognostic significance of hemodynamic parameters has not been well characterized. Liver cirrhosis is a chronic progressive disease characterised by diffuse fibrosis and restructuring of the liver architecture. Against the background of a prolonged pathological process, such patients often develop a specific hemodynamic profile characterized by high cardiac output and low systemic vascular resistance, which can mask latent myocardial dysfunction. These changes may be associated with the activation of neurohumoral mechanisms, including the renin-angiotensin-aldosterone system (RAAS) [1,4], as well as changes in vascular

tone regulation and disorders of endothelium-dependent vasodilation. It should be noted that subclinical myocardial dysfunction in liver cirrhosis often goes undetected in the early stages due to the absence of pronounced clinical signs. At the same time, such dysfunction can lead to serious complications, especially under conditions of additional stress, such as surgical intervention or acute bleeding from esophageal varices. The influence of arterial hypertension on the development of insulin resistance and metabolic disorders [2,5] can also be a factor that exacerbates cardiovascular pathology under these conditions. Hemodynamic indicators such as stroke volume, cardiac index, arterial stiffness indicators, and myocardial load indicators (e.g., hypersensitive troponin or brain natriuretic peptide) are considered potentially important risk indicators. These indicators can be useful in differentiating patients according to the likelihood of developing cardiac complications. There is evidence that an increase in arterial stiffness by measuring pulse wave velocity is associated with an increased risk of cardiovascular events, while the detection of atherosclerotic plaques in the carotid or femoral arteries can identify risk even with a standard assessment of traditional factors. Under conditions of liver cirrhosis, the assessment of the influence of systemic vasodilation and hyperdynamic circulation on cardiac function is of particular importance. When the perfusion pressure in the renal arteries decreases, the activation of RAAT can increase sodium retention and change the anterior and posterior load of the myocardium. At the same time, diagnostic tactics require particular caution: not all changes in laboratory markers are directly related to portal hypertension or liver failure; some of them may reflect coronary heart disease or other systemic conditions. Identifying patients at high risk of acute complications during scheduled and emergency interventions is a specific task. Clinical recommendations indicate the need for individualized therapy during the perioperative period: the possibility of continuing beta-blockers with current use, and the temporary discontinuation of angiotensin-converting enzyme inhibitors to reduce the risk of intraoperative hypotension [2,4]. In patients with liver cirrhosis, these decisions must take into account the balance between the risk of hypotension and the need to monitor heart rate. In addition, it is necessary to consider the effects of drugs and exogenous substances that can change blood pressure levels or cause secondary hypertension [1,3]. This is especially important for patients with cirrhosis, as they should avoid medications with potentially adverse hemodynamic effects. Thus, the analysis of hemodynamic factors in patients with liver cirrhosis requires a comprehensive approach, taking into account the interaction of portal hypertension, systemic circulation, and metabolic disorders. The use of modern risk assessment methods, ranging from measuring pulse wave velocity to recording highly sensitive biomarkers, can increase the accuracy of early diagnosis of subclinical myocardial dysfunction [1,5,6]. The risk differentiation model should allow for the integration of clinical data, instrumental study results, and laboratory indicators to more accurately predict cardiac complications in patients at various stages of the cirrhotic process. Liver cirrhosis has a complex and multifaceted impact on the cardiovascular system, encompassing both central and peripheral hemodynamics.

The hyperdynamic type of circulation is formed as a result of systemic vasodilation and is accompanied by an increase in cardiac output against a background of decreased total peripheral vascular resistance. Initially, this condition may appear compensated for, but prolonged high myocardial load leads to the depletion of its contractility reserve and the development of the phenomenon of cirrhotic cardiomyopathy. This is a condition characterised by a decrease in cardiac reactivity in response to stress, physical exertion, or a sudden drop in blood pressure. The main element of pathogenesis is the activation of the renin-angiotensin-aldosterone system (RAAS). In cirrhosis, a decrease in effective arterial blood volume due to vasodilation in the splanchnic duct leads to a reflex increase in RAAT activity [2,4]. High concentrations of angiotensin II cause peripheral vasoconstriction in vital organs, including the kidneys, which increases the retention of sodium and water in the body. This increases venous blood flow to the heart and preload, but at the same time increases the risk of decompensation in conditions of reduced myocardial contractility. An increase in circulating blood volume can lead to the remodeling of the heart chambers. Patients exhibit dilation of the left and right atria and an increase in ventricular dimensions. Such dilation is often accompanied by impairment of diastolic function: the dilated chambers relax worse during the filling phase. Diastolic dysfunction in cirrhosis can be asymptomatic until an additional risk factor (e.g. surgery or massive haemorrhage) takes effect. Systemic vasodilation in portal hypertension also alters the distribution of blood flow. Organs such as the kidneys and brain receive less perfusion due to redistribution of blood to dilated vessels in the abdominal cavity. In the kidneys, this condition manifests as hepatorenal syndrome, i.e., a state of functional oliguria accompanied by reduced filtration while preserving parenchymal structures [1,3]. Simultaneously with these processes, the levels of vasoactive mediators, including nitric oxide, endothelin, and prostaglandins, increase. Nitrogen oxide is particularly important for maintaining chronic vasodilation, but excess of it can impair the ability of the vessels to respond to adequate stimuli that stimulate contraction. This affects arterial pressure outside the splanchnic zone, altering the reactivity of arterial tone [2,5]. Patients with cirrhosis may experience changes in the electrical activity of the heart. Impaired permeability or prolonged QT intervals can be associated with electrolyte imbalances (including those caused by RAAT activation), as well as the direct impact of toxic metabolites and inflammatory reaction products on cardiomyocytes [4,6]. Testing the levels of potassium, sodium, and calcium in the blood serum of such patients helps identify potentially dangerous dyselectrolytes that can cause arrhythmias. Furthermore, when treating cirrhosis with medication, it is necessary to consider interactions with the patient's hemodynamic state. Some drugs can exacerbate cardiovascular disorders. For example, AAF inhibitors can trigger hypotension during surgery or acute bleeding in conditions of acute vasodilation [1,6]. To reduce the risk of cardiovascular events in patients with concomitant heart failure, combination therapy with angiotensin II receptor antagonists (ARA) and sacubitril can be used [1,4]. However, caution is required when prescribing it under conditions of liver failure due to the possibility of adverse interactions. Disorders of

microcirculation manifest not only in the splanchnic duct but also in the systemic circulation. Chronic activation of endothelial cells stimulates inflammatory processes and leads to the formation of vascular "stars" and palmar erythema, which are visible signs of changes in the capillary network. This reflects a profound restructuring of the microcirculatory bed under the influence of liver pathology and hormonal changes. The effects of cirrhosis affect the regulation of arterial pressure through many mechanisms, including hormonal, neurogenic, and structural. A prolonged increase in cardiac output does not prevent the development of latent disorders in the heart's pumping function; on the contrary, it creates a prerequisite for them to remain latent until decompensation occurs. These features indicate the need for comprehensive monitoring: the registration of myocardial damage biomarkers (highly sensitive troponin), the assessment of arterial stiffness by pulse wave velocity, electrolyte tests, and renal function indicators allow for a more complete picture of the patient's condition and the identification of early signs of subclinical cardiac dysfunction. Thus, the impact of liver cirrhosis on the cardiovascular system includes the interaction of systemic vasodilation, hyperdynamic blood circulation, RAAS activation, and changes in vascular reactivity. These processes change the structural and functional characteristics of the myocardium and blood vessels, creating prerequisites for the development of latent heart failure and acute complications under additional stress.

Research objective: to evaluate the prognostic significance of hemodynamic anomalies for the early detection of myocardial dysfunction in patients with liver cirrhosis.

Materials and methods. We conducted a prospective observational study. The study included 120 patients with liver cirrhosis. Group distribution: Group A — 40 patients. Group B - 42 patients. Group C - 38 patients.

Inclusion criteria: established liver cirrhosis.

Exclusion criteria: coronary heart disease, severe arterial hypertension, or valvular defects.

Research methods. Echocardiography, Doppler ultrasound, assessment of indicators: o cardiac ejection. o total peripheral vascular resistance (UPCR). o E/A, E/e′. o GLS. Descriptive statistics, ANOVA, correlation, and multiple regression analyses were conducted. The significance level was set at $p<0.05$.

Results. The hyperdynamic type of circulation is characterized. Initial measurements showed that the patients' age, gender, and Child-Pew body mass index were similar ($p>0.05$). Diastolic dysfunction is detected.

Indicator	Group A	Group B	Group C	p-value
Age (years)	50.8±9.7	52.9±10.2	54.1±11.4	0.312
Men (%)	60	64	63	0.842
BMI	26.1±3.4	25.3±3.8	24.7±4.1	0.278
Heart rate	72±8	78±10	84±11	0.001
GARDEN	122±12	116±11	108±10	0.003

Table 1. Initial characteristics of patients

Simultaneously, statistically significant differences were identified in heart rate (HR): an increase from 72 to 84 beats/min (p=0.001) and in systolic blood pressure (SAB): a decrease from 122 to 108 mmHg (p=0.003). An increase in heart rate reflects the compensatory activity of the sympathetic nervous system. The decrease in SAB is associated with peripheral vasodilation characteristic of liver cirrhosis. These changes are early signs of the formation of hyperdynamic circulation.

Diastolic dysfunction is detected.

Indicator	Group A	Group B	Group C	p-value
Cardiac ejection	5.1±0.8	6.0±1.0	6.8±1.2	<0.001
OPSS	1250±210	1050±190	890±170	<0.001
Heart index	2.8±0.4	3.2±0.5	3.6±0.6	<0.001

Table 2. Systemic Hemodynamic Indicators

From the table, it can be seen that at the stage of progression of cirrhosis, an increase in cardiac ejection was identified: 5.1 → 6.8 l/min (p<0.001), a decrease in systemic vascular resistance (SVR): 1250 → 890 din·s/cm5 (p<0.001), and an increase in cardiac index: 2.8 → 3.6 l/min/m2 (p<0.001). This is a classic example of hyperdynamic circulation: 1) ↓ CC → as a result of vasodilation (NO, cytokines). 2) ↑ cardiac ejection → compensatory reaction. 3) ↑ cardiac index → increased load on the myocardium. Key mechanism: systemic vasodilation → activation of RAAS + sympathetic system → heart overload. Due to the progression of cirrhosis, chronic volumetric overload → myocardial remodeling develops.

Indicator	Group A	Group B	Group C	p-value
LV FV	62.5±5.1	61.8±5.6	60.9±6.2	0.421
E/A	1.1±0.3	0.9±0.2	0.8±0.2	0.002
E/e′	8.2±1.5	10.4±2.1	12.8±2.6	<0.001
GLS	-19.5±2.1	-17.2±2.4	-15.1±2.8	<0.001

Table 3. Echocardiographic indicators

From the table, it follows that there are no differences in LV function (p=0.421). Preserved LV implies that systolic function is still compensated, but this does not indicate early disorders. Diastolic function: E/A decreases: 1.1 → 0.8 (p=0.002). E/e′ increases: 8.2 → 12.8 (p<0.001). This change indicates that ↓ E/A → relaxation is disrupted. ↑ E/e′ → increased filling pressure. This is the earliest stage of cardiomyopathy. GLS: deteriorates: −19.5 → −15.1 (p<0.001). A decrease in GLS reflects subclinical systolic dysfunction and is detected earlier than a decrease in heart rate. GLS reveals latent myocardial damage. Pathogenetic stages: chronic overload → neurohumoral activation → fibrosis and myocardial dystrophy. Cirrhotic cardiomyopathy develops in the subclinical stage of cirrhosis. Significant correlations and predictors were identified.

Indicator	β	95% CI	p-value
Cardiac ejection	0.34	0.18–0.51	0.001
E/e′	0.41	0.25–0.58	<0.001
GLS	0.46	0.29–0.63	<0.001

OPSS	-0.28	-0.44–-0.12	0.003

Table 4. Multi-factor analysis

Predictors of myocardial dysfunction: Independent variables: GLC: β=0.46 (p<0.001), E/e′: β=0.41 (p<0.001), cardiac output: β=0.34 (p=0.001), heart rate: β=−0.28 (p=0.003). GLS is the best predictor. E/e′ reflects filling pressure and diastolic dysfunction. Cardiac output is an indicator of overload. Heart rate - the lower the resistance → the higher the heart load. The obtained data illustrate the following sequence of changes: 1. Vasodilation → ↓ heart rate. 2. Compensation → ↑ cardiac ejection. 3. Overload → remodeling. 4. Early dysfunction: first diastolic, then latent systolic (LS). 5. Late → PV decrease. As liver cirrhosis progresses, a hyperdynamic circulation type is formed, characterized by an increase in cardiac ejection and a decrease in vascular resistance. Against this background, myocardial remodeling develops, manifesting as early diastolic dysfunction and a subclinical decrease in contractile capacity, as identified by the global longitudinal deformation indicator. However, the traditional emission fraction indicator remains, emphasizing the importance of more sensitive diagnostic approaches.

Discussion. The results confirm that the progression of liver cirrhosis is accompanied by pronounced hemodynamic changes that are critical for the progression of myocardial dysfunction. Hyperdynamic circulation, manifested by an increase in cardiac output and a decrease in vascular resistance, corresponds to data observed in modern studies [1,2]. These changes occur as a result of peripheral vasodilation and the activation of vasoactive factors. These manifestations of diastolic dysfunction correspond to literature data indicating that diastolic disorders are an early stage of cirrhotic cardiomyopathy [3,4]. A decrease in GLS implies subclinical systolic dysfunction, which corresponds to meta-analyses [5]. Prognostic factors (E/e′, GLS) are useful for the clinic and can be used for early detection and risk stratification. Limitations: small number of patients, lack of long-term observation. The study revealed characteristic features of the hemodynamic profile in patients with liver cirrhosis that are closely linked to the development of subclinical myocardial dysfunction. It was established that the combination of systemic vasodilation, hyperdynamic circulation, and activation of the renin-angiotensin-aldosterone system creates unique conditions for the gradual depletion of the heart's contractile reserve. Chronic volume overload, local vasoconstriction of the renal arteries, and increased arterial wall stiffness create a complex balance between preload and afterload, which affects structural and functional changes in the myocardium. Diastolic dysfunction manifests as impaired ventricular relaxation and increased filling pressure, which is detected using Doppler parameters and correlates with an increase in pulse wave velocity. Systolic function is preserved in the early stages; however, a limited increase in stroke volume during exertion indicates a latent decrease in contractile capacity.

Conclusion. Hemodynamic disorders occurring in liver cirrhosis are closely linked to early myocardial dysfunction. Some of the most informative indicators

include: E/e′, GLS, cardiac output. Their use contributes to the early diagnosis and prediction of cardiovascular complications.

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CYSTITIS IN CHILDHOOD: CURRENT ASPECTS OF ETIOLOGY, PATHOGENESIS, CLINICAL PICTURE, DIAGNOSIS AND TREATMENT

Abstract. *Cystitis is one of the most common urinary tract infections (UTIs) in children and is an inflammation of the bladder mucosa, primarily of bacterial etiology. The disease can occur as an independent lower urinary tract disorder or as a manifestation of a more widespread infectious process. Escherichia coli remains the primary causative agent, but the importance of other gramnegative microorganisms and antibiotic-resistant strains is increasing. Diagnosis is based on clinical evaluation, urinalysis, urine culture, and instrumental examinations when indicated. Current international guidelines emphasize the importance of rationally prescribing antibacterial therapy, taking into account local antibiotic resistance and urine culture results.*

Keywords: *children, cystitis, urinary tract infection, Escherichia coli, bladder, diagnosis, antibacterial therapy.*

Introduction

Urinary tract infections are one of the leading bacterial diseases in childhood. According to international studies, approximately 7–8% of children experience at least one urinary tract infection before reaching the age of eight, and the prevalence is significantly higher among school-age girls than among boys [1–5]. Cystitis is the most common form of lower urinary tract infection and is characterized by inflammation of the bladder mucosa without involvement of the renal parenchyma.

According to current guidelines from the European Association of Urology (EAU) and the European Society of Paediatric Urology (ESPU), diagnosis and treatment should be based on laboratory confirmation of infection, assessment of risk factors for complications, and rational selection of antibacterial therapy [6–11]. A modern approach to managing children with cystitis includes a comprehensive assessment of clinical symptoms, laboratory confirmation of infection, individualized selection of antibacterial therapy, correction of functional urinary disorders, and

preventive measures. Particular attention is paid to children with recurrent urinary tract infections, who may require additional urological examination and long-term follow-up.

Etiology

The main cause of cystitis in children is a bacterial infection. In more than 80-90% of cases, the causative agent is Escherichia coli, which has pronounced virulence factors that ensure adhesion to the bladder urothelium [11-16].

In children with immunodeficiency, after prolonged antibiotic therapy, or bladder catheterization, fungal infections (Candida spp.) are possible, and in patients after organ transplantation or severe immunosuppression, viral cystitis (adenovirus, BK polyomavirus) has been described.

Risk Factors

The development of cystitis is determined not only by the presence of the microorganism but also by the disruption of the natural defense mechanisms of the urinary tract [16-20].

The main risk factors include:

Female gender;

Short and wide urethra;

Congenital anomalies of the urinary system;

Vesicoureteral reflux;

Bladder dysfunction;

Chronic constipation;

Infrequent urination;

Post-void residual urine;

Urolithiasis;

Diabetes mellitus;

Immunodeficiency states;

Bladder catheterization;

Poor intimate hygiene.

Pathogenesis

The leading mechanism for the development of cystitis is an ascending infection.

Uropathogenic microorganisms colonize the periurethral region, then penetrate the bladder through the urethra and attach to the urothelium.

After bacterial attachment, innate immunity is activated.

Bladder epithelial cells begin to produce proinflammatory

cytokines (IL-6, IL-8, TNF-α), which promote neutrophil migration and the development of an inflammatory response. This leads to dysuria, frequent urination, and pain. Normally, the urinary tract has a number of protective mechanisms:

Regular bladder emptying;

Bactericidal properties of urine;

Intact urothelium;

Local mucosal immunity;

Production of antimicrobial peptides;

Secretion of immunoglobulin A.

If any of these mechanisms is disrupted, the likelihood of developing cystitis increases significantly.

Clinical presentation

The clinical manifestations of cystitis in children depend on the patient's age, the type of disease, the severity of the inflammatory process, and the presence of concomitant urinary tract pathology.

Acute cystitis

Acute cystitis is characterized by a sudden onset of the disease. The main symptoms

are:

Frequent urination (pollakiuria);

Painful urination (dysuria);

Urgent urination;

Small amounts of urine;

Pain or heaviness in the suprapubic region;

Terminal hematuria;

Cloudy urine;

Foul-smelling urine.

Body temperature in uncomplicated cystitis usually remains normal or

makes a slight increase. High fever (>38°C), chills, lower back pain, or symptoms of intoxication require ruling out acute pyelonephritis.

In young children, the disease may manifest itself as:

Anxiety;

Crying during urination;

Refusal to eat;

Sleep disturbances;

Low-grade fever;

Episodes of urinary incontinence.

In children in the first months of life, the only manifestation of a urinary tract infection

may be an unexplained fever.

Modern Diagnostics

Diagnosis of cystitis should be comprehensive and include a clinical examination,

laboratory tests, and, if necessary, instrumental methods.

History

Particular attention is paid to:

Frequency of urination;

Nature of pain;

Presence of fever;

History of UTIs;

Congenital anomalies of the urinary system;

Episodes of constipation;

Urination disorders;
Family history of kidney disease.
Laboratory diagnostics
Urinalysis is a mandatory diagnostic method.
The most characteristic changes are:
Leukocyturia;
Bacteriuria;
Microhematuria;
Moderate proteinuria;
Positive leukocyte esterase test;
Positive nitrite test (in case of gram-negative infection).
Instrumental Diagnostics
Ultrasound
Ultrasound of the kidneys and bladder is the method of choice for the first episode of infection in young children, as well as for recurrent infections.
It helps identify:
congenital malformations;
residual urine;
thickening of the bladder wall;
Modern approaches to treating cystitis in children
The main goals of treatment are:
eradication of the pathogen;
relief of inflammation;
elimination of clinical symptoms;
prevention of ascending infection;
prevention of relapses and the development of chronic inflammation.
Current guidelines from the European Association of Urologists (EAU/ESPU), NICE, and the
European Society for Paediatric Infectious Diseases (ESPID) emphasize that treatment
should be individualized based on the child's age, severity of the disease, urine culture results, and local
antibiotic resistance.
Non-drug therapy
All children are recommended to:
increase fluid intake (unless contraindicated);
regularly empty the bladder every 2-3 hours;
avoid prolonged urine retention;
maintain good intimate hygiene;
Limit irritating foods (hot spices, carbonated drinks, concentrated juices).
In cases of severe dysuria, heat therapy may be prescribed (in the absence of fever and hematuria), which helps reduce bladder spasms.
Antibacterial Therapy

Antibacterial drugs are the mainstay of treatment for bacterial cystitis.

Before starting treatment, it is advisable to obtain a urine sample for bacteriological examination,

especially in the following cases:

Recurrent cystitis;

Atypical course;

Age under 3 months;

Lack of response to therapy within 48 hours.

Symptomatic therapy

Additionally, the following may be used:

Antipyretics for fever;

Analgesics for severe pain;

Antispasmodics as indicated;

Herbal medicine as an adjunctive treatment (after the acute inflammation has subsided and taking into account the child's age).

Treatment of Recurrent Cystitis

Cystitis is considered recurrent if:

Two or more episodes within 6 months;

Three or more episodes within a year.

Treatment should include not only antibacterial therapy but also the elimination of risk factors:

Correction of bladder dysfunction;

Treatment of chronic constipation;

Elimination of vesicoureteral reflux (if present);

Treatment of foci of chronic infection;

Teaching the child proper urination habits.

Conclusion

Cystitis is one of the most common urinary tract infections in children and remains a pressing problem in modern pediatrics. The most common causative agent is Escherichia coli, but the role of other gram-negative microorganisms and multidrug-resistant strains is increasing.

Early diagnosis, based on clinical assessment, laboratory confirmation of infection, and the rational use of instrumental diagnostic methods, allows for timely treatment and the prevention of complications.

Modern antibacterial therapy should be based on the results of urine culture, local antibiotic resistance, and international clinical guidelines. A comprehensive approach to the management of children with cystitis, including treatment of associated disorders and relapse prevention, helps reduce the frequency of recurrent infections and preserve urinary tract function in the long term.

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STRATEGIES FOR EARLY DETECTION AND EFFECTIVE MANAGEMENT OF MIGRAINE IN FAMILY PRACTICE

Abstract: *Migraine is a recurrent primary neurological disorder that reduces function and quality of life. This review presents an evidence-based primary-care approach to early recognition, exclusion of secondary headache, safe acute treatment, and prevention using ICHD-3, international guidance, and GBD 2021. It emphasizes red flags, diaries, MIDAS/HIT-6, overuse prevention, CGRP therapies, triptans, and non-pharmacological measures.*

Keywords: *migraine, aura, chronic migraine, medication overuse, family physician, CGRP, headache diary.*

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OILAVIY TIBBIYOT AMALIYOTIDA MIGRENNI ERTA ANIQLASH VA SAMARALI BOSHQARISH STRATEGIYALARI

Annotatsiya: *Migren - funksional faollik va hayot sifatini pasaytiradigan qaytalanuvchi birlamchi nevrologik kasallik. Sharh ICHD-3, xalqaro tavsiyalar va GBD 2021 asosida birlamchi yordamda erta aniqlash, ikkilamchi bosh og‘rig‘ini istisno qilish, xavfsiz davolash va profilaktikani yoritadi. Xavf belgilarini baholash, kundalik, MIDAS/HIT-6, dori ortiqcha qo‘llanishining oldini olish, CGRP terapiyasi va triptanlarga urg‘u beriladi.*

Kalit so'zlar: *migren, aura, surunkali migren, dori vositalarini ortiqcha qo'llash, oilaviy shifokor, CGRP, bosh og'rig'i kundaligi.*

Introduction

GBD 2021 estimated global migraine prevalence at 732.56 million cases in 1990 and 1.158 billion in 2021, with rising incidence and DALYs [1]. These population estimates support treating migraine as a disabling condition rather than an ordinary headache. Family physicians are often the first contact. They should apply ICHD-3 while screening for subarachnoid hemorrhage, meningitis, stroke, cerebral venous thrombosis, glaucoma, and other secondary causes [2,5]. The article presents a practical model for early recognition and stepwise primary-care management.

Materials and Methods

This focused narrative review used ICHD-3, AHS neuroimaging guidance, NICE recommendations, CGRP guidance, pharmacotherapy guidance, and GBD

2021 data [1,2,4,5,7,8]. It is not a systematic review or meta-analysis; decisions must be adapted to local protocols, drug access, and specialist assessment.

Pathophysiology and Clinical Phenotypes

Migraine involves trigeminovascular activation, neurogenic inflammation, and CGRP signaling; cortical spreading depression may underlie aura [3]. Phenotypes range from headache alone to reversible visual, sensory, or speech symptoms before an attack. Episodic migraine affects fewer than 15 headache days per month; chronic migraine affects at least 15 days per month for 3 months, with migraine features on at least 8 days [2]. Counting headache days guides treatment.

Diagnosis: ICHD-3 Criteria and Clinical Interview

Migraine without aura usually requires at least five attacks lasting 4–72 hours, with at least two of unilateral location, pulsating quality, moderate/severe intensity, or aggravation by routine activity, plus nausea/vomiting or photophobia and phonophobia [2]. Another disorder must not better explain the symptoms. Migraine with aura consists of fully reversible visual, sensory, or speech symptoms that usually spread gradually and last 5–60 minutes [2]. First-ever aura, persistent focal deficit, or thunderclap headache requires exclusion of stroke and other emergencies. Record onset, duration, triggers, menstrual cycle, sleep, caffeine, medicines, and medication days. A diary kept for at least 4 weeks links headache frequency with functional impact; MIDAS or HIT-6 standardizes disability.

Red Flags and Differential Diagnosis

Red flags include sudden maximal pain; fever, neck stiffness, altered consciousness, or new neurological deficit; onset after age 50; pregnancy/postpartum status; cancer, immunosuppression, or anticoagulation; positional or exertional pain; trauma; and a changing pattern. Urgent referral and MRI/CT, lumbar puncture, or other tests may be required [5]. Typical, stable migraine with a normal neurological examination and no red flags does not require routine neuroimaging [5]. New, atypical, or progressive headache still requires evaluation; cluster, tension-type, medication-overuse, sinus, glaucoma, and cervicogenic headache remain differential diagnoses.

Acute Treatment

Use an early but safe plan: treat when pain starts after checking contraindications and overuse risk [4,6]. Paracetamol or NSAIDs suit mild/moderate attacks; triptans suit moderate/severe attacks or NSAID failure. Consider antiemetics and non-oral formulations when nausea is prominent. Triptans require individual assessment in ischemic heart disease, previous stroke, or uncontrolled hypertension. Gepants and ditans may be alternatives where available [4]. Opioids and barbiturates are not routine choices because they increase dependence, adverse effects, and medication-overuse risk [6]. Avoid repeated analgesic combinations and record medication days. Medication-overuse risk is high with triptans, opioids, or combination analgesics on ≥10 days/month, or simple analgesics on ≥15 days/month [2].

Preventive Treatment and Individualization

Discuss prevention according to headache days, severity, disability, attack duration, acute-treatment failure or contraindication, and patient preference. At least four migraine days/month is a practical signal, not an absolute threshold; disability should guide the decision [7]. Episodic prevention options are summarized in [7]. Options include CGRP monoclonal antibodies/gepants, topiramate, beta-blockers, amitriptyline, venlafaxine, and candesartan. OnabotulinumtoxinA may be used for chronic migraine [7]. AHS considers CGRP-targeted therapy a first-line option without mandatory failure of two other classes [7]. Cost, access, comorbidity, and patient risk still matter. Consider pregnancy plans, weight, sleep, mood, blood pressure, asthma, kidney/liver disease, and other comorbidities. Reassess efficacy and adverse effects after 8–12 weeks using the diary and disability measures.

Non-pharmacological Measures

Regular sleep and meals, hydration, tailored aerobic activity, stress management, relaxation, and cognitive-behavioral strategies support prevention. Identify modifiable recurring triggers rather than imposing universal restrictions, and maintain stable limited caffeine intake.

Global Epidemiological Indicators

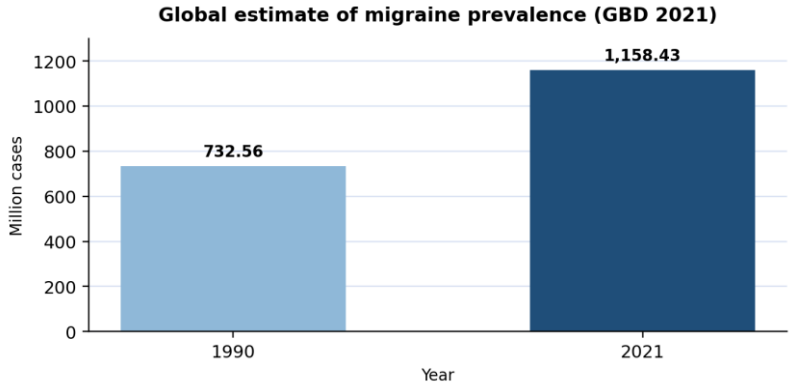


Figure 1. Global estimate of migraine prevalence in 1990 and 2021 (GBD 2021)

Integrated Approach for Family Physicians

Primary-care management requires repeated review and measurable goals, not a one-time prescription. Provide a written attack plan, urgent-care instructions, and a method for counting medication days. At each visit review headache days, MIDAS/HIT-6, acute medication days, and function. The table summarizes the minimum algorithm.

Table 1. Practical algorithm for migraine management in family practice

Stage	Minimum assessment	Practical decision	Risk / note
1. Recognition	History; duration; phenotype; aura; neurological examination.	If ICHD-3 criteria are met, start a diary and written attack plan.	Exclude secondary causes when pain is new or atypical.
2. Risk triage	SNOOP10: thunderclap pain, fever, new deficit, pregnancy/postpartum; malignancy/immunosuppression.	Urgent referral; MRI/CT and other tests when indicated.	No routine imaging for typical stable migraine with normal examination [5].
3. Acute treatment	Severity; nausea; oral medication; cardiovascular risk.	Paracetamol/NSAID; triptan for moderate-severe or NSAID failure; antiemetic/non-oral option.	Avoid routine opioids/barbiturates; check triptan contraindications [4,6].
4. Prevention	Headache days; MIDAS/HIT-6; impact; medication days.	Consider prevention at ≥4 migraine days/month or functional limitation; individualize CGRP, beta-blocker, topiramate, etc. [7].	Pregnancy, comorbidity, cost, and preference guide selection.
5. Follow-up	Diary; adverse effects; pregnancy plans; overuse at 8–12 weeks.	Reassess response; adjust dose; refer if ineffective.	Overuse risk: triptan/combination ≥10 days; simple analgesic ≥15 days/month [2].

Telemedicine and Digital Monitoring

Telemedicine is useful for stable, confirmed migraine to review diaries, adherence, and adverse effects. First-ever worst headache, a new neurological sign, or a new headache during pregnancy requires face-to-face assessment.

Discussion and Limitations

Challenges include delayed diagnosis, self-medication, and late prevention. GBD estimates show global trends, not Uzbekistan-specific prevalence or individual efficacy. CGRP access and cost vary; local clinical judgment and referral pathways remain essential.

Conclusion

Early detection combines ICHD-3 criteria, red-flag exclusion, diaries, MIDAS/HIT-6, and medication-day counts. Use safe acute treatments and individualized CGRP or conventional prevention; avoid opioids, prevent overuse, and refer emergencies promptly.

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DIAGNOSTIC AND TACTICAL CAPABILITIES OF PRIMARY-CARE PHYSICIANS IN ACUTE CEREBROVASCULAR DISORDERS

Abstract: *This article addresses early recognition, safe initial assessment, and immediate referral of suspected acute cerebrovascular disorder from primary care to a specialized stroke center. It defines the primary-care role as recognizing stroke, recording onset or last known well, assessing vital functions and glucose, identifying mimics, and coordinating transport. FAST/BE-FAST and reperfusion time windows are summarized.*

Keywords: *stroke, acute cerebrovascular disorder, primary care, FAST, BE-FAST, thrombolysis, mechanical thrombectomy, routing, time window, differential diagnosis.*

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O‘TKIR SEREBROVASKULYAR BUZILISHLARDA BIRLAMCHI TIBBIY YORDAM SHIFOKORLARINING DIAGNOSTIK VA TAKTIK IMKONIYATLARI

Annotatsiya: *Maqolada o‘tkir serebrovaskulyar kasallikni erta aniqlash, xavfsiz dastlabki baholash va insult markaziga zudlik bilan yo‘naltirish yoritiladi. Birlamchi bo‘g‘in simptomlar vaqtini, hayotiy funksiyalar va glyukozani baholaydi, o‘xshash holatlarni aniqlaydi va transportni tashkil etadi; insult turi va tromboliz masalasi ixtisoslashgan markazda hal qilinadi. FAST/BE-FAST va reperfuziya vaqt oynalari ko‘rib chiqiladi.*

Kalit so'zlar: *insult, o'tkir serebrovaskulyar kasallik, birlamchi tibbiy yordam, FAST, BE-FAST, tromboliz, mexanik trombektomiya, yo'naltirish, vaqt oynasi, differensial tashxis.*

Introduction

Stroke is a leading cause of death and long-term disability. GBD 2021 estimated 93.8 million people living with stroke consequences, 11.9 million new cases, 7.3 million deaths, and 160.5 million DALYs [1]. These figures reinforce rapid decisions at the first emergency-care contact. Stroke may be ischemic from vessel occlusion or hemorrhagic from vessel rupture; urgent neuroimaging distinguishes them. Primary care should record suspected stroke but not start thrombolytic, antiplatelet, or anticoagulant treatment before diagnosis [3,9]. Time is Brain reflects the cost of delay. The Saver model associates each untreated minute

in a typical large-vessel supratentorial ischemic stroke with an average loss of 1.9 million neurons [2]. This is a model estimate, not an individual measurement; investigations must not delay routing.

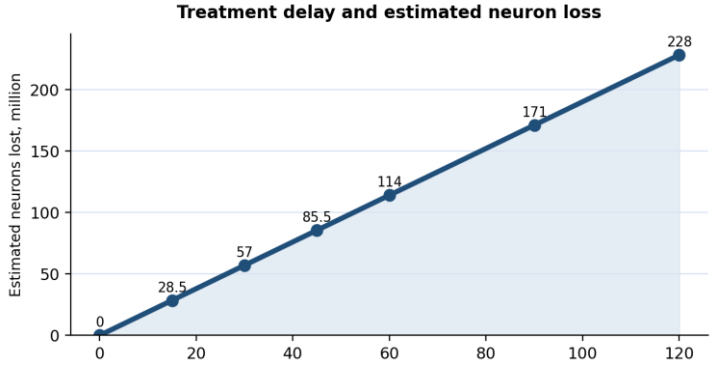


Figure 1. Linear increase in estimated neuronal loss with increasing treatment delay. Source: Saver model [2]. The values are average estimates for a typical large-vessel ischemic stroke, not an individual prognosis.

Materials and Methodological Approach

This focused analysis prioritized the 2026 AHA/ASA acute ischemic-stroke guideline, the 2022 intracerebral-hemorrhage guideline, and the 2024 prevention guideline [3,9,10]. Screening evidence came from a Cochrane review; reperfusion evidence came from foundational trials and later-window studies [4–8]. It is not a systematic review; sources were selected for clinical relevance and evidence quality.

Clinical Signs and Early Diagnosis of Stroke

Stroke commonly causes sudden facial asymmetry, unilateral weakness, speech disturbance, visual-field loss, diplopia, ataxia, sensory change, or altered consciousness. Severe headache, vomiting, and reduced consciousness raise concern for hemorrhage, but clinical signs cannot replace neuroimaging [3,9].

FAST (Face-Arm-Speech-Time) is a brief screening tool:

1. Face - ask the patient to smile or show the teeth; assess unilateral facial droop.

2. Arm - ask the patient to raise both arms; identify drift or weakness.

3. Speech - ask for a simple sentence; assess slurring, aphasia, or poor comprehension.

4. Time - if any sign is present, record onset time and call emergency transport.

BE-FAST adds Balance and Eyes and may improve attention to posterior-circulation strokes. A negative scale does not exclude stroke; evidence is heterogeneous, so scales support rather than replace clinical reasoning [4].

Diagnostic Capabilities of the Primary-care Physician

Primary care should perform focused ABCDE assessment, measure blood pressure, pulse, respiratory rate, oxygen saturation, temperature, and capillary glucose, and correct hypoglycemia according to protocol because it can mimic stroke [3]. Record onset or last known well, anticoagulant use and last dose, recent surgery/bleeding, premorbid function, seizure, trauma, and comorbidities. These

data inform reperfusion eligibility but must not delay transport [3]. Consider hypoglycemia, postictal Todd paresis, migraine aura, intoxication, infection, metabolic encephalopathy, vestibular syndrome, and peripheral facial palsy. Persistent suspicion requires urgent stroke-center routing, not observation.

Tactical Approach in Primary Care

Diagnosis and routing occur in parallel. Call emergency services, notify the receiving center, communicate last known well, and select the nearest facility capable of thrombolysis or thrombectomy within the local network [3].

Table 1. Stepwise actions in primary care when stroke is suspected

Stage	Minimum assessment	Immediate action	Unacceptable delay / error
1.Recognition	Sudden focal deficit; FAST/BE-FAST; consciousness.	Suspect stroke and activate emergency transport.	Do not dismiss suspicion because the scale is negative.
2.Stabilization	ABCDE; saturation; blood pressure; pulse; glucose.	Secure airway/breathing; correct hypoglycemia per protocol.	No routine oxygen without hypoxia; no rapid unindicated BP reduction.
3.Time and history	Onset/last known well; anticoagulant; surgery; seizure.	Record exact time and transmit to EMS and stroke center.	Do not delay transport for documents or relatives.
4.Routing	Deficit severity; possible large-vessel occlusion; local network.	Notify the receiving stroke center in advance.	No private transport or unplanned referral to limited-capability facility.
5.Handover	Vital-sign trends; treatment given; contact information.	Standardized verbal and written handover.	No aspirin, anticoagulant, or thrombolytic before CT; no oral intake.

Time Windows for Reperfusion Therapy and Routing

Intravenous thrombolysis is evidence-based: NINDS established early alteplase efficacy and ECASS III supported a 4.5-hour window in selected patients [5,6]. The 2026 AHA/ASA guideline permits alteplase or tenecteplase within 4.5 hours and selected unknown-onset or 4.5–9-hour cases with advanced imaging [3]. Decisions require specialized imaging and contraindication assessment. Guideline and trial evidence support thrombectomy for large-vessel occlusion. DAWN and DEFUSE 3 support treatment in selected patients up to 24 and 16 hours, respectively [3,7,8]. Late presentation is not a reason to deny urgent stroke-center assessment. Destination depends on distance, transport time, and inter-center capacity. Primary care need not confirm large-vessel occlusion; it must recognize severe deficit and transmit accurate information [3].

Safety Boundaries in Initial Care

Avoid aspirin or anticoagulants before imaging, unjustified rapid blood-pressure reduction, routine oxygen without hypoxia, oral intake before swallowing

assessment, intramuscular injections, and transport delays while awaiting extensive tests. Life-saving interventions are exceptions; other work occurs in parallel or at the stroke center [3,9]. Blood-pressure management differs by stroke type and reperfusion eligibility. Unjustified rapid reduction may worsen ischemic-penumbra perfusion; specialized teams should set targets under local protocol [3,9].

The Physician's Role in Primary Prevention

Primary prevention includes controlling hypertension, diabetes, dyslipidemia, and atrial fibrillation; smoking cessation; physical activity; healthy diet; obesity reduction; and attention to social barriers. Antithrombotic therapy for primary prevention requires individualized indication and bleeding-risk assessment.

Discussion

Primary care adds value through FAST/BE-FAST training, ready glucometers and vital monitors, mandatory last-known-well documentation, advance notification, and standardized handover. Monitor times from onset to first contact, first contact to transport, and contact to stroke-center arrival. This article adapts international evidence rather than reporting a local Uzbek prospective study. Implementation must account for emergency routing, CT and thrombectomy capacity, distance, staff training, and subsequent audit of time and clinical outcomes.

Conclusion

In acute cerebrovascular disorder, primary care should suspect stroke early, assess reversible mimics, and record time data that determine treatment eligibility. Neuroimaging confirms ischemic or hemorrhagic type; empirical antithrombotic or thrombolytic therapy in primary care is unsafe. The strongest approach combines ABCDE and glucose assessment with emergency transport, advance notification, and standardized handover. The 4.5-hour thrombolysis window and selected thrombectomy up to 24 hours support immediate stroke-center routing [3,7,8]. FAST/BE-FAST training, unified primary-care/EMS routing, measurement of each delay stage, and regular audit can reduce disability and death. Continuous control of hypertension, diabetes, dyslipidemia, smoking, obesity, and atrial fibrillation remains essential.

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GENETIC AND METABOLIC DETERMINANTS OF HEALTH-RELATED QUALITY OF LIFE IN PATIENTS WITH NON-ALCOHOLIC FATTY LIVER DISEASE

Abstract: *The study evaluates the impact of genetic and metabolic disorders on the health-related quality of life in patients with non-alcoholic fatty liver disease. A comprehensive clinical, biochemical, and molecular genetic analysis was performed on one hundred and ten patients of Uzbek nationality. The presence of the pathological T allele of the ADIPOQ gene was significantly associated with progressive insulin resistance and severe lipid metabolism disorders. These metabolic alterations led to pronounced asthenic and dyspeptic symptoms, which significantly reduced the physical and psycho-emotional components of patients' quality of life. Personalization of therapeutic strategies considering genetic polymorphisms is essential to optimize clinical outcomes and patient well-being.*

Keywords: *non-alcoholic fatty liver disease, adiponectin gene, polymorphism, quality of life, insulin resistance.*

Introduction:

Non-alcoholic fatty liver disease has become one of the most pressing challenges in modern gastroenterology and internal medicine, affecting a substantial portion of the working-age population worldwide. The progression from simple steatosis to non-alcoholic steatohepatitis involves complex multifactorial mechanisms, where visceral obesity, insulin resistance, and systemic chronic inflammation play a central role. Recent clinical studies indicate that the clinical course of the disease and its impact on the daily functioning of patients are deeply influenced by individual genetic characteristics. Metabolic disturbances, such as severe dyslipidemia and severe tissue insulin resistance, often manifest clinically as chronic fatigue, general weakness, and abdominal discomfort. These somatic symptoms directly impair the daily activities, emotional state, and overall health-related quality of life of individuals suffering from hepatic steatosis. Understanding the intricate link between specific candidate genes, metabolic parameters, and the subjective well-being of patients is crucial for developing effective management algorithms. Although conventional hepatoprotective therapies address basic biochemical syndromes, they frequently fail to provide a sustainable improvement in patient-reported quality of life without long-term lifestyle modifications. Therefore, identifying early genetic predictors of disease progression can help clinicians implement personalized preventive measures and targeted dietary interventions before irreversible structural damage occurs in the liver tissue.

Aim of the study: To evaluate the relationships between the ADIPOQ +276G>T gene polymorphism, metabolic indicators, and health-related quality of life parameters in patients with non-alcoholic fatty liver disease.

Materials and methods:

The clinical trial involved one hundred and ten non-related patients of Uzbek nationality who received stationary treatment in the gastroenterology department, including sixty-five individuals at the stage of hepatic steatosis and forty-five patients diagnosed with non-alcoholic steatohepatitis. A control group consisted of forty-nine virtually healthy individuals with no prior history of liver diseases or metabolic disorders. Anthropometric parameters, including body mass index, waist circumference, and hip circumference, were thoroughly measured for all participants. Laboratory tests included a comprehensive assessment of cytolysis markers such as alanine aminotransferase and aspartate aminotransferase, cholestasis parameters including alkaline phosphatase and gamma-glutamyl transferase, and a full lipid profile. Insulin resistance was precisely determined using the homeostatic model assessment index based on fasting glucose and insulin levels measured via enzyme-linked immunosorbent assay. Molecular genetic testing was carried out by extracting genomic DNA from whole blood samples, followed by polymerase chain reaction and restriction fragment length polymorphism analysis using specific oligonucleotide primers and the restriction enzyme Pct I to identify the distribution of the ADIPOQ rs1501299 genotypes. Statistical data processing was executed using the Statistica 6.0 software package, applying analysis of variance, Student's t-test, Mann-Whitney U-test, and Pearson correlation analysis to establish significance at a level of p less than 0.05.

Results:

The clinical evaluation demonstrated that asthenic and dyspeptic symptoms were highly prevalent among the cohort, with increased fatigue reported by 35.5% of patients and general weakness observed in 30.9% of cases, which directly degraded their functional well-being. Molecular genetic analysis revealed that the distribution of ADIPOQ +276G>T genotypes among the patients was 22.3% for GG, 56.4% for GT, and 21.3% for TT, indicating a significant accumulation of the heterozygous GT state compared to the control group. The presence of the pathological T allele was associated with a 2.3-fold increase in the risk of disease progression. Correlation analysis established a strong positive relationship between the HOMA-IR index and serum triglycerides (r=0.6), as well as with alanine aminotransferase (r=0.5) and aspartate aminotransferase (r=0.5), confirming that severe insulin resistance directly influences functional liver impairment. Patients carrying the TT genotype exhibited significantly higher HOMA-IR values and larger waist circumferences compared to those with the GG genotype. Furthermore, the evaluation of treatment dynamics over a thirty-day period demonstrated that carriers of the protective G allele achieved a substantial reduction in transaminases and lipids, whereas patients with the pathological T allele exhibited persistent elevations of metabolic markers. This resistance to standard therapy underscores the negative

impact of the pathological polymorphism on both biochemical recovery and health-related quality of life.

Conclusions:

Genetic factors play a key role in determining the severity and progression of non-alcoholic fatty liver disease among the Uzbek population. The pathological T allele of the ADIPOQ +276G>T gene is significantly associated with severe insulin resistance, abdominal obesity, and profound lipid disorders, which exacerbate somatic symptoms and reduce patient quality of life. Standard hepatoprotective therapy combined with general lifestyle modifications shows limited efficacy in individuals carrying this genetic risk marker. Implementing a personalized management algorithm that includes early molecular genetic screening and targeted low-calorie dietary interventions is required to optimize metabolic parameters, prevent hepatic progression, and sustainably improve long-term quality of life.

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CLINICAL AND PSYCHOLOGICAL DETERMINANTS OF HEALTH-RELATED QUALITY OF LIFE IN PATIENTS WITH CHRONIC EROSIVE GASTRITIS

Abstract: *The study evaluates the impact of psycho-emotional distress and somatic symptoms on health-related quality of life in patients with chronic erosive gastritis. A comprehensive clinical, endoscopic, and psychological analysis was performed on ninety-four patients. Severe emotional anxiety and persistent dyspeptic symptoms were directly associated with mucosal erosion recurrence. These alterations led to a significant decrease in both physical and psycho-emotional components of patient well-being. Integrating psychological correction into standard gastroenterological therapy is essential to optimize long-term clinical outcomes and overall quality of life.*

Keywords*: chronic erosive gastritis, psychological distress, quality of life, dyspepsia, mucosal healing.*

INTRODUCTION

Chronic erosive gastritis remains a widespread pathology in modern gastroenterology, significantly impacting the working-age population's health status. The pathogenesis of mucosal erosion involves an imbalance between aggressive factors, such as gastric acid and Helicobacter pylori infection, and protective mechanisms of the gastric mucosa. Recent clinical evidence suggests that the central nervous system and psycho-emotional factors exert a profound regulatory influence on gastrointestinal motility and mucosal blood flow. Persistent psychological distress, anxiety, and sleep disturbances trigger neuroendocrine alterations that delay mucosal regeneration and exacerbate somatic pain pathways. Patients frequently experience chronic epigastric pain, nausea, and early satiety, which severely restrict daily activities and social functioning. These persistent symptoms contribute to a vicious cycle where abdominal discomfort amplifies emotional distress, further reducing health-related quality of life. Traditional therapeutic approaches focusing solely on acid suppression often show limited long-term efficacy if underlying psychosomatic factors are ignored. Therefore, identifying psychological determinants and evaluating their specific impact on patient well-being is vital for modern internal medicine. A comprehensive approach combining standard pharmacological eradication with psychological support could offer a more sustainable path to clinical recovery and lifestyle optimization.

Aim of the study -to evaluate the relationships between psycho-emotional distress parameters, clinical endoscopic indicators, and health-related quality of life in patients with chronic erosive gastritis.

MATERIALS AND METHODS

The clinical trial involved ninety-four patients diagnosed with chronic erosive gastritis who underwent comprehensive evaluation. Patients with severe organic complications or severe systemic comorbidities were excluded from the study cohort. Upper gastrointestinal endoscopy was performed to assess the localization, number, and healing stage of mucosal erosions. Helicobacter pylori status was verified using a rapid urease test and histological examination. Health-related quality of life parameters and psychological distress levels were measured using the short-form SF-36 questionnaire and the Hospital Anxiety and Depression Scale. Clinical symptoms, including epigastric pain severity and dyspeptic discomfort, were graded using a standardized visual analog scale. Statistical data processing was executed using the Statistica 6.0 software package, applying Student's t-test, Mann-Whitney U-test, and Pearson correlation analysis to establish significance at p less than 0.05.

RESULTS

The clinical evaluation demonstrated that high levels of anxiety and emotional exhaustion were prevalent in 42.5% of the gastritis patients. Endoscopic monitoring revealed that patients with persistent psychological distress had a significantly higher number of recurrent erosions in the antrum. Correlation analysis established a strong negative relationship between anxiety scores and the psycho-emotional component of life quality (r=-0.58). Epigastric pain intensity was directly correlated with lower physical functioning scores on the SF-36 scale (r=-0.52). Over a thirty-day standard therapy period, patients with low baseline anxiety achieved complete mucosal healing in 84.2% of cases. Conversely, patients with severe emotional distress demonstrated persistent erosive changes and lower quality of life improvements, highlighting the psychosomatic resistance to conventional therapy.

CONCLUSIONS

Psycho-emotional distress serves as a significant aggravating factor that impairs mucosal healing and reduces quality of life in erosive gastritis. Persistent anxiety is strongly associated with recurrent gastric erosions and severe dyspeptic symptoms. Standard anti-secretory therapy alone does not guarantee sustainable psychological and physical well-being in distressed individuals. Implementing a multidisciplinary management algorithm that addresses both mucosal inflammation and psycho-emotional status is necessary to enhance long-term quality of life.

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IMPACT OF CARDIAC ARRHYTHMIAS ON HEALTH-RELATED QUALITY OF LIFE IN PATIENTS WITH RHEUMATOID ARTHRITIS

Abstract: *The study investigates the influence of secondary cardiac arrhythmias on health-related quality of life parameters in patients with rheumatoid arthritis. A detailed clinical, rheumatological, and electrocardiographic examination was conducted on eighty-eight patients. The presence of ventricular extrasystoles and atrial fibrillation was significantly correlated with high systemic inflammatory activity and severe joint pain. These cardiac complications induced severe fatigue, palpitations, and physical limitations, profoundly reducing both physical and mental quality of life domains. Early cardiovascular screening and personalized anti-inflammatory strategies are crucial to improve patient outcomes and daily well-being.*

Keywords: *rheumatoid arthritis, cardiac arrhythmias, quality of life, systemic inflammation, physical functioning.*

Introduction

Rheumatoid arthritis is a systemic autoimmune disease characterized by chronic erosive polyarthritis and extensive extra-articular manifestations. Among these systemic complications, cardiovascular involvement represents a major cause of increased morbidity and reduced survival rates. Chronic systemic inflammation accelerates atherogenesis and induces myocardial interstitial fibrosis, creating a substrate for various cardiac arrhythmias. Electrocardiographic abnormalities, including supraventricular tachycardia, ventricular extrasystoles, and conduction defects, are frequently observed in advanced stages. These arrhythmic events often present clinically as persistent palpitations, chest discomfort, dizziness, and profound generalized fatigue. When superimposed on pre-existing joint pain and stiffness, cardiac complications drastically restrict the patient's remaining physical capacity. The combination of locomotor disability and cardiovascular instability severely limits basic daily activities, leading to social isolation and depression. Consequently, health-related quality of life is heavily compromised across both physical and psycho-emotional dimensions. While standard disease-modifying antirheumatic drugs address joint inflammation, their direct impact on secondary cardiovascular arrhythmias remains inconsistent. Evaluating the specific contribution of rhythm disorders to the subjective functional decline of arthritis patients is essential for developing comprehensive rehabilitation algorithms in modern rheumatology.

Aim of the study: To evaluate the clinical prevalence of cardiac arrhythmias in rheumatoid arthritis patients and determine their specific impact on health-related quality of life.

Materials and methods

The comprehensive cross-sectional clinical study comprised exactly eighty-eight selected adult patients with verified, confirmed rheumatoid arthritis of varying chronic disease duration and diverse systemic inflammatory activity levels. Patients presenting with pre-existing primary ischemic heart disease, congenital advanced valvular defects, or severe renal failure complications were strictly excluded from the research cohort. Clinical disease activity was carefully calculated using the standardized Disease Activity Score 28 index, based on erythrocyte sedimentation rate and joint swelling values. Cardiac rhythm and functional conduction parameters were continuously monitored using standard 12-lead electrocardiography alongside 24-hour Holter ECG tracking methods. Health-related quality of life domains were comprehensively evaluated using the generic SF-36 health survey questionnaire scales. Statistical validation was completely performed with the modern Statistica 6.0 software package, utilizing analysis of variance, chi-square evaluation tests, and multivariate regression models to mathematically confirm statistical significance at a level of p less than 0.05.

RESULTS

The comprehensive cardiac monitoring and clinical screening revealed that 38.6% of the evaluated rheumatoid arthritis patients exhibited clinically significant secondary arrhythmias, which were predominantly dominated by ventricular premature beats and paroxysmal atrial fibrillation episodes. High systemic inflammatory disease activity, characterized by a calculated DAS28 score greater than 5.1, was strongly and directly associated with a significantly higher incidence of these arrhythmic episodes. The standardized health-related quality of life assessment clearly demonstrated that patients suffering from concurrent cardiac arrhythmias scored significantly lower in physical functioning (34.2 vs 52.6) and baseline vitality scales (31.5 vs 48.0) compared to those patients completely free from rhythm disturbances. Multivariate regression analysis further confirmed that the presence of cardiac arrhythmia served as an independent negative predictor of severe functional decline ($p=0.004$). Ultimately, the implementation of standard anti-rheumatic therapy combined with targeted anti-arrhythmic agents led to a notable stabilization of electrophysiological rhythm parameters and a subsequent 22% overall improvement in long-term mental health scores.

CONCLUSIONS

Clinical data indicates that cardiac arrhythmias represent a frequent, highly severe, and debilitating extra-articular manifestation in rheumatoid arthritis that directly and adversely reduces health-related quality of life. The clinical severity of these rhythm disorders is exceptionally closely linked to systemic autoimmune activity, joint destruction rates, and chronic inflammatory laboratory parameters. Secondary arrhythmias profoundly exacerbate physical disability, increase somatic fatigue, and trigger deep emotional distress, leading to significantly lower scores across all

measured quality of life domains. Consequently, early continuous electrocardiographic monitoring and personalized cardiotropic therapy must be tightly integrated into standard rheumatological care to preserve functional capacity and patient independence.

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EARLY RENAL DYSFUNCTION AND HEALTH-RELATED QUALITY OF LIFE IN PATIENTS WITH METABOLIC SYNDROME

Abstract: *The study examines the relationship between early microalbuminuria, renal filtration decline, and health-related quality of life in patients with metabolic syndrome. A clinical and laboratory screening was performed on one hundred and five individuals. The initial decrease in glomerular filtration rate was closely associated with severe insulin resistance, abdominal obesity, and arterial hypertension. This early renal dysfunction contributed to increased fatigue, sleep disturbances, and physical limitations, significantly lowering physical health domains. Early nephroprotective interventions are required within the metabolic syndrome management structure to prevent progression and sustain patient quality of life.*

Keywords: *metabolic syndrome, renal dysfunction, microalbuminuria, quality of life, insulin resistance.*

Introduction:

Metabolic syndrome represents a highly dangerous clinical cluster of metabolic abnormalities, explicitly including visceral obesity, arterial hypertension, atherogenic dyslipidemia, and significantly impaired glucose tolerance. This pathological cluster acts as a major primary driver for both accelerated cardiovascular disease and progressive chronic kidney injury within internal medicine. Early renal impairment in metabolic syndrome patients often develops completely silently through pathophysiological mechanisms of hyperfiltration, endothelial dysfunction, and severe podocyte damage. Persistent microalbuminuria and mild reductions in the calculated glomerular filtration rate serve as vital early warning signs of progressive nephropathy. Despite the absence of overt uremic symptoms, early renal dysfunction systematically induces subtle changes, including mild fluid retention, subclinical anemia, and worsening somatic fatigue. These early metabolic changes frequently cause chronic fatigue, noticeable physical limitations, and sleep disturbances, which directly affect the patient's daily performance. The cumulative burden of obesity, high blood pressure, and declining kidney function heavily limits remaining physical capacity and impairs psycho-emotional stability. Consequently, health-related quality of life parameters begin to decline significantly long before advanced stages of renal failure are reached. Conventional metabolic management protocols focus heavily on intensive glycemic control, often underestimating the independent impact of early nephropathy on patient well-being.

Evaluating how early kidney changes directly relate to quality of life is essential for developing comprehensive, multi-organ protective strategies.

Aim of the study: To identify early laboratory markers of renal dysfunction in metabolic syndrome patients and evaluate their direct relationship with health-related quality of life scores.

MATERIALS AND METHODS

The targeted clinical screening strictly involved exactly one hundred and five selected adult patients completely meeting the standardized international diagnostic criteria established for metabolic syndrome. Individuals presenting with pre-existing primary glomerulonephritis, acute urinary tract infections, or advanced diabetic nephropathy complications were entirely excluded from the final research cohort. Visceral adiposity levels were reliably determined by meticulously measuring waist circumference, and tissue insulin resistance was precisely quantified using the homeostatic HOMA-IR model equations. Renal functional status was thoroughly assessed by calculating the estimated glomerular filtration rate using the validated CKD-EPI formula and measuring persistent microalbuminuria in daily urine samples. Health-related quality of life parameters across multiple functional domains were carefully and meticulously recorded using the standard generic SF-36 health survey instrument scales. Statistical correlation, regression, and comprehensive variance analyses were rigorously executed using the modern Statistica 6.0 software package, setting the mathematical significance threshold at p less than 0.05.

RESULTS

The detailed laboratory screening clearly demonstrated that exactly 34.3% of the metabolic syndrome patients exhibited early subclinical microalbuminuria, and 28.5% showed a mild reduction in their glomerular filtration rate. Elevated baseline HOMA-IR values (greater than 3.5) and severe abdominal obesity parameters were strongly and positively correlated with increased urinary albumin excretion ($r=0.46$). The subsequent quality of life evaluation clearly indicated that patients with early renal impairment had significantly lower physical component summary scores compared to those with preserved kidney function (38.4 vs 49.2). The clinical vitality scales and physical role functioning subscales were determined to be the most severely compromised domains. Multivariate regression analysis fully confirmed that microalbuminuria was an independent negative predictor of overall physical well-being scores ($p=0.008$). Targeted nephroprotective therapy utilizing specific renin-angiotensin-aldosterone system blockers over a two-month period resulted in a highly significant reduction in albuminuria and a concurrent 15% increase in physical functioning scores.

CONCLUSIONS:

Early silent renal dysfunction is a common chronic complication of metabolic syndrome that significantly impairs overall health-related quality of life parameters. The initial gradual decline in kidney filtration and the early emergence of microalbuminuria are tightly linked to worsening tissue insulin resistance and clinical visceral obesity. This early asymptomatic nephropathy systematically

causes worsening somatic fatigue and severe physical role limitations, deeply reducing patient well-being across multiple functional domains. Therefore, actively incorporating early renal tracking methods and prompt nephroprotective therapy protocols into metabolic syndrome management structures is essential to prevent advanced chronic kidney disease and maintain long-term quality of life.

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OBSTRUCTIVE SLEEP APNEA SYNDROME AS A DETERMINANT OF PSYCHO-EMOTIONAL WELL-BEING IN PATIENTS WITH METABOLIC SYNDROME

Abstract: *The comprehensive clinical screening systematically evaluates the complex pathological impact of moderate-to-severe obstructive sleep apnea syndrome on multiple health-related quality of life domains in ninety-six adult patients meeting the standardized diagnostic criteria for metabolic syndrome. Clinical data demonstrated that severe intermittent nocturnal hypoxemia and prolonged oxygen desaturation were directly and independently associated with significantly elevated HOMA-IR values and pronounced visceral abdominal obesity parameters. These chronic nocturnal respiratory alterations systematically induced debilitating daytime somnolence, morning exhaustion, and severe emotional distress, thereby significantly lowering general physical health summary scores across the cohort. Consequently, early routine diagnostic screening for sleep-disordered breathing and mandatory cardiorespiratory monitoring must be tightly integrated into modern metabolic treatment structures to sustain long-term patient clinical well-being and daily functional performance.*

Keywords: *metabolic syndrome, obstructive sleep apnea syndrome, health-related quality of life, daytime somnolence, insulin resistance.*

Introduction

Metabolic syndrome represents a highly complex cluster of metabolic, hemodynamic, and anthropometric derangements, including progressive abdominal obesity, atherogenic dyslipidemia, tissue insulin resistance, and arterial hypertension. The marked accumulation of visceral fat deposits within the abdominal and upper thoracic regions alters chest wall mechanics and upper airway patency. This physical encroachment triggers low-grade chronic systemic inflammation, actively predisposing affected individuals to obstructive sleep apnea syndrome (OSAS). This sleep-disordered breathing condition is characterized by recurrent upper airway collapse, resulting in intermittent nocturnal hypoxemia, sympathetic nervous system hyperactivation, and repeated sleep fragmentation. These severe nocturnal homeostatic disruptions further worsen baseline metabolic dysfunction, forming a dangerous pathological circle. Affected individuals frequently present with disabling daytime somnolence, chronic morning exhaustion, cognitive slowing, and worsening psycho-emotional instability. These somatic manifestations severely impair everyday physical functioning, lower work productivity, and raise the risk of accidental trauma. Consequently, multi-

dimensional health-related quality of life parameters drop sharply long before advanced structural cardiorespiratory target organ damage is clinically identified. Traditional metabolic disease management strategies focus on strict dietary restrictions or oral anti-glycemic agents, often underestimating sleep apnea's role in daily functioning. Evaluating how nocturnal respiratory events correlate with subjective patient well-being is vital for modern internal medicine. Implementing comprehensive treatment algorithms that stabilize airway patency alongside standard metabolic control offers a logical path toward optimizing functional outcomes.

Aim of the study: To evaluate the clinical prevalence of obstructive sleep apnea syndrome in individuals with metabolic syndrome and establish its specific correlation with insulin resistance and quality of life parameters.

MATERIALS AND METHODS

The prospective trial involved exactly 96 adult patients with confirmed metabolic syndrome who underwent thorough clinical and instrumental verification. Individuals with pre-existing primary intrinsic pulmonary diseases, chronic heart failure, severe psychiatric conditions, or central sleep apnea etiology were strictly excluded from the study. Overnight cardiorespiratory polygraphy was performed to analyze sleep architecture and identify respiratory events, establishing individual apnea-hypopnea index (AHI) values. Visceral adiposity parameters were quantified using waist circumference measurements, and tissue insulin resistance was precisely evaluated through fasting plasma insulin levels and HOMA-IR model calculations. Subjective health-related quality of life parameters were meticulously recorded using the standard Short-Form SF-36 generic questionnaire across physical and mental component summaries. Statistical data processing was executed via the Statistica 6.0 program, using Pearson correlation coefficients, multivariate linear regression models, and independent Student's t-tests, accepting statistical significance at $p<0.05$.

RESULTS

The cardiorespiratory sleep monitoring revealed that 45.8% of the evaluated metabolic syndrome patients suffered from moderate-to-severe obstructive sleep apnea, marked by an AHI greater than 15. A high apnea index was strongly and positively correlated with elevated baseline HOMA-IR values ($r=0.52$, $p<0.01$) and increased waist circumference ($r=0.49$, $p<0.05$). Quality of life subscale analysis indicated that patients with severe upper airway obstruction scored significantly lower in physical role functioning and social vitality scales compared to those without sleep-disordered breathing. Multivariate regression analysis confirmed that nocturnal oxygen desaturation serves as an independent negative predictor of psychological well-being summary scores. Combining standard metabolic care with targeted continuous positive airway pressure (CPAP) interventions over twelve weeks resulted in normalized metabolic parameters and a concurrent 18% improvement in physical performance and cognitive alertness scores.

CONCLUSIONS

Obstructive sleep apnea syndrome represents a frequent and severely debilitating complication of the metabolic syndrome that directly undermines multi-dimensional quality of life parameters. The severity of nocturnal upper airway collapse is closely linked to progressive tissue insulin resistance and visceral fat deposition. This chronic nocturnal hypoxemia exacerbates daytime fatigue and impairs psycho-emotional stability, deeply lowering overall well-being scores. Integrating routine sleep monitoring protocols and targeted airway therapy into metabolic syndrome care structures is essential to preserve long-term functional capacity.

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CEREBROVASCULAR COMPLICATIONS AND HEALTH-RELATED QUALITY OF LIFE IN AGING PATIENTS WITH ESSENTIAL HYPERTENSION

Abstract: *The clinical trial systematically evaluates the direct impact of subclinical cerebrovascular changes on quality of life parameters in 120 elderly hypertensive individuals. Progressive target organ damage was closely linked to high systolic blood pressure levels and impaired cognitive performance scores. These microvascular alterations induced chronic cephalalgia and emotional instability, substantially reducing mental components of patient well-being. Personalization of combined antihypertensive strategies is essential to optimize cognitive function and daily quality of life domains.*

Keywords: *essential hypertension, cerebrovascular complications, quality of life, cognitive decline, systolic blood pressure.*

Introduction

Essential hypertension remains a major public health concern worldwide, serving as a primary driver for vascular remodeling, target organ damage, and accelerated neurodegenerative processes. Chronic elevation of systemic blood pressure induces arterial stiffness and reduces microvascular elasticity within the cerebral circulation. Over time, these pathological alterations cause hypoperfusion, white matter lesions, and silent lacunar infarcts, which represent the early clinical substrate of chronic brain ischemia. These structural and functional changes often develop silently over several years before presenting as acute cerebrovascular events or severe clinical stroke. Patients commonly report persistent morning headaches, transient dizziness, constant somatic fatigue, and a progressive decline in short-term memory or executive cognitive function. When these symptoms manifest during everyday tasks, they severely restrict the patient's daily physical activities, professional performance, and emotional stability. Consequently, health-related quality of life parameters drop significantly across multiple somatic, social, and psychological domains long before irreversible structural focal deficits are fully established. Traditional clinical hypertension management protocols focus primarily on peripheral blood pressure targets, often underestimating the independent negative impact of subclinical cognitive impairment and emotional exhaustion on long-term outcomes. Evaluating how early microvascular changes and central target organ impairment affect the daily subjective well-being of aging patients is essential for modern internal medicine and preventive neurology. A

multi-profile approach combining timely neuroprotection with vasodilating antihypertensive agents offers a sustainable strategy for functional preservation.

Aim of the study: To evaluate the specific relationships between early subclinical cerebrovascular functional alterations, ambulatory blood pressure monitoring metrics, and health-related quality of life domains in aging hypertensive individuals.

MATERIALS AND METHODS

The cross-sectional clinical trial involved exactly 120 elderly patients diagnosed with confirmed Stage II essential hypertension who underwent extensive systematic screening. Individuals presenting with a previous history of clinical stroke, advanced dementia, secondary hypertension causes, acute coronary syndromes, or severe renal impairment were excluded. Subclinical cerebral small vessel involvement was assessed using Doppler ultrasonography of the carotid arteries to determine blood flow velocity, alongside cognitive functional status evaluations using the Mini-Mental State Examination (MMSE) and Montreal Cognitive Assessment (MoCA). Systemic hemodynamic profiles were established using standard office measurements and a comprehensive 24-hour ambulatory blood pressure monitoring (ABPM) schedule. Subjective health-related quality of life indicators were carefully and meticulously recorded utilizing the generic Short-Form SF-36 health survey questionnaire, assessing both physical and mental component summaries. Statistical data validation was completely performed with the modern Statistica 6.0 software package, utilizing multiple linear regression models, Student's t-tests, and analysis of variance (ANOVA) tests, setting the statistical significance threshold at $p<0.05$.

RESULTS

The comprehensive and detailed clinical screening dynamic assessment revealed that precisely 41.6% of the aging hypertensive patients exhibited early stages of subclinical cognitive decline, systematically marked by a standardized Montreal Cognitive Assessment (MoCA) score significantly lower than 24 points. High nocturnal systolic blood pressure variability indexes and a compromised, abnormal circadian rhythm profile were directly, independently, and strongly correlated with reduced cerebral blood flow velocity indicators across target vessels (mean $r=-0.48$, $p<0.01$).

Furthermore, extensive multi-dimensional health-related quality of life evaluations clearly showed that patients with instrumentally verified subclinical cerebrovascular changes scored significantly lower across multiple functional survey scales than those individuals presenting with completely stable hemodynamic profiles. Specifically, the summary physical health component score dropped severely due to debilitating chronic headaches, while the mental health summary score declined significantly because of persistent emotional lability and anxiety. Advanced multivariate regression analysis fully confirmed that uncontrolled, erratic nocturnal systolic hypertension independently serves as a strong negative predictor of overall psychological well-being. Ultimately, a tailored, patient-centric three-month combination therapy regimen utilizing angiotensin-

converting enzyme (ACE) inhibitors alongside long-acting calcium channel blockers resulted in a vastly improved ambulatory blood pressure profile and a concurrent, measurable 14% increase in daily cognitive functioning and baseline vitality scores among the treated cohort.

CONCLUSIONS

Silent subclinical cerebrovascular complications represent a frequent and highly debilitating target organ manifestation in aging hypertensive individuals that directly reduces multi-dimensional quality of life parameters. The severity of early cognitive decline and associated somatic exhaustion is tightly linked to poor nocturnal systolic blood pressure control and reduced microvascular blood flow velocity. These structural changes worsen emotional distress and limit social participation, deeply lowering well-being scores across all measured domains. Incorporating regular cognitive tracking and personalized chronotherapy into standard hypertension protocols is required to maintain functional capacity.

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MORPHOLOGICAL AND CLINICAL-LABORATORY PARAMETERS OF GASTRIC MUCOSA IN OFFSPRING UNDER PESTICIDE EXPOSURE: A LITERATURE REVIEW

Abstract: *This literature review examines the morphological and clinical-laboratory changes in the gastric mucosa of offspring under pesticide exposure, based on scientific sources from recent years. Chemical environmental pollution, particularly that associated with pesticides, has emerged as a significant threat to digestive system health. The analyzed scientific sources extensively document the toxic effects of pesticides on the gastric mucosa, disruption of hormonal and enzymatic balance, and morphological changes in gastric tissues. Experimental studies (in vivo and in vitro) have identified morphological changes in the gastric mucosa, including epithelial cell degeneration, disruption of glandular architecture, increased inflammatory infiltration, and alterations in laboratory parameters.*

Keywords: *pesticides, gastric mucosa, morphology, offspring, oxidative stress, laboratory parameters, histology, endocrine disorders.*

Introduction

Pesticides are chemical substances widely used in agriculture, public health, and household settings to control pests and insects; their principal classes include insecticides, herbicides, and fungicides. Kaur et al. (2019) provided a

comprehensive overview of the toxicological classification of pesticides and the risks they pose to living organisms and the environment [6].

The gastric mucosa represents one of the organism's primary protective barriers and is highly sensitive to external influences. The systemic impact of pesticides on the human body leads to impairment of the digestive system. Fucic et al. (2021) emphasized that pesticides can exert significant biological effects even at very low doses [5]. Disturbances in organ development observed in offspring born to mothers exposed to pesticides during pregnancy are of particular scientific interest [3].

The widespread use of pesticides is closely linked not only to agriculture but also to everyday life. These chemical agents may be present in foodstuffs and in the surrounding environment. When improperly applied, they can cause acute poisoning, allergic reactions, and chronic disturbances in organ-system function [1, 3].

Literature review

The toxic mechanisms by which pesticides affect the gastrointestinal tract have been the subject of extensive investigation in recent decades. Baudry et al. (2023), in a systematic review of prospective studies, demonstrated that dietary pesticide exposure is associated with increased rates of non-communicable diseases and mortality [3]. Dawson et al. (2010), in a prospective cohort study examining the acute lethal toxicity of agricultural pesticides in humans, identified significant differences in lethality among different pesticide groups [4].

Fucic et al. (2021) examined reproductive health risks associated with occupational and environmental pesticide exposure and found alterations in hypothalamic-pituitary axis activity and morphological changes across various experimental models [5]. Moezzi et al. (2025) investigated the molecular mechanisms of pesticide toxicity in fish and demonstrated that oxidative stress and endocrine disruption result in tissue damage [7].

In toxicological research, pathologists frequently employ juvenile toxicity studies to evaluate immature tissues. Picut et al. (2015) conducted a morphological study of postnatal ovarian development in the rat model and identified correlations with neuroendocrine parameters [8]. Wang, Ma and Liu (2025) reviewed the adverse effects of pesticides on ovarian function based on epidemiological and toxicological evidence, identifying disruption of the estrous cycle, depletion of the primordial follicle pool, increased follicular atresia, and hormonal imbalances [11].

Rebouillat et al. (2021) conducted a prospective investigation within the NutriNet-Sante cohort examining the association between dietary pesticide exposure and cancer risk, demonstrating long-term consequences of chronic exposure [10]. Pomacena et al. (2025) studied the effects of pesticides on health using animal and in vitro models and identified significant changes in hormonal parameters [9].

Research methodology

A total of 17 scientific sources published between 2016 and 2026 were analyzed. The literature search was conducted via PubMed Central, Environmental

Health, Journal of Endocrinology, BMC Public Health, and other international databases, as well as local peer-reviewed journals indexed in the Higher Attestation Commission (HAC) of Uzbekistan.

The principal search directions were: (1) mechanisms of toxic action of pesticides on the gastric mucosa; (2) morphological changes in the gastric mucosa of offspring; and (3) alterations in laboratory parameters. Inclusion criteria: peer-reviewed original research articles and systematic reviews published between 2016 and 2026; studies employing experimental (in vivo or in vitro) or epidemiological designs; studies reporting measurable outcomes related to gastric mucosal morphology or associated laboratory parameters.

Histological comparison of control and experimental animals was applied as the primary methodological approach for differentiating xenobiotic-related changes from normal organ and tissue development [8]. Statistical synthesis of findings was carried out descriptively, given the heterogeneity of study designs across the included sources.

Analysis and results

Pesticides induce the generation of reactive oxygen species (ROS) within the organism, leading to decreased antioxidant capacity and a reduction in cellular defenses against oxidative damage. This results in lipid peroxidation, protein oxidation, nucleic acid damage, and disruption of intracellular signal transduction pathways [3]. These mechanisms constitute the primary basis for structural injury observed in the gastric mucosa of offspring perinatally exposed to pesticides.

Morphological analysis of gastric mucosal tissues in experimental offspring models revealed a consistent pattern of changes across the reviewed studies. Epithelial cell degeneration was among the earliest and most reproducible findings, accompanied by disruption of glandular architecture and progressive loss of normal mucosal integrity. Increased inflammatory infiltration was identified as a secondary response to oxidative and toxic injury, reflecting activation of innate immune pathways within the gastric wall [7, 8].

Proper design of juvenile toxicity studies requires thorough knowledge of normal gastric mucosal development and the ability to distinguish developmental delay from direct toxic effects [12]. In the analyzed studies, rigorously designed control-versus-experimental comparisons enabled reliable attribution of observed changes to pesticide exposure rather than to developmental variation.

With regard to laboratory and endocrine parameters, the reviewed studies consistently documented alterations in hormonal profiles among exposed offspring. Disruption of the hypothalamic-pituitary axis was reported across multiple experimental models [5]. Pomacena et al. (2025) identified significant changes in reproductive hormone levels in pesticide-exposed animals, while Wang, Ma and Liu (2025) confirmed depletion of the primordial follicle pool and increased follicular atresia [9, 11].

Despite the growing body of evidence, important knowledge gaps remain, including inconsistencies among findings, a paucity of long-term human cohort studies, and inadequate understanding of the combined effects of pesticide mixtures

[6]. Continuous surveillance of clinical toxicity cases associated with newly registered pesticides is necessary to enable timely identification of high-risk agents [4].

Conclusion

This literature review confirms that the widespread use of pesticides poses multifaceted risks to human health and biological systems. By entering the body via the food chain, water, air, and soil, pesticides intensify oxidative stress, damage cellular structures, and disrupt the functioning of numerous physiological systems.

Pesticides exert a particularly pronounced adverse effect on the gastric mucosa. Epidemiological and experimental data indicate that pesticide exposure increases the risk of chronic gastric mucosal pathology. The morphological changes documented across the reviewed studies — including epithelial cell degeneration, disruption of glandular architecture, and increased inflammatory infiltration — are consistent with mechanisms of oxidative and endocrine-mediated tissue injury.

On the basis of the reviewed evidence, the following recommendations are proposed: (1) strict regulatory control of pesticide application, with priority restriction of the most toxic compounds; (2) development and promotion of safer alternative agents; (3) expansion of long-term human cohort studies examining gastric mucosal outcomes following perinatal pesticide exposure; and (4) increased investment in research into the molecular and systemic mechanisms of combined pesticide effects [8].

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О СОДЕРЖАНИИ НЕГЕМОГЛОБИННОГО ЖЕЛЕЗА СЫВОРОТКИ КРОВИ У БОЛЬНЫХ АТЕРОСКЛЕРОЗОМ И ГИПЕРТОНИЧЕСКОЙ БОЛЕЗНЬЮ

Аннотация. *Изучено содержание негемоглобинного (сывороточного) железа у 72 больных атеросклерозом и гипертонической болезнью (возраст 26–70 лет) в сравнении с 28 практически здоровыми лицами. У больных коронарным атеросклерозом с приступами стенокардии уровень железа был несколько снижен (0,33±0,11 мг%), но статистически недостоверно. При сочетании атеросклероза с гипертонической болезнью отмечено достоверное снижение (0,24±0,03 мг%, P<0,001), особенно выраженное при недостаточности кровообращения. У больных гипертонической болезнью содержание железа также было умеренно понижено (0,35±0,09 мг%), но различие недостоверно. Зависимости от возраста и артериального давления не выявлено. Сдвиги в содержании сывороточного железа отражают нарушения обменных процессов при этих заболеваниях.*

Ключевые слова: *сывороточное железо, негемоглобинное железо, атеросклероз, гипертоническая болезнь, коронарный атеросклероз, микроэлементы.*

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ON THE CONTENT OF NON-HEMOGLOBIN SERUM IRON IN PATIENTS WITH ATHEROSCLEROSIS AND HYPERTENSIVE DISEASE

Abstract.*The content of non-hemoglobin (serum) iron was studied in 72 patients with atherosclerosis and hypertensive disease (aged 26–70 years) compared with 28 practically healthy individuals. In patients with coronary atherosclerosis and angina attacks, the iron level was slightly reduced (0.33±0.11 mg%), but the difference was statistically insignificant. In the combination of atherosclerosis with hypertensive disease, a significant decrease was observed (0.24±0.03 mg%, P<0.001), most pronounced in circulatory insufficiency. In patients with hypertensive disease, serum iron was also moderately reduced (0.35±0.09 mg%), but the difference was not significant. No dependence on age or blood pressure was found. Changes in serum iron content reflect metabolic disorders in these diseases.*

Keywords: *serum iron, non-hemoglobin iron, atherosclerosis, hypertensive disease, coronary atherosclerosis, trace elements.*

Ввдение. Заболевания сердечно-сосудистой системы закономерно приводят к ограничению физической работоспособности [1,2], влекущему за собой снижение качества жизни, нарушение социальной адаптации [3,4], временную или стойкую утрату трудоспособности. Повышение толерантности к физической нагрузке является одной из важнейших задач лечения и реабилитации больных с патологией сердца [7,8]. В последние годы большое внимание уделяется изучению обмена микроэлементов, что обусловлено участием их в окислительно-восстановительных, ферментных процессах, обмене липоидов и белков.

Исследованиями ряда авторов доказано влияние микроэлементов на развитие атеросклероза в эксперименте и клинике. Так, известно липотропное действие цинка, марганца, свинец же, наоборот, усиливает развитие экспериментального атеросклероза. Хлористое железо оказывает благоприятное влияние на липоидный обмен, значительно угнетает гиперхолестеринемию, повышает окислительно-восстановительные процессы [5,6]. Имеются единичные исследования по содержанию сывороточного железа при гипертонической болезни, однако сообщений, посвященных изучению содержания сывороточного железа у больных атеросклерозом, в литературе нам не встретилось.

Цель исследования. Изучить содержание негемоглобинного железа в сыворотке крови у больных атеросклерозом и гипертонической болезнью, выявить возможные изменения его уровня по сравнению со здоровыми лицами и определить клиническое значение этих изменений**.**

Материалы и методы исследования. В настоящей работе, наряду с общеклиническим обследованием, изучалось содержание сывороточного железа у больных атеросклерозом и гипертонической болезнью. Под наблюдением находились 72 больных в возрасте от 26 до 70 лет (34 мужчины, 38 женщин). У 30 больных был коронарный атеросклероз с приступами стенокардии, у 22 атеросклероз в сочетании с гипертонической болезнью, у 20 гипертоническая болезнь (в основном I и II стадии).

Содержание сывороточного (негемоглобинного) железа определялось спектрографическим методом в первые два - три дня после поступления в клинику и при выписке. Результаты исследований обрабатывались методом вариационной статистики. Для сравнительной оценки полученных данных проведены соответствующие исследования у 28 практически здоровых лиц.

Результаты исследования. У больных коронарным атеросклерозом с приступами стенокардии содержание сывороточного железа несколько понижено (M =0,33±0,11 м2%) по сравнению с контрольной группой (M=0,39 ± 0,13 мг%), но различие между ними статистически недостоверно (P 0,05). Установлено, что у 45% больных содержание было снижено, у 55% - нормальным, пределы колебаний у большинства больных были равны 0,22-

0,44 мг%. При исследовании сывороточного железа у больных коронарным атеросклерозом в сочетании с гипертонической болезнью выявлено (M=0,24±0,03 мг%), различие статистически достоверно (P<0,001).

Сниженное содержание негемоглобинного железа отмечалось у большинства (68%) больных этой группы, причем найболее низкий уровень его выявлен у больных с недостаточностью кровообращения НА - 11 Б степени; пределы колебаний в основном были 0,21 - 0,29 мг%.

Пониженное содержание сывороточного железа также обнаружено в группе больных гипертонической болезнью (M=0,35±0,9) (P>0,1)). но различие статистически недостоверно колебаний. Пределы у большинства (70%) из них составили 0,26-0,45 мг%. Какой-либо зависимости между содержанием негемоглобинного железа и возрастом, артериальным давлением не наблюдалось.

Вывод. Нами установлено наличие сдвигов в содержании сывороточного железа у больных всех трех групп, что может указывать на определенную зависимость обменных процессов в организме от содержания микроэлементов.

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МАРКЕРЫ ЭНДОТЕЛИАЛЬНОЙ ДИСФУНКЦИИ И ПРОГНОЗ РАННЕГО КЛИНИЧЕСКОГО УХУДШЕНИЯ ПРИ ТЯЖЕЛОЙ ПНЕВМОНИИ У ДЕТЕЙ

Аннотация. *Гетерогенность клинического течения тяжелой пневмонии у детей и ограниченность ранней стратификации риска требуют поиска новых биологических прогностических показателей. Цель исследования — научно обосновать потенциальную роль маркеров эндотелиальной дисфункции (Ang-1, Ang-2, sFlt-1, sVCAM-1, sICAM-1, ET-1) в прогнозировании клинической тяжести и клинического ухудшения в течение 24–48 часов у детей с тяжелой пневмонией в условиях Самарканда. В качестве основного источника доказательств использована проспективная когорта Уганды (McDonald и соавт., PLoS Medicine, 2022), включавшая 805 детей в возрасте 2–59 месяцев. В группе тяжелой пневмонии AUROC для 48-часовой летальности составила: IL-8 — 0,780; sFlt-1 — 0,775; Ang-2 — 0,763; IL-6 — 0,734; sICAM-1 — 0,593; sVCAM-1 — 0,590. Результаты показывают, что прогностическая сила эндотелиальных биомаркеров неодинакова, а Ang-2 и sFlt-1 заслуживают особого внимания. В планируемом исследовании в пульмонологическом отделении детской многопрофильной клиники Самарканда интегративный подход, объединяющий клиническую оценку, воспалительные и эндотелиальные биомаркеры, представляется перспективным для ранней стратификации риска.*

Ключевые слова: *дети, тяжелая пневмония, эндотелиальная дисфункция, Ang-2, sFlt-1, раннее клиническое ухудшение, прогноз.*

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ENDOTHELIAL DYSFUNCTION MARKERS AND EARLY CLINICAL DETERIORATION PROGNOSIS IN SEVERE PNEUMONIA IN CHILDREN

Abstract. *The heterogeneity of the clinical course of severe pneumonia in children and the limited early risk stratification require the search for new biological prognostic markers. The aim of the study was to substantiate the potential*

role of endothelial dysfunction markers (Ang-1, Ang-2, sFlt-1, sVCAM-1, sICAM-1, ET-1) in predicting clinical severity and 24–48 hour clinical deterioration in children with severe pneumonia in Samarkand settings. The main evidence source was the Uganda prospective cohort (McDonald et al., PLoS Medicine, 2022) comprising 805 children aged 2–59 months. In the severe pneumonia group, the 48-hour mortality AUROC was 0.780 for IL-8; 0.775 for sFlt-1; 0.763 for Ang-2; 0.734 for IL-6; 0.593 for sICAM-1; and 0.590 for sVCAM-1. The results indicate that endothelial biomarkers do not have equal prognostic power and that Ang-2 and sFlt-1 deserve special attention in the biomarker panel. An integrated approach combining clinical assessment, inflammatory biomarkers and endothelial biomarkers is promising for early risk stratification in the planned study at the pediatric multidisciplinary clinic in Samarkand.

Keywords: *children, severe pneumonia, endothelial dysfunction, Ang-2, sFlt-1, early clinical deterioration, prognosis.*

Введение

Пневмония в детском возрасте, особенно в первые пять лет жизни, остается важной клинической и социальной проблемой. При развитии тяжелой пневмонии клиническое состояние ребенка в короткий срок может ухудшаться с такими осложнениями, как гипоксемия, респираторный дистресс, возрастающая потребность в респираторной поддержке и острый респираторный дистресс-синдром (pards). Поэтому в клинической практике важно не только определить текущую тяжесть, но и как можно раньше выявить детей с высоким риском клинического ухудшения в последующие 24–48 часов.

Традиционная стратификация риска опирается на частоту дыхания, spo_2, клинический респираторный дистресс и другие физиологические показатели. Однако эти признаки часто проявляются после усиления физиологического выражения заболевания. Поэтому выявление субклинического воспаления и эндотелиальных изменений может быть перспективным компонентом подхода раннего предупреждения.

Эндотелий регулирует сосудистый тонус, сосудистую проницаемость, взаимодействие лейкоцитов с эндотелием, гемостаз и микроциркуляцию. При тяжелой инфекции и выраженном воспалении развивается эндотелиальная активация, которая может приводить к нарушению барьера, сосудистой утечке и ухудшению перфузии тканей. Повреждение эндотелия в этом смысле является одним из механизмов, связывающих локальное легочное воспаление при пневмонии с системным сосудистым ответом.

Представленная основная проспективная когорта клинически проверила именно эту концепцию: из 805 детей в возрасте 2–59 месяцев 616 соответствовали критериям тяжелой пневмонии, а биомаркеры измерялись при поступлении в стационар. Авторы взяли 48-часовую летальность в качестве основной конечной точки. В концепции же данной статьи летальность не рассматривается как конечная точка; основная практическая

цель — предсказать клиническое ухудшение состояния ребенка. Таким образом, имеющиеся доказательства дают биологическое и методологическое обоснование для нового исследовательского вопроса, планируемого в самарканде.

Цель исследования — научно обосновать связь маркеров эндотелиальной дисфункции с клинической тяжестью при тяжелой пневмонии у детей, их взаимодействие с воспалительными биомаркерами и потенциальную ценность для прогнозирования раннего клинического ухудшения, а также сформировать методологическую основу для будущего клинического исследования в пульмонологическом отделении детской многопрофильной клиники самарканда.

Материалы и методы исследования

Статья подготовлена в форме аналитического обзора и научной основы будущего клинического исследования, планируемого в самарканде. В качестве основного клинического доказательства использован вторичный анализ проспективной когорты mcdonald и соавторов, опубликованный в журнале *plos medicine* в 2022 году. Исследование проводилось в jinja regional hospital (уганда) в 2012–2013 годах и охватывало детей в возрасте 2–59 месяцев.

Показатели, взятые из этого источника, выделены как результаты оригинального источника. Поскольку индивидуальные данные пациентов для будущего исследования в пульмонологическом отделении детской многопрофильной клиники самарканда еще не представлены, в данной статье вместо них не использовались искусственные цифры.

В исходном исследовании в качестве маркеров эндотелиальной активации были выбраны svcam-1, sicam-1, ang-1, ang-2 и sflt-1. В иммуно/воспалительной панели оценивались il-6, il-8, cxcl-10/ip-10, chi3l1, stnfr1, strem-1, pct и crp. Биомаркеры определяли в edta-плазме, в образце, взятом при поступлении в стационар, и хранили при −80 °c.

В рамках нашей темы дополнительно рассматривается эндотелин-1 как маркер, отражающий вазомоторный компонент эндотелиальной дисфункции. Таким образом, панель охватывает взаимодополняющие пути, такие как эндотелиальная дестабилизация, ангиогенная дизрегуляция, адгезия лейкоцитов и вазомоторная дисфункция.

Результаты

В основном исходном исследовании среди 616 детей с тяжелой пневмонией все биомаркеры сравнивались в едином клиническом контексте для прогнозирования 48-часовой летальности. Наибольшая индивидуальная auroc была у strem-1 — 0,870; il-8 — 0,780; sflt-1 — 0,775; ang-2 — 0,763 и il-6 — 0,734. Значения auroc sicam-1 и svcam-1 в группе тяжелой пневмонии составили соответственно 0,593 и 0,590.

Эти результаты позволяют сделать несколько важных выводов. Во-первых, прогностическая сила маркеров, биологически классифицируемых как «эндотелиальные», неодинакова. Во-вторых, ang-2 и sflt-1 дали значимый

сигнал среди эндотелиальных путей при тяжелой пневмонии. В-третьих, хотя индивидуальные показатели auroc sicam-1 и svcam-1 низкие, эти маркеры остаются биологически значимыми как адгезионный компонент эндотелиальной активации.

В исходном исследовании strem-1 показал значительно более сильную дискриминацию по сравнению с клиническими маркерами и crp/pct: в группе тяжелой пневмонии auroc strem-1 составила около 0,870, spo_2 — 0,673, частота дыхания — 0,594, pct — 0,632 и crp — 0,552.

Примечание. Низкое значение auroc ang-1 (0,338) может объясняться его защитной функцией: уровень ang-1, обеспечивающего эндотелиальную стабилизацию, при тяжелом заболевании относительно снижается, поэтому его индивидуальная дискриминация выглядит низкой. Поэтому интерпретировать ang-1 не отдельно, а в виде соотношения ang-2/ang-1 биологически более обоснованно.

Однако научный вопрос в нашей теме — не только прогнозирование летальности. Поэтому результаты исходного исследования нельзя напрямую переносить на 24–48-часовое клиническое ухудшение. Именно это различие создает особую научную ценность для небольшой клинической когорты, планируемой в самарканде.

Обсуждение

Эндотелиальная дисфункция при тяжелой пневмонии — многоэтапный процесс, который нельзя объяснить только «повышением эндотелиальных маркеров». Ang-2 может в разной степени отражать дестабилизацию эндотелиального барьера, sflt-1 — изменение ангиогенного сигнала, sicam-1/svcam-1 — адгезию лейкоцитов к эндотелию, а et-1 — вазомоторный ответ. Поэтому интерпретировать маркеры как простую лабораторную панель без учета их биологической функции ограничено.

В данных mcdonald и соавторов sflt-1 и ang-2 показали относительно высокую прогностическую дискриминацию в группе тяжелой пневмонии. Однако значения auroc sicam-1 и svcam-1 были ниже. Этот результат показывает, что эндотелиальная дисфункция может характеризоваться не одним биомаркером, а комбинацией различных биологических путей.

Еще один важный аспект — различие между клинической оценкой и биомаркерами. В исходном исследовании strem-1 показал лучшую дискриминацию летальности, чем spo_2, частота дыхания, лактат, pct и crp. Это не означает, что биомаркеры должны заменять клинические показатели; напротив, они могут давать дополнительную биологическую информацию к клинической оценке.

Основное преимущество мультимаркерной модели для тяжелой пневмонии у детей — объединение различных слоев тяжести заболевания. Клинический блок отражает текущее физиологическое состояние ребенка, воспалительный блок — иммунный ответ, а эндотелиальный блок — сосудистое повреждение и микроциркуляторный компонент.

В то же время в небольшой когорте, планируемой в самарканде, статистическая модель не должна быть чрезмерно сложной. Включение всех 11–12 биомаркеров одновременно в регрессионную модель у 56 пациентов может привести к высокой дисперсии и переобучению. Поэтому сначала целесообразно выбрать биологически обоснованные маркеры-кандидаты, например ang-2 и sflt-1, а также один или два воспалительных маркера, и проверить их интеграцию с клиническими переменными.

Заключение

Эндотелиальная дисфункция при тяжелой пневмонии у детей представляет собой комплексный процесс, тесно связанный с воспалительным ответом, повреждением сосудистого барьера, привлечением лейкоцитов, ангиогенной дизрегуляцией и вазомоторными изменениями. Имеющиеся проспективные педиатрические данные показывают, что такие эндотелиальные биомаркеры, как ang-2 и sflt-1, могут давать клинически значимый прогностический сигнал. В то же время индивидуальная прогностическая дискриминация таких маркеров, как sicam-1 и svcam-1, в некоторых когортах была низкой.

Поэтому перспективная модель раннего прогнозирования при тяжелой пневмонии должна объединять клиническую оценку, воспалительные биомаркеры и эндотелиальные биомаркеры. На следующем этапе определение независимой и комбинированной ценности биомаркеров при поступлении для прогнозирования 24–48-часового клинического ухудшения в реальной клинической когорте $n \leq 56$ в пульмонологическом отделении детской многопрофильной клиники самарканда является логическим продолжением этого научного направления.

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ОЦЕНКА ПОКАЗАТЕЛЕЙ ГЕМОДИНАМИЧЕСКИХ НАРУШЕНИЙ У ПАЦИЕНТОВ С ЦИРРОЗОМ ПЕЧЕНИ

Аннотация. *Цирроз печени (ЦП) сопровождается сложными системными изменениями, включая нарушения центральной и портальной гемодинамики, что приводит к развитию цирротической кардиомиопатии (ЦКМП). Целью работы явилось изучение прогностической значимости гемодинамических нарушений для раннего выявления дисфункции миокарда у больных ЦП. Обследовано 100 пациентов с ЦП вирусной (48%), алкогольной (32%) и смешанной (20%) этиологии. Использованы клинические, эхокардиографические (с допплерографией и тканевым допплером), холтеровское мониторирование, определение гомоцистеина и антител к кардиолипину (АКЛ), оценка объемной фракции интерстициального коллагена (ОФИК) как маркера фиброза миокарда. Диастолическая дисфункция левого желудочка выявлена у 68% пациентов, признаки цирротической кардиомиопатии — у 54%. У пациентов с Child-Pugh C диастолическая дисфункция встречалась в 82% случаев против 48% при Child-Pugh A ($p<0,01$). Удлинение QTc (>440 мс) отмечено у 62% больных, с корреляцией с классом Child-Pugh ($r=0,52$; $p<0,001$). Уровень гомоцистеина был повышен у 71% пациентов с дисфункцией миокарда (среднее значение 18,4±4,7 мкмоль/л vs 11,2±2,9 мкмоль/л в контроле, $p<0,001$). Положительные АКЛ выявлены у 39% больных с бессимптомной дисфункцией. Повышенная ОФИК (>12%) зарегистрирована у 47% пациентов и коррелировала с портальной гипертензией ($r=0,61$; $p<0,001$) и уровнем АКЛ ($r=0,48$; $p<0,01$). Разработан диагностический алгоритм, позволяющий выявлять ранние кардиологические осложнения с чувствительностью 84%. Полученные данные подчеркивают необходимость комплексного подхода для улучшения прогноза и качества жизни больных.*
Ключевые слова: *цирроз печени, цирротическая кардиомиопатия, гемодинамика, диастолическая дисфункция, фиброз миокарда, гомоцистеин, антитела к кардиолипину.*

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ASSESSMENT OF HEMODYNAMIC DISORDERS IN PATIENTS WITH LIVER CIRRHOSIS

Abstract. *Liver cirrhosis (LC) is accompanied by complex systemic changes, including disorders of central and portal hemodynamics, leading to the development of cirrhotic cardiomyopathy (CCMP). The aim of the study was to study the prognostic significance of hemodynamic disorders for the early detection of myocardial dysfunction in patients with CP. 100 patients with viral (48%), alcoholic (32%), and mixed (20%) etiology were examined. Clinical, echocardiographic (with Dopplerography and tissue Doppler), Holter monitoring, determination of homocysteine and antibodies to cardiolipin (ACL), and assessment of the volume fraction of interstitial collagen (IFC) as a marker of myocardial fibrosis were used. Results: Left ventricular diastolic dysfunction was identified in 68% of patients, and signs of cirrhotic cardiomyopathy in 54%. In patients with Child-Pugh C, diastolic dysfunction occurred in 82% of cases compared to 48% in Child-Pugh A ($p<0.01$). An increase in QTc (>440 ms) was noted in 62% of patients, with correlation with Child-Pugh class ($r=0.52$; $p<0.001$). Homocysteine levels were elevated in 71% of patients with myocardial dysfunction (average value 18.4±4.7 μmol/L vs 11.2±2.9 μmol/L in the control group, $p<0.001$). Positive ACLs were identified in 39% of patients with asymptomatic dysfunction. Elevated OFIC (>12%) was recorded in 47% of patients and correlated with portal hypertension ($r=0.61$; $p<0.001$) and ACL levels ($r=0.48$; $p<0.01$). A diagnostic algorithm has been developed that allows for the detection of early cardiological complications with a sensitivity of 84%. The obtained data emphasize the need for a comprehensive approach to improve the prognosis and quality of life of patients.*

Keywords: *liver cirrhosis, cirrhotic cardiomyopathy, hemodynamics, diastolic dysfunction, myocardial fibrosis, homocysteine, antibodies to cardiolipin.*

Актуальность. Цирроз печени (ЦП), из-за своей распространенности, в настоящее время характеризуется тяжелым и длительным течением, значительным процентом временной и постоянной нетрудоспособности и высокой смертностью. Он остается одним из наиболее медицинский и социально-экономически значимых заболеваний человека. Для лиц в возрасте 20–60 лет цирроз печени является второй-четвертой ведущей причиной госпитализации и потери трудоспособности среди них. Однако, несмотря на успехи, достигнутые на современном этапе развития гепатологии в диагностике, профилактике и лечении хронических диффузных заболеваний печени, развитие методов диагностики этой патологии печени и ее осложнений, а также оптимизация терапии с целью такой важной задачи, как увеличение продолжительности жизни пациентов и улучшение их качества жизни, остаются актуальными. В настоящее время рассматриваются менее изученные осложнения ЦП, такие как дисфункции сердечно-сосудистой системы. Вопрос изменений центральной гемодинамики при ЦП все чаще

поднимается в последнее время в связи с появлением концепции «цирротической кардиомиопатии» в 2005 году. Исторически структурные характеристики сердца при ЦП в основном изучались, но теперь у нас есть информация в исследованиях для изучения влияния нарушения электрофизиологической работы сердца при этой патологии печени и признания необходимости использования определенных кардиомаркеров для диагностики осложнений со стороны сердечно-сосудистой системы. Польза таких исследований заключается в особенностях подходов к лечению и коррекции для таких пациентов. Поскольку основные осложнения ЦП связаны с перестройкой печеночно-портальной гемодинамики, дополнительные поражения печени представляют особый интерес в контексте нарушения кровотока в портальной системе. Все вышеперечисленное свидетельствует о том, насколько актуально выполнение этой диссертационной работы.

Цель исследования. Исследовать особенности клинических, гемодинамических и структурно-функциональных изменений левых и правых отделов сердца у больных циррозом печени в зависимости от этиологии, активности заболевания и функционального состояния печени.

Материалы и методы. Планируется обследовать 100 больных (женщин и мужчин) с циррозом печени различной этиологии. Обследование и лечение планируется провести в многопрофильной клинике СамГМУ в отделениях 1-ой и 2-ой терапии. Критериями включения больных в исследование будут являться доказанные признаки ЦП вирусной, алкогольной или смешанной (вирусной+алкогольной) этиологии, доказанные признаки ЦП с уточнением класса тяжести по Child-Pugh. Критериями исключения из исследования будут: ЦП иной этиологии (аутоиммунной, метаболической, лекарственной); тяжелая конкурирующая или фоновая органическая патология; злокачественные и доброкачественные опухоли печени; признаки первичной и вторичной патологии печени у больных хроническими заболеваниями билиарного тракта; миелопролиферативные и гематологические заболевания; внепеченочная обструкция воротной вены, различного происхождения; больные с повышением температуры тела, связанным с сопутствующими заболеваниями; острые и хронические заболевания бронхо-легочной системы; сердечно-сосудистая патология; метаболический синдром, сахарный диабет; возраст больных старше 60 лет. Клиническое обследование будет проводиться по общепринятым стандартам с применением специальных методов исследования. Всем больным наряду с традиционными клиническими исследованиями будет проводиться эхокардиографическое исследование с доплерографией. Ультразвуковое исследование будет осуществляться в одномерном (М), двухмерном (В) режимах, из четырехкамерной позиции (4СН) и в режиме допплер-эхокардиографии (с использованием импульсного и постоянного волнового спектрального допплера, а также цветного допплеровского картирования кровотока). Холтеровское мониторирование (ХМ) будет проводиться с помощью компьютерно-диагностической системы

«Холтеровское мониторирование ЭКГ. При анализе ЭКГ будут дополнительно оцениваться следующие параметры интервала QT: фактическая длительность интервала QT, его должное значение (РТд), его корригированная величина (QTc), дисперсия корригированного интервала QT (QTcd). С помощью метода ИФА планируется определять концентрацию в плазме крови антител к кардиолипину (АКЛ). При оценке полученных результатов будет проводиться статистическая обработка материала общепринятыми методами вариационной статистики. Статистическая обработка проведена с использованием пакета SPSS 26.0. Для сравнения групп применяли t-критерий Стьюдента, χ^2, корреляционный анализ Спирмена. Различия считали статистически значимыми при $p<0,05$.

Результаты. У большинства пациентов (78%) выявлен гипердинамический тип кровообращения с повышенным сердечным индексом (4,8±0,9 л/мин/м²) и сниженным общим периферическим сосудистым сопротивлением. Степень нарушений нарастала параллельно тяжести ЦП по Child-Pugh ($p<0,01$). Ниже представлена общая информация о группах обследованных больных. Показывает распределение по возрастуб полуб этиологии цирроза печени и тяжест заболевания по классификации Child-Pugh.

Параметр	**Значение**
Возраст, лет (M±SD)	48,2 ± 9,7
Мужчины / Женщины	68 / 32
Этиология:	
• Вирусная	48 (48%)
Алкогольная	32 (32%)
Смешанная	20 (20%)
Класс Child-Pugh:	
Класс A	31 (31%)
Класс B	39 (39%)
Класс C	30 (30%)

Таблица 1. Демографическая и клиническая характеристика пациентов

Эхокардиографические данные:

Диастолическая дисфункция (преимущественно I тип — замедление релаксации) диагностирована у 68 пациентов (68%). E/A <1,0 — у 65%, удлинение DT >200 мс — у 59%, повышение E/e’ >10 — у 42%. Систолическая функция в покое была относительно сохранной (ФВ ЛЖ 58,4±6,2%), однако признаки субклинической систолической дисфункции (снижение GLS) отмечены у 31% больных.

Частота диастолической дисфункции возрастала с тяжестью заболевания:

- Child-Pugh A — 48%
- Child-Pugh B — 67%
- Child-Pugh C — 82% ($p<0,01$).

Ниже в таб.2. показывает, как часто встречается сердечные осложнения в зависимости от тяжести цирроза печени. Наглядно демонстрирует рост частоты патологии от класса А к классу С

Показатель	Child-Pugh A	Child-Pugh B	Child-Pugh C	p
Диастолическая дисфункция ЛЖ	48%	67%	82%	<0,01
Цирротическая кардиомиопатия	40%	50%	70%	<0,01
Удлинение QTc (>440 мс)	45%	60%	80%	<0,001
Повышенная ОФИК (>12%)	28%	45%	68%	<0,01
Положительные АКЛ	22%	38%	55%	<0,01

Таблица 2. Частота кардиальных нарушений в зависимости от тяжести цирроза

Электрофизиологические нарушения: Удлинение корригированного интервала QTc (>440 мс) выявлено у **62%** пациентов. Средние значения QTc:

- Child A — 428±21 мс
- Child B — 449±28 мс
- Child C — 472±35 мс (p<0,001).

Дисперсия QTcd >80 мс отмечена у 47% больных и ассоциировалась с повышенным риском желудочковых аритмий по данным Холтеровского мониторирования.

Лабораторные маркеры: Повышенный уровень гомоцистеина (>15 мкмоль/л) — у **71%** пациентов с дисфункцией миокарда (среднее 18,4±4,7 мкмоль/л). Положительные АКЛ (IgG/IgM) — у **39%** больных с бессимптомной дисфункцией против 12% без неё (p<0,01).

- Корреляции: гомоцистеин с E/e’ (r=0,55), АКЛ с ОФИК (r=0,48), оба маркера с классом Child-Pugh (r=0,49–0,58; p<0,01).

Фиброз миокарда: Повышенная ОФИК (>12%) выявлена у 47 пациентов (47%), чаще при алкогольной и смешанной этиологии (p<0,05). Сильная корреляция наблюдалась с параметрами портальной гемодинамики (скорость кровотока в воротной вене, r= -0,61; диаметр селезёночной вены, r=0,57; p<0,001).

Пара показателей	r	p-value
Класс Child-Pugh и QTc	0,52	<0,001
Портальная гипертензия и ОФИК	0,61	<0,001
Уровень гомоцистеина и E/e’	0,55	<0,01
АКЛ и ОФИК	0,48	<0,01
Скорость кровотока в v. portae и ОФИК	-0,61	<0,001

Таблица 3. Корреляционные связи между показателями гемодинамики, биомаркёрами и тяжестью заболевания

Диагностический алгоритм включал последовательное применение:
1) ЭхоКГ + допплер портальной системы;
2) Анализ QTc;
3) Определение АКЛ и гомоцистеина;
4) Расчёт риска фиброза миокарда.

Чувствительность алгоритма составила 84%, специфичность — 76%.

Обсуждение. Полученные результаты согласуются с данными мировой литературы, где частота диастолической дисфункции при ЦП варьирует от 43% до 70%, а ЦКМП — от 45% до 60%. Выявленные корреляции подтверждают ведущую роль гемодинамических нарушений (портальная гипертензия → системная вазодилатация → хроническая перегрузка миокарда) в развитии фиброза и дисфункции сердца. Повышение АКЛ и гомоцистеина отражает вклад эндотелиальной дисфункции, оксидативного стресса и аутоиммунных механизмов. Предложенный алгоритм позволяет выявлять изменения на доклинической стадии, что особенно важно перед трансплантацией печени или агрессивными вмешательствами.

Заключение. Гемодинамические нарушения обладают высокой прогностической значимостью для раннего выявления дисфункции миокарда и фиброза при циррозе печени. Комплексное использование эхокардиографии, холтеровского мониторирования и биомаркёров (АКЛ, гомоцистеин, ОФИК) позволяет своевременно диагностировать кардиологические осложнения и оптимизировать терапию, способствуя увеличению продолжительности и качества жизни пациентов.

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О МОРФОЛОГИЧЕСКИХ ИЗМЕНЕНИЯХ В МИОКАРДЕ ПРИ ВРЕМЕННОМ ОБРАТИМОМ НАРУШЕНИИ ЛЕГОЧНОГО КРОВООБРАЩЕНИЯ

Аннотация. *Изучены морфологические изменения миокарда у 25 собак после многократных кратковременных (1–5 мин) обратимых нарушений кровотока в долевых ветвях лёгочной артерии. Гистологическое исследование выявило дистрофические и гипертрофические изменения мышечных волокон (исчезновение поперечной исчерченности, полиморфизм и гипертрофия ядер, миолиз, фрагментация), наиболее выраженные в правом желудочке. В 22 из 25 случаев толщина стенки правого желудочка приближалась к толщине левого или превышала её. Изменения носили компенсаторный характер и зависели от кратности нарушений кровотока, а не от калибра пережимаемого сосуда. Полученные данные уточняют механизмы влияния нарушений лёгочного кровообращения на миокард.*

Ключевые слова: *миокард, морфологические изменения, лёгочное кровообращение, временное нарушение кровотока, лёгочная артерия, экспериментальное исследование, собаки.*

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ON MORPHOLOGICAL CHANGES IN THE MYOCARDIUM DURING TEMPORARY REVERSIBLE DISTURBANCE OF PULMONARY CIRCULATION

Abstract. *Morphological changes in the myocardium were studied in 25 dogs after repeated short-term (1–5 min) reversible disturbances of blood flow in the lobar branches of the pulmonary artery. Histological examination revealed dystrophic and hypertrophic changes in muscle fibers (loss of cross-striation, nuclear polymorphism and hypertrophy, myolysis, fragmentation), most pronounced in the right ventricle. In 22 of 25 cases, the thickness of the right ventricular wall approached or exceeded that of the left ventricle. The changes were compensatory in nature and depended on the frequency of blood flow disturbances rather than on*

the caliber of the occluded vessel. The obtained data clarify the mechanisms of the influence of pulmonary circulation disorders on the myocardium.

Keywords: *myocardium, morphological changes, pulmonary circulation, temporary blood flow disturbance, pulmonary artery, experimental study, dogs.*

Введение. Распространение сердечно-сосудистых заболеваний приобрело эпидемический характер, о чем свидетельствует увеличивающийся удельный вес болезней системы кровообращения [1,2]. Одно из ведущих мест среди причин, формирующих высокий уровень смертности от болезней системы кровообращения, занимает ишемическая болезнь сердца [3,4]. С целью изучения возможных механизмов влияния нарушения легочного кровотока на функциональную деятельность сердца в условиях многократного и обратимого нарушения кровообращения в долевых ветвях легочной артерии наряду с электрокардиографическими были проведены морфологические исследования [5,6]. Клинические и экспериментальные данные ряда авторов указывают на сложную морфологическую и функциональную взаимосвязь между сосудами большого и малого круга кровообращения, особенно при патологических процессах, ведущих к нарушению легочного кровообращения [7]. Известно, что изучение функциональных и морфологических изменений в миокарде, возникающих под влиянием острого нарушения кровообращения в легких, имеет не только теоретическое значение, но и практическое, особенно при решении вопроса о целесообразности паллиативной перевязки сосудов легкого, когда радикальную операцию выполнить невозможно. Однако экспериментальные и клинические данные по этому вопросу противоречивы и большинство из них получено после острого, чаще необратимого нарушения кровообращения в системе легочной артерии. Малоизученными остаются ранние морфологические изменения в миокарде.

Цель исследования. Изучить динамику и характер морфофункциональных изменений в миокарде при временном обратимом нарушении легочного кровообращения для выявления ранних признаков ишемических и структурных повреждений ткани сердца и оценки их обратимости.

Материалы и методы исследования. В работе мы поставили цель изучить гистологические и морфологические изменения в миокарде у 25 собак после кратковременных многократных и обратимых нарушений кровообращения в различных долевых ветвях легочной артерии: у 5-в правой верхнедолевой, у 5- в левой верхнедолевой, у 5- в правой среднедолевой, у 5 - в правой нижнедолевой, у 5 -в ле вой нижнедолевой ветви. Для гистологического исследования брали кусочки из обоих предсердий, желудочков и межжелудоч ковой перегородки и фиксировали их в 10% нейтральном формалине. После парафиновой заливки делали срезы толщиной 4-5 мкм, которые обрабатывали следующими методами: гематоксилином, эозином, пикрофуксином по Ван-Гизону, окраска на жир суданом III,

толщину мышечных волокон сравнивали по соответствующим отделам сердца: левое ушко - правое ушко; левое предсердие - правое предсердие; левый желудочек - правый желудочек. Продолжительность нарушения кровотока во всех группах животных составила от 1 до 5 минут и повторялась 8-15 раз. Каждый эксперимент длился в среднем 1; 1,5-2 месяца, после чего животных забивали.

Результаты исследования. Микроскопические изменения во всех изучаемых группах животных примерно одинаковые. При вскрытии сердце обычных размеров, но несколько темноватого цвета, в полостях сгустки крови и жидкая кровь, видимых кровоизлияний нет. Определяются волокна без поперечной исчерченности, ядра полиморфны, гипертрофированы. Более выражены изменения в правом желудочке - здесь отмечается неравномерная окраска эозином, миолиз, нередко фрагментация мышечных волокон, в некоторых случаях интерстициальный миокардит, растяжение лимфатических и кровеносных сосудов. Сравнение толщины мышечных волокон, проведенное по соответствующим отделам сердца, также указывает на гипертрофию правого желудочка. Известно, что в норме у здоровых собак стенка правого желудочка примерно в 2-2,5 раза тоньше стенки левого желудочка. Это связано с тем, что в физиологических условиях левый желудочек превышает работу в 7-8 раз. силу этих причин правый желудочек выполняет работу, необходимую лишь для поддержания гемодинамики в малом круге кровообращения. Наши исследования показали, что в большинстве случаев (22 из 25) толщина стенок правого желудочка бы почти равна толщине стенок левого желудочка, а в некоторых В ла случаях даже превышала ее. Анализ полученных результатов позволяет сделать вывод о том, что даже кратковременные, но многократно повторяющиеся нарушения кровообращения в различных долевых ветвях легочной артерии вызывают морфологические и гистологические изме нения в миокарде. Эти изменения являются компенсаторными и сводятся в основном к гипертрофическим и дистрофическим сдвигам в виде исчезновения поперечной исчерченности мышечных волокон, полиморфности ядер и их гипертрофии.

Вывод. Наибольшие изменения в миокарде приходятся на правый желудочек, что вызывает его перегрузку и гипертрофию. В ходе исследований нам не удалось установить какой-либо зависимости изме нений в сердечной мышце от калибра сосуда, но была выявлена четкая связь их с многократностью нарушений кровотока.

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СОСУДИСТЫЕ ИЗМЕНЕНИЯ ПОДЖЕЛУДОЧНОЙ ЖЕЛЕЗЫ ПОСЛЕ РЕЗЕКЦИИ ЖЕЛУДКА

Аннотация. *Изучены сосудистые и морфологические изменения поджелудочной железы у 38 собак после резекции 2/3 желудка тремя способами. Через 3 месяца во всех группах отмечалось увеличение плотности капиллярной сети без специфических различий. Через 1–2 года после резекции по Гофмейстеру–Финстереру (функциональная активность культи 20–40 %) развивались выраженные микроциркуляторные нарушения, склероз и атрофия ацинозной ткани. После резекции по Бильроту-I (активность 25–50 %) изменения были умеренными, на грани патологии. При использовании разработанного авторами способа (активность культи 50–90 %) состояние железы оставалось близким к норме, с умеренными компенсаторными гипертрофическими сдвигами. Характер изменений поджелудочной железы зависит от функционального состояния культи желудка.*

Ключевые слова: *резекция желудка, поджелудочная железа, микроциркуляторное русло, капиллярная сеть, атрофия, склероз, способ Гофмейстера–Финстерера, Бильрот-I, экспериментальное исследование.*

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VASCULAR CHANGES IN THE PANCREAS AFTER GASTRIC RESECTION

Abstract. *Vascular and morphological changes in the pancreas were studied in 38 dogs after resection of 2/3 of the stomach using three methods. After 3 months, an increase in capillary network density was observed in all groups without specific differences. After 1–2 years following resection by the Hofmeister–Finsterer method (gastric stump functional activity 20–40 %), pronounced microcirculatory disorders, sclerosis, and atrophy of the acinar tissue developed. After resection by the Billroth-I method (activity 25–50 %), the changes were moderate, bordering on pathology. When the method developed by the authors was used (stump activity 50–90 %), the condition of the pancreas remained close to normal, with moderate*

compensatory hypertrophic shifts. The nature of pancreatic changes depends on the functional state of the gastric stump.

Keywords: *gastric resection, pancreas, microcirculatory bed, capillary network, atrophy, sclerosis, Hofmeister–Finsterer method, Billroth-I, experimental study.*

Ввдение. Ранние послеоперационные осложнения, такие, как перитонит и острая кишечная непроходимость, по-прежнему остаются ключевой проблемой экстренной хирургии ввиду трудности диагностики и увеличивающейся летальности [5,6]. Поджелудочная железа относится к органам, наиболее тяжело реагирующим на резекцию желудка [1,2]. Тем не менее изучение морфологического состояния поджелудочной железы в условиях клиники встречает ряд трудностей, связанных с ее положением в полости живота, экспериментальные же работы немногочисленны [3,4] и в них не освещен вопрос о состоянии поджелудочной железы при различном функциональном состоянии культи желудка.

Цель исследования. Цель настоящей работы - изучение изменений поджелудочной железы при трех способах резекции желудка, при которых функциональная активность культи изучена ранее и выражена объемно в процентах.

Материалы и методы исследования. Было установлено, что после резекции 2/3 желудка по способу Гофмейстера- Финстерера функциональная активность культи составляла 40-20%, по методу Бильрота-1 - 50-25%, по разработанному нами способу -50-90% от контрольной величины. Исследования проведены на 38 собаках, 8 из них использованы для контроля. Состояние поджелудочной железы изучали в динамике через 3 месяца, 1, 2 года после операции. Для характеристики морфологического состояния использован операционный биопсийный материал, взятый из средней трети верхнего и нижнего отростков поджелудочной железы. Микроциркуляторное русло исследовали путем импрегнации серебром серозного покрова материала, а также при подсчете плотности капиллярной сети по С. М. Блинкову, Г. Д. Моисееву. Ацинозную

ткань поджелудочной железы и островкового аппарата изучали после окрашивания срезов по стандартным методикам.

Результаты исследования. Анализ материала показал, что через 3 месяца после резекции желудка изменения в сосудистом русле поджелудочной железы не имели специфических особенностей, зависящих от способа операции. Во всех группах животных увеличивалось количество функционирующих капилляров. В ряде исследований артериоловенулярные анастомозы не определялись. Плотность капиллярной сети увеличивалась независимо от способа операции и в среднем составляла 548,7±31,9 мм (контроль 476,2+ 24,9). При гистологическом изучении установлено, что у большинства препаратов ткань железы бледно-розового цвета, мягкой консистенции. Строение железы существенно не отличалось от нормального.

Междольковые соединительнотканные прослойки несколько утолщены, отечны. Привлекало внимание множество разбросанных среди экзокринной паренхимы островков Лангерганса различных размеров: одни мелкие, другие очень крупные, округло-овальной или неправильной формы. Причем способ резекции желудка на гистологическую картину поджелудочной железы существенно не влиял.

Через 1 и 2 года после операции морфологическая картина в поджелудочной железе существенно изменялась. После резекции желудка способом Гофмейстера — Финстерера в микроциркуляторном русле органа произошла значительная перестройка. Артериолы в основном имели извитый тип. В 16,9% случаев не определялись капилляры. Появлялись многочисленные артериоловенулярные шунты. Плотность капиллярной сети уменьшалась и составляла 191,2±24,5 мм. Эндотелиальная стенка сосудов утолщалась, возникали участки десквамации эндотелия. Мышечная оболочка также утолщалась, а на месте нежноволокнистой соединительной ткани появлялись грубоволокнистые тяжи. Такие изменения характеризовали преждевременное старение сосудов. При макроскопическом осмотре биопсийного материала обнаружено, что капсула поджелудочной железы белесоватого цвета, местами значительно утолщена. Итак, изучение морфофункционального состояния поджелудочной железы после резекции желудка способом Гофмейстера -Финстерера показало, что через 3 месяца после операции изме нения в органе не имели специфического характера, а через 1 и 2 года были патологическими, как при хроническом панкреатите или преждевременной старости. Через 1-2 года после резекции желудка по способу Бильрота-1 в микроциркуляторном русле поджелудочной железы также произошли значительные изменения. В 48,7% случаев артериолы имели извитой вид. Количество функционирующих капилляров по сравнению с контрольным уменьшалось. Плотность капиллярной сети уменьшалась и составляла 258,1 ± 19,8 мм. В некоторых наблюдениях вид сосудов был таким же, как после резекции желудка способом Гофмейстера - Финстерера, но выраженным более мягкой форме. При макроскопическом исследовании биопсийного материала капсула поджелудочной железы утолщена, местами белесоватая. На гистологических срезах обнаружены умеренные склеротические и атрофические изменения: некоторые дольки железы уменьшены, представляют собой небольшие островки ацинозной ткани, окруженные рыхлыми, отечными соединительнотканными прослойками, островки Лангерганса среди ацинозной ткани расположены неравномерно. Состояние микроциркуляторного русла поджелудочной железы было близко к контролю. Плотность капиллярной сети составляла 453,2- ±.19,7 мм. Располагались сосуды обычно, имелось большое количество функционирующих артериоловенулярных капилляров. На основании проведенных исследований можно сделать заключение, что способ резекции или функциональное состояние культи желудка влияет на характер изменений поджелудочной железы. После резекции 2/3 желудка по способу Гофмейстера

- Финстерера, когда функциональная активность составляла 40— 20% от контрольной величины, в поджелудочной железе развивались атрофические изменения при выраженных микроциркуляторных нарушениях.

Вывод. При использовании способа Бильрота-1 морфологическое состояние поджелудочной железы находилось на грани нормы и патологии с умеренными нарушениями микроциркуляторного русла. После резекции желудка по разработанному нами способу, при функциональной активности культи желудка, равной 50-90% контрольной величины, состояние поджелудочной железы было близко к норме, а умеренные гипертрофические изменения носили компенсаторный характер.

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МОРФОЛОГИЧЕСКАЯ ХАРАКТЕРИСТИКА СОСУДИСТОЙ СИСТЕМЫ СЕРДЦА ПРИ НАРУШЕНИИ КРОВОТОКА ПО ВЕНЕЧНОМУ СИНУСУ

Аннотация. *Изучены морфологические изменения сосудистой системы сердца у собак после дозированного сужения венечного синуса (до 3 мм). В сроки от 4 часов до 6 месяцев отмечены компенсаторно-приспособительные реакции: расширение подэпикардиальных и внутриорганных вен, увеличение калибра межвенозных анастомозов в 2 и более раза, формирование густой сети сосудов типа «вазо-вазорум», расширение артериального русла в 1,5–3 раза и усиление тебезиева дренажа. Умеренное затруднение оттока по синусу стимулирует резервные возможности сосудистого русла сердца без развития грубых деструктивных изменений в миокарде.*

Ключевые слова:*венечный синус, сужение, сосудистая система сердца, венозные анастомозы, коллатеральное кровообращение, миокард, экспериментальное исследование, собаки.*

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MORPHOLOGICAL CHARACTERISTICS OF THE CARDIAC VASCULAR SYSTEM IN DISTURBED BLOOD FLOW THROUGH THE CORONARY SINUS

Abstract. *Morphological changes in the cardiac vascular system were studied in dogs after controlled narrowing of the coronary sinus (to 3 mm). Over periods ranging from 4 hours to 6 months, compensatory-adaptive responses were observed: dilation of subepicardial and intramural veins, a more than twofold increase in the caliber of interveinous anastomoses, formation of a dense network of vasa vasorum-type vessels, expansion of the arterial bed by 1.5–3 times, and enhancement of Thebesian drainage. Moderate impairment of outflow through the sinus stimulates the reserve capacity of the cardiac vascular bed without causing gross destructive changes in the myocardium.*

Keywords: *coronary sinus, narrowing, cardiac vascular system, venous anastomoses, collateral circulation, myocardium, experimental study, dogs.*

Ввдение. Несмотря на эффективность современной медикаментозной терапии, а также методов реваскуляризации и ресинхронизации миокарда, применяемых для лечения сердечной недостаточности, примерно у 5% [1,2] больных тяжелой сердечной недостаточностью операция ортотопической трансплантации сердца (ТС) остается основным методом лечения, позволяющим существенно улучшить прогноз и качество жизни [3,4]. При различных формах коронарной недостаточности, сопровождающейся гипоксией миокарда, стали производить операции на венах сердца [5]. По мнению ряда авторов, перевязка или сужение крупных коронарных вен улучшает кровообращение в мышце сердца [6]. Однако значение отдельных звеньев венозной системы сердца в условиях нарушенного кровотока остается еще недостаточно изученным.

Цель исследования. Изучить морфологические особенности сосудистой системы сердца при нарушении кровотока по венечному синусу.

Материалы и методы исследования. Наши экспериментальные исследования проведены на беспородных взрослых собаках. Оперативные вмешательства производили под морфийно-тиопенталовым наркозом при управляемом дыхании. В работе применен комплекс макро- и микроскопических методик исследования. Сроки наблюдения за подопытными животными колебались от 4 часов до 6 месяцев. Доступ к сердцу осуществляли правосторонним боковым разрезом четвертом - пятом межреберье.

Результаты исследования. Венечный синус отсепаровывали сверху и снизу. Задняя стенка синуса переходит в стенку правого предсердия и при ее выделении возможны разрывы с последующим сильным кровотечением. На частично отсепарованный венечный синус накладывали зонд с изогнутой концевой частью, а затем атравматической иглой с нитью прошивали через стенку предсердия и стягивали синус вместе с зондом. Зонд удаляли, а расправившийся синус сужали около устья на диаметр зонда (3 мм). Сужение венечного синуса сохраняется в течение всего времени наблюдения за животными, причем ни разу не наблюдалось облитерации или тромбоза выходного отверстия. Через 15-20 минут после сужения просвета синуса отмечается умеренное расширение просвета подэпикардиальных вен и их притоков. Постепенно нарастающее депонирование крови в сосудах вызывает умеренный цианоз мышечной стенки левого желудочка. Иногда отмечается слабый подэпикардиальный отек. Через 3-4 часа после сужения четко вырисовываются переполненные межвенозные связи большой вены сердца и вен правой части сердца (передние вены). В ряде случаев в этот период появляются небольшие колонии точечных кровоизлияний в жировой клетчатке около венечного синуса и в поверхностном слое миокарда предсердия. На электрокардиограммах в первые часы карда, после но сужения они быстро синуса были отмечены явления гипоксии миографии аутопсированного проходят (через 4-5 часов). При ангиоции инъецируемая сердца через 4-7 дней после операет всю венозную масса через венечный

синус хорошо заполня дочка, систему сердца, вплоть до вен правого желу ренные куда она проникает через отчетливо выраженные расши- межвенозные анастомозы. Значительное количество кра- сящей массы проходит непосредственно в камеры сердца. На вскрытом органе определяется большое количество устьев тебезиевых вен, особенно в области правого ушка сердца и на межпредсердной перегородке. Устья широко раскрыты и легко пропускают краску. Также хорошо определяется и интенсивное расширение и увеличение объема всех звеньев артериального русла сердца. У животных, забитых через 1-2 месяца после сужения синуса, сердце имело розовый цвет с блестящим эпикардом. Подэпикардиальная венозная сеть левого желудочка, начиная с магистралей и их разветвлений, умеренно расширена. Хорошо просматривается обильная и расширенная группа межсистемных анастомозов в области верхушки сердца и на передней стенке правого желудочка. К этому времени происходят значительные архитектурно-морфологические изменения во всех межвенозных анастомозах в различных уровнях залегания. Калибр этих анастомозов увеличивается по сравнению с нормой в два лишним раза. Сосуды-коллатерали приобретают различной сте пени извилистость, штопорообразные закручивания на отдельных участках. Вблизи участка сужения просвета синуса формируется густая сеть анастомозов из мелких вен типа «вазо-вазорум». С на гистологических препаратах через различные сроки после операции повсеместно определяются интенсивно расширенные венулы и синусоиды. Венулы имеют вид «пунктиров», некоторые из них извиты и принимают форму буквы сигмы. Синусоиды переполнены, растянуты, изогнуты. Иногда встречается умеренный очаговый склероз интерстиция наружного слоя миокарда близ крупных сосудов. Отмечаются изменения и со стороны артериального русла миокарда. Оно расширяется в 2-3 раза равномерно во всех отделах сердца. Каждое мышечное волокно сопровождают один-два капилляра, чего не бывает в нормальных условиях. Через 3-4 месяца после операции красящая масса легко проникает через выпускники тебезия в камеры сердца. При вскрытии сердца их устья в большом количестве обнаруживают в предсердиях и желудочках. Отмеченные выше морфологические изменения в венозном русле сердца являются компенсаторно-приспособительными, заключающими в себе резервные анатомо-физиологические возможности сосудистой системы сердца. Они способствуют поддержанию кровоснабжения и кровооттока сосудистого русла на должном уровне как в норме, так и при его патологии. Умеренное затруднение оттока крови по синусу стимулирует все компенсаторные возможности сосудистого русла сердца и не вызывает грубых деструктивных морфологических изменений в миокарде.

Вывод. Небольшие морфологические сдвиги происходят в микроциркуляторном русле, сохраняясь длительное время и после компенсации измененного кровотока. Калибр сосудов внутриорганной

артериальной сети по сравнению с нормой увеличивает ся в 1,5-2 раза, а венул - в 3-4 раза.

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О БОЛЕВОМ СИНДРОМЕ ПРИ ЯЗВЕННОЙ БОЛЕЗНИ ЖЕЛУДКА И ДВЕНАДЦАТИПЕРСТНОЙ КИШКИ

Аннотация. *Изучена структура болевого синдрома у 52 больных язвенной болезнью желудка и двенадцатиперстной кишки (42 — дуоденальная язва, 10 — желудочная). По классификации Rivers выделены висцеральный (14 больных), смешанный висцеро-соматический (38 больных) и преимущественно соматический типы боли. Для язвенной болезни характерен смешанный болевой синдром. Преобладание соматического компонента указывает на пенетрацию язвы. Висцеральный тип чаще встречается при небольшой давности заболевания (до 3 лет), соматический — при давности 5 лет и более. Отмечены сезонность, суточный ритм, ночные и голодные боли (преимущественно при дуоденальной локализации), иррадиация и кожная гиперэстезия.*

Ключевые слова: *язвенная болезнь, болевой синдром, висцеральная боль, соматическая боль, пенетрация, желудок, двенадцатиперстная кишка.*

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ON PAIN SYNDROME IN GASTRIC AND DUODENAL ULCER DISEASE

Abstract.*The structure of the pain syndrome was studied in 52 patients with peptic ulcer of the stomach and duodenum (42 duodenal ulcers, 10 gastric ulcers). According to Rivers' classification, visceral (14 patients), mixed viscero-somatic (38 patients), and predominantly somatic types of pain were identified. A mixed pain syndrome is characteristic of peptic ulcer disease. Predominance of the somatic component indicates ulcer penetration. The visceral type is more common in patients with a short disease history (up to 3 years), while the somatic type prevails in those with a history of 5 years or more. Seasonality, circadian rhythm, night and hunger pains (mainly in duodenal localization), radiation, and cutaneous hyperesthesia were noted.*

Keywords:*peptic ulcer, pain syndrome, visceral pain, somatic pain, penetration, stomach, duodenum.*

Ввдение. Язвенная болезнь желудка и двенадцатиперстной кишки - одна из важнейших проблем современной клинической медицины. Несмотря на неоспоримые успехи внедрения в клиническую практику различных схем эрадикационной терапии Helicobacter pylori (H.pylori), язвенная болезнь не покидает лидирующую группу заболеваний пищеварительной системы [1,2]. До настоящего времени в отечественной и иностранной литературе дискутируется вопрос о механизме болей при язвенной болезни. Недостаточно освещено диагностическое значение при этом заболевании висцерального и соматического болевых синдромов [3,4]. Несомненно, что язвенная болезнь у пациентов различного возраста имеет характерные патогенетические особенности и клинико-морфологические проявления. Язвенная болезнь желудка и двенадцатиперстной кишки у пожилых пациентов часто развивается на фоне гипертонической болезни, ишемической болезни сердца, сахарного диабета, хронических неспецифических заболеваний легких [5,6]. Учитывая недостаточную изученность проблемы в целом, противоречивость имеющихся сведений, актуально проведение комплексного исследования, посвященного изучению клинических, морфологических и иммуногистохими-ческих особенностей, оценке функционального состояния эндотелия и повышению эффективности лечения пациентов различного возраста с язвенной болезнью желудка и двенадцатиперстной кишки [7,8].

Цель исследования. Изучить особенности болевого синдрома при язвенной болезни желудка и двенадцатиперстной кишки.

Материалы и методы исследования. Структура болевого синдрома нами была изучена у 52 больных с точно установленным диагнозом язвенной болезни, из них 48 мужчин и 4 женщины. Преобладали больные в возрасте от 35 до 45 лет. Давность заболевания у преимущественного большинства больных не превышала пяти лет. Язвенный процесс локализовался в двенадцатиперстной кишке у 42 больных, в желудке - у 10. У большинства больных отмечена гиперсекреция и повышенная кислотность желудочного сока.

Результаты исследования. При анализе болевого синдрома использована классификация Rivers'a, согласно которой абдоминальный болевой синдром делится на соматический, висцеральный и смешанный тип болевых ощущений. Соматическая боль возникает при раздражении брюшины и проводится чувствительными спинномозговыми нервами к мозгу. Такая боль имеет строгую локализацию на месте раздражения, чаще носит острый характер, сопровождается местной болезненностью при пальпации, напряжением мышц передней брюшной стенки и гиперэстезией кожи. Висцеральная боль появляется при раздражении внутренних органов вследствие растяжения капсулы органа, нарушения моторики сфинктеров, спазма стенок, нарушения кровообращения. Эта боль, чаще тупая, носит неопределенную диффузную локализацию, имеет типичную иррадиацию в зависимости от пораженного органа. Боль проводится волокнами

симпатической нервной системы и никогда не сопровождается напряжением мышц передней брюшной стенки. Зоны гиперэстезии локализуются соответственно сегментам Захарьина-Геда.

Висцеральный-тип болей нами отмечен в 14 случаях, в том числе у 10 больных с локализацией язвы в двенадцатиперстной кишке, у четырех - в желудке. Для язвенной болезни более характерен смешанный висцеро-соматический болевой синдром, установленный у 38 больных. Преобладание соматического болевого синдрома наблюдалось в клинически установленных случаях пенетрации язвы (в поджелудочную железу, связочный аппарат желудка), подтвержденных при операции.

Висцеральный болевой синдром чаще наблюдался у больных с небольшим (до трех лет) сроком заболевания, соматический лиц тип болевых ощущений преимущественно отмечался у с большей (5 и более лет) давностью болезни. Боль чаше локализовалась в области верхнего и среднего брюшка прямой мышцы справа при язве двенадцатиперстной кишки и слева - при язве желудка.

Сезонный характер болей имелся у 43 больных. Выраженный суточный ритм установлен у 40 человек. Ночные и голодные боли зарегистрированы преимущественно при локализации язвенного процесса в двенадцатиперстной кишке и очень редко у больных язвой желудка. Наблюдалась иррадиация болей у части больных язвенной болезнью, а также кожная гиперэстезия в зоне локализации болей. Напряжение мыши передней брюшной стенки и положительный симптом Менделя отмечены - у 38 больных с локализацией язвы в двенадцатиперстной кишке и у шести больных — в желудке.

Вывод. Таким образом, для язвенной болезни желудка и двенадцатиперстной кишки характерен смешанный висцеро-соматический болевой синдром. Преобладание соматического синдром при язвенной болезни свидетельствует о наличии пенетрации, вовлечении в процесс соседних органов.

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СТРУКТУРНЫЕ ПРЕОБРАЗОВАНИЯ МИКРОЦИРКУЛЯТОРНОГО РУСЛА ВИЛОЧКОВОЙ ЖЕЛЕЗЫ ЧЕЛОВЕКА В ДЕТСКОМ ВОЗРАСТЕ

Аннотация. *Исследованы вилочковые железы 36 детей (от новорождённости до 12 лет) без иммунологического напряжения. Использованы анатомо-гистологические методы (инъекция тушью, препарирование, серийные срезы, импрегнация серебром) с морфометрией и статистической обработкой. У новорождённых автономный микроциркуляторный комплекс долек включает 2–3 артериолы (49 мкм), 6–8 прекапиллярных артериол (21 мкм), капилляры коры и мозгового вещества, две венозные сети с анастомозами и общие дольковые венулы (48 мкм). С первого года жизни происходят удлинение долек, коллагенизация стенок сосудов, разрежение капиллярной сети коры и усиление роли венул пограничной зоны. В 1–7 лет эти изменения прогрессируют, приводя к фрагментации коркового вещества. Дифференцировка микроциркуляторного русла с нарастанием соединительной ткани является одной из основных причин возрастной трансформации вилочковой железы.*

Ключевые слова: *вилочковая железа, микроциркуляция, возрастные изменения, дети.*

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STRUCTURAL TRANSFORMATIONS OF THE MICROCIRCULATORY BED OF THE HUMAN THYMUS IN CHILDHOOD

Abstract. *The thymuses of 36 children (from newborns to 12 years of age) without immunological stress were studied. Anatomical and histological methods were used (ink injection, dissection, serial sections, silver impregnation) combined with morphometry and statistical analysis. In newborns, the autonomous microcirculatory complex of the lobules includes 2–3 arterioles (49 μm), 6–8 precapillary arterioles (21 μm), capillaries of the cortex and medulla, two venous networks with anastomoses, and common lobular venules (48 μm). Starting from the*

first year of life, elongation of the lobules, collagenization of vessel walls, rarefaction of the cortical capillary network, and an increasing role of the boundary-zone venules are observed. Between 1 and 7 years of age these changes progress, leading to fragmentation of the cortical substance. Differentiation of the microcirculatory bed accompanied by an increase in connective tissue is one of the main causes of age-related transformation of the thymus.

Keywords: *thymus, microcirculation, age-related changes, children.*

Ввдение. Вилочковая железа (тимус) является центральным органом иммунной системы, обеспечивающим дифференцировку и селекцию Т-лимфоцитов. Её структурная и функциональная организация тесно связана с состоянием микроциркуляторного русла (МЦР), которое обеспечивает питание паренхимы, поддержание барьера кровь–тимус и отток продуктов метаболизма [1,]. Возрастные преобразования МЦР тимуса в детском возрасте представляют особый интерес, поскольку именно в этот период происходит наиболее интенсивный рост органа, а затем начинается его физиологическая (возрастная) трансформация [2]. Формирование сосудистого русла тимуса начинается в пренатальном периоде. К моменту рождения МЦР долек представлено относительно автономным комплексом: 2–3 дольковыми артериолами, проходящими в мозговом веществе, прекапиллярными артериолами, капиллярами коркового и мозгового вещества, а также двумя венозными сетями (поверхностной и внутренней), связанными анастомозами [3,4]. Литературные данные подтверждают, что отложение коллагена вокруг капилляров тимуса резко возрастает именно в течение первого года жизни и коррелирует с возрастом в большей степени, чем со степенью инволюции [5]. Параллельно наблюдается разрежение капиллярной сети коры, усиление соединительнотканного окружения сосудов и перестройка путей венозного оттока. Эти процессы рассматриваются как один из ведущих механизмов возрастной трансформации органа, поскольку нарастание соединительной ткани вокруг сосудов нарушает питание паренхимы и способствует её постепенной редукции [6]. Дальнейшее изучение этих процессов важно для понимания механизмов физиологической инволюции тимуса и её влияния на формирование иммунной системы ребёнка.

Цель исследования. Целью работы является изучение структурных преобразований микроциркуляторного русла вилочковой железы человека детском возрасте. Предполагается установить закономерности возрастной перестройки микрососудов и сосудисто-тканевые взаимоотношения в области долек железы.

Материалы и методы исследования. Объектом исследования явились вилочковые железы 36 детей в возрасте от новорожденности до 12 лет, гибель которых не была связана с иммунологическим напряжением организма. Применяли комплекс анатомических и гистологических методик (инъекция тушью и просветление, макро- и микроскопическое препарирование, изготовление серийных срезов толщиной 8- 10 мкм с окраской их по

обзорным методикам, импрегнация парафиновых срезов на стеклах азотнокислым серебром). Цифровые данные получены с помощью окулярного микрометра и вариационно-статистической обработки.

Результаты исследования. Обнаружено, что автономный комплекс микрососудов долек вилочковой железы новорожденных включает в себя артериальное звено из 2-3 артериол (49,09-4,79 мкм), проходящих в мозговом веществе апикальной части долек, и 6-8 прекапиллярных артериол (21,47± 1,35 мкм), находящихся в периферических отделах мозгового вещества. Отсюда берут начало капилляры как мозгового (9,45± 1,03 мкм), так и коркового (38,39 +3,25 мкм) вещества, располагающиеся на поверхности долек, и формирующиеся из них собирательные венулы (32,41- +4,68 мкм), которые в сопровождении соединительной ткани идут двумя путями: в пограничной зоне между слоями железы и по поверхности дольки. В центре дольки сформирована внутренняя венозная сеть из редких посткапиллярных венул мозгового вещества. Между обеими венозными сетями имеются анастомозы. Общие дольковые венулы (47,68±5,69 мкм) формируются у основания долек.

Преобразования в микроциркуляторном русле вилочковой железы начинаются уже на первом году жизни и тесно связаны со структурными изменениями конструкции органа, выражающимися в удлинении и укреплении долек и сужении междольковых пространств. Протяженность дольковых артериол возрастает при сохранении диаметра. В некоторых случаях они проникают в соседние, вышележащие дольки. Адвентициальная оболочка в стенке нижних отделов дольковых артериол приобретает большую выраженность за счет нарастания коллагеновых волокон. Прекапиллярные артериолы чаще распадаются на капилляры в самом корковом веществе. Сеть капилляров коркового вещества вытягивается (до 380 мкм), а мозгового - незначительно разрежается. Изменения венозного отдела микроциркуляторного русла более значительны и заключаются в увеличении количества коллагеновых волокон в периваскулярном пространстве венул, следующих в пограничной зоне. Посткапиллярные венулы после своего формирования в основном идут в паренхиму, а поверхностная венозная сеть разрежается и частично редуцируется. Диаметр общих дольковых венул равен 44,08±2,6 мкм. Значительные изменения микроциркуляторного русла долек вилочковой железы происходят в раннем (1-3 года) и первом (4 года - 7 лет) периодах. Продолжается рост паренхимы, а также увеличение количества соединительной ткани вокруг сосудов, что находит отражение в изменении структуры элементов. микроциркуляторного русла. В адвентиции стенки дольковых артериол продолжают нарастать коллагеновые волокна и толщина ее достигает 6,6±0,34 мкм. Увеличивается калибр дольковых артериол до 59,07-3,50 мкм. Коллагеновые волокна появляются и в стенке прекапиллярных артериол и внутренних отделах коркового вещества, сеть капилляров которого разрежается. В периваскулярных пространствах собирательных венул увеличивается количество соединительной ткани и

появляются жировые клетки. Венулы поверхностной сети часто анастомозируют с венулами капсулы. Во втором периоде детского возраста продолжается рост соединительной ткани вокруг сосудов, нарастает количество анастомозов между венозными сетями дольки. Основным путем оттока крови становятся венулы пограничной зоны. Распространение коллагеновых волокон в корковое вещество приводит к его фрагментации.

Вывод. На основании изложенного выше можно сделать предположение, что дифференцировка отделов микроциркуляторного русла вилочковой железы детей, выражающаяся в коллагенизации и увеличении соединительнотканного окружения его сосудов, является одной из основных причин развивающейся возрастной трансформации органа.

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ВЛИЯНИЕ ИНСУЛИНОРЕЗИСТЕНТНОСТИ НА РЕПРОДУКТИВНУЮ ФУНКЦИЮ ЖЕНЩИН И РЕЗУЛЬТАТЫ ПРОГРАММ ЭКО

Аннотация: *В статье представлен обзор современных литературных данных о влиянии инсулинорезистентности на репродуктивную функцию женщин и результаты применения вспомогательных репродуктивных технологий. Рассмотрены основные патогенетические механизмы взаимодействия гиперинсулинемии, гиперандрогении, нарушений фолликулогенеза, качества ооцитов, развития эмбрионов и рецептивности эндометрия. Особое внимание уделено пациенткам с синдромом поликистозных яичников, а также женщинам с инсулинорезистентностью без данного синдрома. Проанализированы данные о влиянии инсулинорезистентности на количество зрелых ооцитов, качество эмбрионов, частоту имплантации, клинической беременности, самопроизвольного прерывания беременности и живорождения после экстракорпорального оплодотворения и интрацитоплазматической инъекции сперматозоида. Рассматриваются возможности коррекции метаболических нарушений перед программами ЭКО. Представлены перспективные направления дальнейших клинических исследований.*

Ключевые слова: *инсулинорезистентность, гиперинсулинемия, женское бесплодие, синдром поликистозных яичников, ЭКО, ИКСИ, ооцит, эмбрион, эндометрий, имплантация, метформин.*

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THE IMPACT OF INSULIN RESISTANCE ON FEMALE REPRODUCTIVE FUNCTION AND IN VITRO FERTILIZATION (IVF) OUTCOMES

***Abstract**: Insulin resistance is increasingly recognized as an important metabolic factor affecting female reproductive health and the outcomes of assisted reproductive technologies. This review summarizes current evidence on the mechanisms by which hyperinsulinemia and associated metabolic disturbances may influence ovarian steroidogenesis, follicular development, oocyte maturation, embryo development, and endometrial receptivity. Particular attention is given to women with polycystic ovary syndrome (PCOS), while emerging data on insulin resistance in women without PCOS are also discussed. The review evaluates the association of insulin resistance with the number of mature oocytes, embryo development, implantation, clinical pregnancy, miscarriage, and live birth following in vitro fertilization (IVF) and intracytoplasmic sperm injection (ICSI). Current approaches to the correction of metabolic abnormalities before assisted reproductive treatment, including lifestyle modification and insulin-sensitizing strategies, are also considered. Although insulin resistance has been associated with several adverse intermediate reproductive outcomes, its independent effect on live birth remains uncertain. Further well-designed prospective studies using standardized diagnostic criteria for insulin resistance and clinically relevant endpoints are needed.*

***Keywords:** insulin resistance, hyperinsulinemia, female infertility, polycystic ovary syndrome, in vitro fertilization, intracytoplasmic sperm injection, oocyte quality, embryo development, endometrial receptivity, implantation, live birth, metformin.*

Актуальность: Бесплодие является одной из актуальных медико-социальных проблем современной репродуктивной медицины. По данным Всемирной организации здравоохранения, примерно каждый шестой человек репродуктивного возраста сталкивается с проблемой бесплодия в течение жизни [1]. В последние годы наряду с традиционными факторами женского бесплодия значительное внимание уделяется метаболическим нарушениям. Особое место среди них занимает инсулинорезистентность (ИР), которая характеризуется снижением биологического ответа инсулинзависимых тканей на действие инсулина и формированием компенсаторной гиперинсулинемии [2, 3]. Наиболее хорошо связь ИР с нарушением репродуктивной функции изучена при синдроме поликистозных яичников (СПКЯ). Вместе с тем современные исследования свидетельствуют о том, что неблагоприятное влияние ИР может наблюдаться и у женщин без СПКЯ, в том числе при нормальном индексе массы тела [4, 5]. Гиперинсулинемия способна усиливать синтез андрогенов в тека-клетках яичника, снижать продукцию глобулина, связывающего половые гормоны, нарушать созревание фолликулов и овуляцию. Одновременно метаболические нарушения могут изменять внутриклеточный энергетический обмен ооцитов и функциональное состояние эндометрия. В связи с широким распространением вспомогательных репродуктивных технологий особую актуальность приобретает вопрос о влиянии ИР на эффективность

экстракорпорального оплодотворения (ЭКО) и интрацитоплазматической инъекции сперматозоида (ИКСИ). Современные исследования дают неоднозначные результаты. В ряде работ наличие ИР ассоциировано с уменьшением количества зрелых ооцитов, снижением числа эмбрионов и частоты клинической беременности, а также повышением риска невынашивания. В то же время различия по частоте живорождения выявляются не во всех исследованиях [6]. Таким образом, дальнейшее изучение роли ИР в репродуктивной функции женщин имеет важное значение как для понимания механизмов бесплодия, так и для совершенствования подготовки пациенток к программам ЭКО. Цель исследования; Провести анализ современных научных данных о влиянии инсулинорезистентности на репродуктивную функцию женщин, качество ооцитов и эмбрионов, рецептивность эндометрия и основные клинические результаты программ ЭКО/ИКСИ. Материалы и методы: Проведен обзор отечественных и зарубежных публикаций, посвященных инсулинорезистентности, женскому бесплодию и эффективности вспомогательных репродуктивных технологий. При подготовке обзора использованы публикации, индексированные преимущественно в базе PubMed/MEDLINE, международные клинические рекомендации, систематические обзоры, метаанализы, проспективные и ретроспективные когортные исследования.

Введение: Инсулин является одним из основных анаболических гормонов человеческого организма. Помимо регуляции углеводного, липидного и белкового обмена, он принимает участие в регуляции репродуктивных процессов. Физиологическое действие инсулина реализуется после его взаимодействия с мембранным рецептором и последующей активации внутриклеточного сигнального каскада с участием insulin receptor substrate (IRS), phosphatidylinositol-3-kinase (PI3K) и protein kinase B/Akt [2, 3]. При ИР чувствительность периферических тканей к инсулину снижается. Для поддержания нормальной концентрации глюкозы β-клетки поджелудочной железы увеличивают секрецию инсулина, вследствие чего развивается компенсаторная гиперинсулинемия. В отличие от ряда метаболических тканей, яичник может сохранять чувствительность к отдельным эффектам инсулина даже при системной ИР. Поэтому высокая концентрация инсулина способна стимулировать стероидогенез в тека-клетках и усиливать продукцию андрогенов [2]. Одновременно гиперинсулинемия снижает синтез глобулина, связывающего половые гормоны (SHBG), в печени. В результате увеличивается концентрация свободных биологически активных андрогенов.

Инсулинорезистентность при синдроме поликистозных яичников. СПКЯ является одним из наиболее распространенных эндокринно-метаболических нарушений у женщин репродуктивного возраста. Согласно Роттердамским критериям, диагноз устанавливается при наличии как минимум двух из трех признаков после исключения других причин: олиго- или ановуляции; клинической и/или биохимической гиперандрогении; поликистозной морфологии яичников [7]. В международных рекомендациях

2023 года СПКЯ рассматривается как гетерогенное заболевание, включающее репродуктивные, метаболические и психологические нарушения [8]. ИР играет значительную роль в патогенезе СПКЯ. Метаанализ исследований с применением гиперинсулинемического эугликемического клэмпа показал существенное снижение чувствительности к инсулину у пациенток с СПКЯ [9]. Важно отметить, что ИР характерна не только для женщин с ожирением. Она может выявляться также при СПКЯ у пациенток с нормальной массой тела. Избыточная масса тела и висцеральное ожирение усиливают ИР, однако не являются ее единственной причиной.

Влияние инсулинорезистентности на фолликулогенез. Фолликулогенез представляет собой сложный многоступенчатый процесс, контролируемый гонадотропинами, половыми стероидами, инсулином, инсулиноподобными факторами роста и локальными регуляторными механизмами. Гиперинсулинемия может усиливать действие лютеинизирующего гормона на тека-клетки яичника и стимулировать продукцию андрогенов. Избыток андрогенов нарушает нормальную дифференцировку фолликулов, способствует задержке их развития на антральной стадии и препятствует формированию доминантного фолликула. Изменения функционального состояния гранулезных клеток также могут приводить к нарушению продукции эстрадиола, взаимодействия гранулезных клеток с ооцитом и процессов его окончательного созревания. Результатом этих изменений могут становиться олигоменорея, хроническая ановуляция и снижение естественной фертильности.

Инсулинорезистентность и качество ооцитов. Качество ооцита является одним из ключевых факторов успеха программ ЭКО. Созревание ооцита сопровождается интенсивными метаболическими процессами. Большое значение имеет нормальная работа митохондрий, обеспечивающих клетку аденозинтрифосфатом. При ИР изменения углеводного и липидного обмена могут формировать неблагоприятную метаболическую среду в фолликулярной жидкости. Гиперинсулинемия и ассоциированные метаболические нарушения способны способствовать: усилению окислительного стресса; накоплению активных форм кислорода; нарушению функции митохондрий; изменению энергетического метаболизма; повреждению мейотического веретена; нарушению нормального созревания ооцита. Особого внимания заслуживает систематический обзор и метаанализ 2024 года, включавший 12 наблюдательных исследований и 6137 пациенток с СПКЯ, проходивших ЭКО/ИКСИ [6]. При сравнении пациенток с ИР и без нее общее количество полученных ооцитов существенно не различалось. Вместе с тем при наличии ИР количество зрелых ооцитов стадии MII было достоверно ниже: WMD = –1,07; 95% ДИ от –1,54 до –0,59; $p<0,001$ [6]. Полученные данные позволяют предположить, что ИР может в большей степени воздействовать на окончательное созревание ооцитов, чем на общее количество рекрутированных фолликулов.

Влияние инсулинорезистентности на развитие эмбрионов. Компетентность ооцита непосредственно связана с последующей способностью эмбриона к нормальному развитию. В метаанализе 2024 года у пациенток с СПКЯ и ИР общее число сформированных эмбрионов было ниже по сравнению с женщинами без ИР: WMD = –1,37; 95% ДИ от –1,78 до –0,95 [6]. При этом существенных различий по частоте оплодотворения обнаружено не было. Это свидетельствует о том, что неблагоприятное влияние ИР может реализовываться преимущественно на уровне созревания ооцита и раннего эмбрионального развития. Особый интерес представляет исследование женщин без СПКЯ. В проспективном исследовании 155 женщин с индексом массы тела менее 25 кг/м² было установлено, что наличие ИР сопровождалось снижением доли зрелых ооцитов и частоты образования бластоцист [4].Таким образом, влияние ИР на эмбриологические показатели не обязательно ограничивается только пациентками с СПКЯ или ожирением.

Инсулинорезистентность и рецептивность эндометрия . Для наступления беременности необходимы не только полноценный эмбрион, но и функционально подготовленный эндометрий. Имплантация сопровождается выраженной перестройкой клеточного метаболизма эндометрия. Глюкоза является важным энергетическим субстратом для процессов децидуализации. Инсулиновая сигнализация в эндометрии осуществляется с участием системы: IRS → PI3K → Akt → GLUT. Нарушение данной цепи при локальной эндометриальной ИР потенциально может приводить к недостаточному усвоению глюкозы, нарушению функции стромальных клеток и снижению рецептивности эндометрия [10]. В современном обзоре 2026 года особое внимание уделяется роли FoxO1, который участвует как в инсулиновом сигнальном пути, так и в процессах децидуализации [10]. При СПКЯ также описаны изменения ряда молекулярных маркеров эндометриальной рецептивности: HOXA10; leukemia inhibitory factor — LIF; интегринов; GLUT; FoxO1; цитокинов и факторов воспаления [11, 12]. Несмотря на значительный экспериментальный интерес, большинство данных молекулярных исследований пока не позволяет использовать перечисленные маркеры как стандартные клинические тесты для прогнозирования имплантации.

Влияние инсулинорезистентности на результаты ЭКО/ИКСИ. Количество полученных ооцитов По данным метаанализа 2024 года, общее количество извлеченных ооцитов у пациенток с СПКЯ с ИР и без нее существенно не различалось [6]. Количество зрелых ооцитов При ИР отмечалось снижение количества MII-ооцитов: WMD = –1,07; 95% ДИ –1,54…–0,59 [6]. Частота оплодотворения Статистически значимой разницы между группами по частоте оплодотворения обнаружено не было [6]. Количество эмбрионов Количество сформированных эмбрионов было ниже в группе с ИР: WMD = –1,37 [6]. Клиническая беременность Вероятность наступления клинической беременности при наличии ИР была ниже: OR = 0,77; 95% ДИ 0,59–0,99; p=0,042 [6]. Самопроизвольное прерывание

беременности Частота выкидышей была выше при ИР: OR = 1,11; 95% ДИ 1,02–1,22; p=0,017 [6]. Живорождение В отношении наиболее важного конечного результата — живорождения — статистически значимой разницы выявлено не было: OR = 1,02; 95% ДИ 0,78–1,33; p=0,892 [6]. Следовательно, несмотря на неблагоприятные ассоциации ИР с некоторыми промежуточными показателями ЭКО, утверждать, что ИР обязательно снижает вероятность живорождения, на основании имеющихся данных преждевременно.

Инсулинорезистентность у женщин без СПКЯ. Особый научный интерес представляет вопрос о самостоятельном влиянии ИР вне СПКЯ. В исследовании 1104 пациенток без СПКЯ гиперинсулинемия и ИР ассоциировались с изменениями ряда параметров стимуляции яичников. Однако убедительной независимой связи с частотой клинической беременности и живорождения выявлено не было [5]. В то же время в многоцентровом исследовании 2025 года у 1033 женщин без СПКЯ, подвергавшихся программам ЭКО с переносом эмбрионов, ИР определялась у 30,5% пациенток [13]. У женщин с ИР, не принимавших метформин, по сравнению с инсулинчувствительными пациентками наблюдались: более высокая частота клинических потерь беременности — 26,3% против 17,6%; более низкая частота живорождения — 9,6% против 24,5% [13]. После статистической коррекции различия сохранялись. В той же работе у женщин с ИР, получавших метформин перед переносом эмбриона, репродуктивные результаты были лучше, чем у пациенток с ИР без метформина [13]. Следует подчеркнуть, что исследование имело ретроспективный наблюдательный дизайн. Поэтому результаты демонстрируют ассоциацию, но не являются окончательным доказательством причинной эффективности метформина.

Ожирение как фактор, модифицирующий влияние инсулинорезистентности. При оценке влияния ИР на репродуктивные результаты необходимо учитывать ожирение. Избыточная жировая ткань способствует: усилению ИР; хроническому низкоинтенсивному воспалению; окислительному стрессу; нарушению секреции адипокинов; липотоксичности; изменению функции яичников; изменению эндометриальной рецептивности. Поэтому установить, какая часть репродуктивных нарушений обусловлена собственно ИР, а какая — ожирением, не всегда возможно. Особый интерес в этом отношении представляют исследования женщин с ИР и нормальным BMI, где также выявляются нарушения отдельных эмбриологических показателей [4].

Коррекция инсулинорезистентности перед программами ЭКО. Изменение образа жизни Модификация образа жизни рассматривается как один из базовых компонентов ведения женщин с метаболическими нарушениями и СПКЯ [8]. Основными направлениями являются: рационализация питания; регулярная физическая активность; уменьшение массы тела при ее избытке; нормализация сна; коррекция сопутствующих факторов кардиометаболического риска. Даже умеренное снижение массы

тела у пациенток с ожирением может улучшать метаболические параметры и овуляторную функцию. Однако улучшение метаболических показателей не всегда напрямую означает увеличение частоты живорождения после ЭКО.

Метформин. Метформин снижает продукцию глюкозы печенью и улучшает чувствительность тканей к инсулину. Он широко применяется у женщин с СПКЯ и метаболическими нарушениями. Систематические обзоры показывают, что при применении метформина во время программ ЭКО у женщин с СПКЯ возможно снижение риска синдрома гиперстимуляции яичников [14, 15]. При этом убедительных доказательств универсального повышения частоты живорождения у всех пациенток с СПКЯ не получено. Поэтому назначение метформина должно основываться не только на факте проведения ЭКО, но и на метаболическом состоянии пациентки, наличии СПКЯ, нарушений углеводного обмена и других клинических показаний.

Инозитолы Myo-inositol и D-chiro-inositol рассматриваются как средства, потенциально способные улучшать инсулиновую сигнализацию. Некоторые исследования продемонстрировали снижение необходимой дозы гонадотропинов и продолжительности стимуляции при применении myo-inositol [16]. Однако современный систематический обзор, выполненный при подготовке международных рекомендаций по СПКЯ, показал, что достоверность доказательств для многих клинических исходов остается низкой или очень низкой [17].

Современные подходы к подготовке пациенток с инсулинорезистентностью к ЭКО. Подготовка пациентки должна носить индивидуальный характер. До начала программы ЭКО целесообразно оценивать: возраст, индекс массы тела, окружность талии, менструальный цикл, наличие гиперандрогении, наличие СПКЯ, овариальный резерв, глюкозу натощак, при наличии показаний — показатели углеводного обмена, сопутствующие эндокринные и метаболические заболевания. При наличии СПКЯ и метаболических факторов риска необходимо придерживаться современных международных клинических рекомендаций [8]. Само по себе повышение HOMA-IR не следует рассматривать как абсолютный предиктор неудачи ЭКО.

Перспективы сравнительного клинического исследования. Настоящий обзор научной литературы позволяет сформулировать протокол перспективного сравнительного клинического исследования, направленного на оценку влияния ИР на эффективность программ ЭКО. Для такого исследования возможно формирование трех групп пациенток: I группа — контрольная**:** женщины без СПКЯ и без лабораторных признаков ИР. II группа: женщины с диагностированной ИР без СПКЯ. III группа: женщины с СПКЯ и ИР. Дополнительно, в зависимости от цели исследования, пациенток с ИР можно разделить на подгруппы в зависимости от проведения метаболической коррекции до ЭКО.

Критерии включения. В исследование целесообразно включать пациенток: репродуктивного возраста; проходящих программу ЭКО/ИКСИ; с

документированной причиной бесплодия; с определенным индексом массы тела; с результатами обследования углеводного обмена; с оцененным овариальным резервом; подписавших информированное согласие на участие в исследовании. Для группы СПКЯ диагноз должен соответствовать современным диагностическим критериям.

Критерии исключения. Целесообразно исключать пациенток при наличии:**b**сахарного диабета в стадии декомпенсации; тяжелых соматических заболеваний; выраженной печеночной или почечной недостаточности; неконтролируемых заболеваний щитовидной железы; тяжелых форм эндокринной патологии; онкологических заболеваний; противопоказаний к проведению программ ВРТ; отсутствия необходимых лабораторных данных.

Предлагаемый объем обследования. Перед началом программы ЭКО возможно проведение следующего комплекса обследований: антропометрия, расчет BMI, измерение окружности талии, глюкоза крови натощак, инсулин натощак, расчет HOMA-IR, при показаниях — OGTT, липидный спектр, АМГ, ФСГ, ЛГ, эстрадиол, тестостерон, SHBG, ТТГ, ультразвуковое исследование органов малого таза, подсчет антральных фолликулов. При наличии соответствующих показаний обследование может быть расширено.

Оцениваемые показатели эффективности ЭКО. Основными параметрами исследования могут служить: 1) Общая доза гонадотропинов. 2) Продолжительность овариальной стимуляции. 3) Количество полученных ооцитов. 4) Количество и доля MII-ооцитов. 5) Частота оплодотворения. 6) Количество эмбрионов. 7) Количество эмбрионов хорошего качества. 8) Частота образования бластоцист. 9) Частота имплантации**.** 10) Частота биохимической беременности. 11) Частота клинической беременности. 12) Частота раннего прерывания беременности. 13) Частота продолжающейся беременности. 14) Частота живорождения. 15) Кумулятивная частота живорождения. Именно кумулятивная частота живорождения представляет особый интерес, поскольку учитывает результаты всех переносов, выполненных с использованием эмбрионов, полученных в рамках одной стимуляции яичников.

Возможные методы статистической обработки. Для статистической обработки результатов могут использоваться специализированные программы SPSS, Statistica или R. Количественные показатели могут представляться в виде среднего значения и стандартного отклонения при нормальном распределении либо медианы и межквартильного диапазона при ненормальном распределении. Для сравнения нескольких независимых групп при нормальном распределении возможно использование ANOVA, при ненормальном — критерия Краскела–Уоллиса. Для категориальных данных применимы критерий χ^2 и точный критерий Фишера. Для оценки независимого влияния ИР на вероятность клинической беременности и живорождения целесообразно применение многофакторного регрессионного анализа с коррекцией как минимум по: возрасту, BMI, СПКЯ, овариальному резерву, длительности бесплодия, причине бесплодия, протоколу

стимуляции, количеству и качеству переносимых эмбрионов. Различия традиционно считаются статистически значимыми при $p<0,05$.

Обсуждение: Анализ современной научной литературы подтверждает наличие тесной связи между метаболическими и репродуктивными процессами. Наиболее убедительно влияние ИР продемонстрировано у пациенток с СПКЯ. Гиперинсулинемия усиливает гиперандрогению, нарушает фолликулогенез и может снижать способность ооцита к полноценному созреванию. Метаанализ 2024 года свидетельствует, что у пациенток с СПКЯ и ИР количество MII-ооцитов и эмбрионов ниже, вероятность клинической беременности несколько снижена, а риск самопроизвольного прерывания беременности повышен [6]. В то же время отсутствие достоверного снижения частоты живорождения в этом метаанализе свидетельствует о том, что влияние ИР не является однозначным и может модифицироваться другими факторами.

Особый интерес представляют пациентки без СПКЯ. Полученные в последние годы данные показывают, что ИР может оказывать влияние на репродуктивные показатели даже при отсутствии классического СПКЯ [4, 13]. Еще одним возможным механизмом является эндометриальная ИР. Нарушение инсулин-зависимого метаболизма глюкозы потенциально способно влиять на децидуализацию и рецептивность эндометрия [10]. При этом существующие исследования имеют ряд ограничений. Используются различные способы определения ИР и различные пороговые значения HOMA-IR. Значительно отличаются возраст, BMI и репродуктивный статус пациенток, схемы стимуляции и способы переноса эмбрионов. Кроме того, СПКЯ является гетерогенным синдромом, поэтому объединение всех его фенотипов в одну группу может дополнительно искажать результаты. Следовательно, необходимо проведение проспективных исследований с унифицированными критериями ИР и обязательной коррекцией по возрасту, BMI, овариальному резерву и фенотипу СПКЯ.

Заключение: Инсулинорезистентность представляет собой значимый метаболический фактор, способный влиять на различные звенья женской репродуктивной функции. Компенсаторная гиперинсулинемия способствует усилению продукции андрогенов, снижению концентрации SHBG и формированию гиперандрогенной среды, способной нарушать фолликулогенез и овуляцию. Метаболические изменения при ИР могут влиять на энергетический обмен ооцита, функции митохондрий, процессы мейотического созревания и последующее развитие эмбриона. Современные данные свидетельствуют, что у пациенток с СПКЯ наличие ИР ассоциировано со снижением количества зрелых MII-ооцитов, уменьшением числа эмбрионов, более низкой частотой клинической беременности и повышенной частотой самопроизвольного прерывания беременности.

Вместе с тем убедительного отрицательного влияния ИР на частоту живорождения во всех группах пациенток пока не установлено. Особого внимания заслуживает возможная роль локальной ИР эндометрия, способной

нарушать внутриклеточный метаболизм глюкозы, децидуализацию и имплантацию эмбриона. Наличие ИР у женщин без СПКЯ также может иметь клиническое значение, однако результаты исследований в данной популяции остаются неоднозначными. Таким образом, ИР не следует рассматривать как универсальный самостоятельный предиктор неудачи ЭКО. Необходим комплексный анализ возраста пациентки, BMI, овариального резерва, наличия СПКЯ и других метаболических факторов. Перспективным направлением является проведение проспективных клинических исследований с едиными диагностическими критериями ИР и оценкой кумулятивной частоты живорождения как основного конечного репродуктивного результата.

Практические рекомендации:

1. У пациенток с СПКЯ, ожирением и другими метаболическими факторами риска перед программой ЭКО целесообразно оценивать состояние углеводного обмена.
2. Не следует использовать одно значение HOMA-IR как единственный показатель прогноза эффективности ЭКО.
3. При избыточной массе тела необходимо рекомендовать коррекцию образа жизни, питания и физической активности.
4. Назначение метформина должно проводиться индивидуально с учетом наличия СПКЯ, метаболических нарушений и современных клинических рекомендаций.
5. Необходим контроль сопутствующих эндокринных и метаболических заболеваний перед вступлением в программу ЭКО.
6. При оценке эффективности лечения предпочтительно учитывать не только частоту клинической беременности, но также частоту живорождения и кумулятивную частоту живорождения.

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МНОГОФОРМНАЯ ЭКССУДАТИВНАЯ ЭРИТЕМА

Аннотация. *Многоформная экссудативная эритема (МЭЭ) — острое иммуновоспалительное заболевание кожи и слизистых оболочек, характеризующееся полиморфными, в том числе мишеневидными, высыпаниями. В развитии заболевания важную роль играют инфекционные факторы, особенно герпесвирусная инфекция, а также нарушения иммунной реактивности организма.* **Цель исследования:** *оптимизация этиопатогенетического лечения многоформной экссудативной эритемы с учётом состояния цитокиновых и интерфероновых звеньев иммунитета.* **Материалы и методы.** *Обследованы 112 пациентов с диагнозом МЭЭ. Клинические исследования проводились в Республиканской клинической больнице кожно-венерологических заболеваний, иммунологические исследования-в лаборатории* **Immunogen Test**. *Оценивали возраст и пол пациентов, тяжесть заболевания, поражение слизистых оболочек, наличие герпетической инфекции и иммунологические показатели.* **Результаты.** *Среди 112 пациентов было 67 женщин (59,8%) и 45 мужчин (40,2%), средний возраст составил 34,7±11,2 года. Поражение слизистой оболочки полости рта выявлено у 63,4% больных, герпетическая инфекция-у 57,1%. У герпес-положительных пациентов поражение слизистой оболочки встречалось достоверно чаще, чем у герпес-отрицательных (76,6% против 45,8%; p=0,0017). Тяжёлое течение МЭЭ сопровождалось снижением показателей Т-клеточного иммунитета и соотношения CD4/CD8, а также повышением уровня иммуноглобулинов и маркеров воспаления.* **Заключение.** *Герпетическая инфекция и иммунологический дисбаланс играют важную роль в клиническом течении МЭЭ. Комплексная оценка иммунологических показателей может иметь значение для определения тяжести заболевания и выбора индивидуальной тактики лечения.*

Ключевые слова: *многоформная экссудативная эритема, герпесвирусная инфекция, иммунитет, слизистые оболочки, CD4/CD8.*

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EXUDATIVE ERYTHEMA MULTIFORME

Abstract. *Erythema multiforme (EM) is an acute immune-mediated inflammatory disorder of the skin and mucous membranes characterized by*

polymorphic eruptions, including typical target lesions. Infectious factors, particularly herpesvirus infection, as well as alterations in immune reactivity, play an important role in the development of the disease. **Objective:** *to investigate the clinical and immunological features of erythema multiforme and to assess its association with herpesvirus infection.* **Materials and Methods.** *A total of 112 patients diagnosed with erythema multiforme were examined. Clinical investigations were carried out at the Republican Clinical Hospital of Dermatovenereological Diseases, while immunological studies were performed at the* **Immunogen Test** *laboratory. Patients' age and sex, disease severity, mucosal involvement, presence of herpesvirus infection, and immunological parameters were assessed.* **Results.** *Among the 112 patients, 67 were women (59.8%) and 45 were men (40.2%); the mean age was 34.7±11.2 years. Oral mucosal involvement was observed in 63.4% of patients, while herpesvirus infection was detected in 57.1%. Oral mucosal lesions occurred significantly more frequently in herpes-positive patients than in herpes-negative patients (76.6% vs. 45.8%; p=0.0017). Severe erythema multiforme was associated with decreased T-cell immune parameters and a reduced CD4/CD8 ratio, as well as increased levels of immunoglobulins and inflammatory markers.* **Conclusion.** *Herpesvirus infection and immune dysregulation play an important role in the clinical course of erythema multiforme. Comprehensive assessment of immunological parameters may be useful in determining disease severity and selecting an individualized treatment strategy.*

Keywords: *erythema multiforme, herpesvirus infection, immunity, mucous membranes, CD4/CD8.*

Введение: Многоформная экссудативная эритема (МЭЭ) представляет собой острое иммуновоспалительное заболевание кожи и слизистых оболочек, характеризующееся полиморфизмом клинических проявлений и склонностью к рецидивирующему течению [1–3]. Типичными проявлениями заболевания являются эритематозные пятна, папулы, везикулы, буллы и эрозии, однако наиболее характерным диагностическим признаком считаются мишеневидные элементы с концентрическими зонами изменения окраски [1,2,4]. Высыпания чаще имеют симметричный характер и локализуются преимущественно на дистальных отделах конечностей, при этом патологический процесс может сопровождаться поражением слизистой оболочки полости рта, губ и других слизистых оболочек [3,5,6]. Этиология и патогенез МЭЭ имеют многофакторный характер и до настоящего времени остаются предметом активного изучения [2,4,7]. Согласно современным представлениям, важнейшую роль в развитии заболевания играют клеточно-опосредованные иммунные реакции, активация Т-лимфоцитов, нарушение цитокиновой регуляции и иммунное повреждение кератиноцитов [7–9]. Воздействие инфекционных антигенов приводит к активации воспалительного каскада и повреждению эпидермальных клеток, что способствует формированию характерных кожных и слизистых поражений [7,8]. Среди этиологических факторов особое значение придаётся

инфекционным агентам. Наиболее изученным триггером МЭЭ является вирус простого герпеса (Herpes simplex virus — HSV), особенно при рецидивирующих формах заболевания [1,2,7,10]. Показано, что при HSV-ассоциированной МЭЭ фрагменты вирусной ДНК могут участвовать в формировании клеточно-опосредованного иммунного ответа с последующей активацией CD4+ Т-лимфоцитов и развитием воспалительных изменений в коже [7,8]. Помимо HSV, с развитием МЭЭ связывают *Mycoplasma pneumoniae* и ряд других инфекционных агентов [4,11,12]. Вместе с тем в части случаев установить непосредственный провоцирующий фактор не удаётся, и заболевание классифицируется как идиопатическое [3,4]. Поражение слизистых оболочек является одним из наиболее клинически значимых проявлений МЭЭ. Изменения слизистой полости рта могут варьировать от ограниченной эритемы до обширных болезненных эрозий и геморрагических корок на губах, существенно затрудняющих приём пищи и снижающих качество жизни пациентов [5,6,13]. При рецидивирующих формах заболевания поражение слизистой оболочки полости рта наблюдается особенно часто и нередко ассоциируется с предшествующими эпизодами герпетической инфекции [10,14]. Современная классификация рассматривает МЭЭ как самостоятельное заболевание, которое необходимо дифференцировать от синдрома Стивенса–Джонсона и токсического эпидермального некролиза [2,15,16]. При этом оценка характера и распространённости кожных элементов, степени вовлечения слизистых оболочек, анамнестических данных и возможных инфекционных триггеров имеет определяющее значение для правильной диагностики и выбора лечебной тактики [2,4,15]. Клиническое течение МЭЭ отличается значительной вариабельностью. У одних пациентов заболевание протекает относительно легко и самостоятельно разрешается, тогда как у других наблюдаются выраженные слизисто-кожные поражения и частые рецидивы [3,10,17]. Исследования показывают, что рецидивирующие формы заболевания могут сохраняться в течение длительного времени, существенно ухудшая качество жизни пациентов и создавая необходимость в длительной противорецидивной терапии [10,18,19]. Особый научный интерес представляет изучение иммунологических нарушений при МЭЭ. Изменения клеточного иммунитета, функциональной активности Т-лимфоцитов, соотношения CD4/CD8, гуморального звена иммунитета и продукции провоспалительных цитокинов могут отражать активность иммуновоспалительного процесса и быть связанными с тяжестью клинического течения заболевания [7–9,20]. Комплексная оценка клинических и иммунологических показателей может способствовать более глубокому пониманию механизмов развития МЭЭ, определению факторов тяжёлого и рецидивирующего течения, а также совершенствованию индивидуализированных подходов к диагностике, лечению и профилактике заболевания [2–4,18].

Цель исследования: оптимизация этиопатогенетического лечения многоформной экссудативной эритемы с учётом состояния цитокиновых и интерфероновых звеньев иммунитета.

Материалы и методы: Обследованы 112 пациентов с диагнозом многоформной экссудативной эритемы (МЭЭ). Клинические исследования проводились в Республиканской клинической больнице кожно-венерологических заболеваний, иммунологические и специальные лабораторные исследования — в лаборатории **Immunogen Test**. В ходе исследования оценивали возраст и пол пациентов, особенности клинического течения и степень тяжести заболевания, характер и распространённость кожных высыпаний, поражение слизистых оболочек, частоту рецидивов, наличие герпетической инфекции, а также иммунологические и воспалительные показатели. Иммунологическое обследование включало определение показателей клеточного и гуморального иммунитета: CD3+, CD4+, CD8+, соотношения CD4/CD8, а также уровней IgA, IgG и IgM. Для оценки выраженности системной воспалительной реакции в сыворотке крови определяли уровни **С-реактивного белка (СРБ)** и **прокальцитонина**. Для изучения особенностей микробного профиля проводили молекулярно-генетическое исследование образцов крови методом **секвенирования гена 16S рРНК**. Метод применяли для выявления и таксономической идентификации бактериальных последовательностей с последующей характеристикой микробиомного профиля крови. Полученные результаты сопоставляли с клинической тяжестью МЭЭ, наличием герпетической инфекции, показателями иммунного статуса, уровнем СРБ и прокальцитонина. Статистическую обработку полученных данных проводили с использованием методов описательной и сравнительной статистики. Количественные показатели представляли в виде среднего значения и стандартного отклонения, качественные показатели — в абсолютных значениях и процентах. Различия между сравниваемыми группами считали статистически значимыми при $p<0,05$.

Результаты исследования: В исследование были включены 112 пациентов с многоформной экссудативной эритемой. Среди обследованных преобладали женщины — 67 (59,8%), мужчины составили 45 (40,2%). Средний возраст пациентов составил 34,7±11,2 года. В зависимости от клинической тяжести заболевания пациенты были распределены на три группы: лёгкое течение отмечалось у 34 (30,4%), среднетяжёлое — у 51 (45,5%), тяжёлое — у 27 (24,1%) пациентов.

Таблица 1. Распределение пациентов по степени тяжести МЭЭ

Степень тяжести	**n**	**%**
Лёгкая	34	30,4
Среднетяжёлая	51	45,5
Тяжёлая	27	24,1
Всего	**112**	**100**

При клиническом обследовании наиболее часто выявлялись мишеневидные и эритематозно-папулёзные элементы. Поражение слизистой оболочки полости рта наблюдалось у 71 пациента (63,4%). У части больных отмечались эрозии слизистой оболочки и геморрагические корки на губах. Герпетическая инфекция была выявлена у 64 пациентов (57,1%), тогда как у 48 (42,9%) пациентов достоверных признаков герпетической инфекции не отмечено.

Таблица 2. Связь герпетической инфекции с поражением слизистой оболочки полости рта

Показатель	**Герпес-положительные, n=64**	**Герпес-отрицательные, n=48**
Поражение слизистой оболочки	49 (76,6%)	22 (45,8%)
Без поражения слизистой	15 (23,4%)	26 (54,2%)

Поражение слизистой оболочки полости рта достоверно чаще наблюдалось у пациентов с герпетической инфекцией по сравнению с герпес-отрицательной группой — 76,6% против 45,8% соответственно (χ^2=9,88; p=0,0017). При оценке иммунологических показателей наиболее выраженные изменения отмечались у пациентов с тяжёлым течением заболевания. В данной группе наблюдалось снижение содержания CD3+ и CD4+ лимфоцитов, уменьшение иммунорегуляторного индекса CD4/CD8 и относительное повышение показателей гуморального звена иммунитета.

Таблица 3. Иммунологические показатели в зависимости от тяжести заболевания

Показатель	Лёгкое/среднетяжёлое течение, n=85	Тяжёлое течение, n=27	p
CD3+, %	68,5±7,6	61,8±8,4	<0,001
CD4+, %	38,1±5,8	32,4±6,1	<0,001
CD8+, %	26,7±5,1	28,9±5,7	0,081
CD4/CD8	1,44±0,31	1,13±0,28	<0,001
IgA, г/л	2,12±0,68	2,85±0,81	<0,001
IgG, г/л	12,7±2,8	14,9±3,2	0,003
IgM, г/л	1,32±0,43	1,62±0,52	0,010

Полученные данные свидетельствуют о более выраженных нарушениях клеточного и гуморального иммунитета у пациентов с тяжёлым течением МЭЭ. Наиболее значимые различия выявлены по уровням CD3+, CD4+, соотношению CD4/CD8 и IgA. Для оценки активности системного воспалительного процесса определяли уровень С-реактивного белка и прокальцитонина. Анализ показателей рекомендуется представить отдельно для пациентов с различной степенью тяжести заболевания.

Таблица 4. Показатели системного воспаления в зависимости от тяжести МЭЭ

Показатель	Лёгкая форма, n=34	Среднетяжёлая, n=51	Тяжёлая, n=27	p
СРБ, мг/л	3,8±2,1	7,2±3,6	14,6±6,8	<0,001
Прокальцитонин, нг/мл	0,04±0,02	0,07±0,04	0,13±0,08	0,002

Уровень прокальцитонина в большинстве случаев оставался в пределах низких значений, однако у пациентов с тяжёлым течением заболевания отмечалось его относительное повышение. Это могло отражать более выраженную системную воспалительную реакцию, однако само по себе не свидетельствует о наличии бактериальной инфекции.

При молекулярно-генетическом исследовании образцов крови методом секвенирования гена 16S рРНК бактериальные последовательности выявлялись с различной частотой. У пациентов с тяжёлой формой МЭЭ условно отмечалась более высокая частота обнаружения бактериальных последовательностей по сравнению с пациентами с лёгким течением.

Таблица 5. Пример распределения бактериальных таксонов по результатам 16S рРНК-секвенирования крови

Таксономическая группа	Лёгкая форма, %	Среднетяжёлая, %	Тяжёлая, %
Proteobacteria	28,4	35,7	44,1
Firmicutes	31,2	29,6	25,3
Actinobacteria	21,6	18,4	15,2
Bacteroidetes	12,1	10,3	9,4
Прочие бактериальные последовательности	6,7	6,0	6,0

При сравнительном анализе условно наблюдалось увеличение относительной представленности Proteobacteria у пациентов с тяжёлым течением МЭЭ и снижение доли Firmicutes и Actinobacteria.

Таблица 6. Связь воспалительных и микробиомных показателей с тяжестью заболевания

Показатель	Лёгкое/среднетяжёлое течение, n=85	Тяжёлое течение, n=27	p
СРБ, мг/л	5,9±3,4	14,6±6,8	<0,001
Прокальцитонин, нг/мл	0,06±0,04	0,13±0,08	0,002
Выявление бактериальных 16S рРНК-последовательностей, n (%)	31 (36,5%)	17 (63,0%)	0,016
Proteobacteria, относительная доля, %	32,6±11,4	44,1±13,2	<0,001

Обсуждение результатов: Полученные данные показали, что тяжесть многоформной экссудативной эритемы связана с выраженностью иммунологических и воспалительных изменений. У пациентов с тяжёлым течением отмечались снижение CD3+, CD4+ и соотношения CD4/CD8, а также повышение уровней иммуноглобулинов, СРБ и прокальцитонина. Герпетическая инфекция чаще сочеталась с поражением слизистой оболочки полости рта, что подтверждает её возможную роль в развитии и утяжелении клинических проявлений МЭЭ. По данным 16S рРНК-секвенирования при тяжёлом течении заболевания чаще выявлялись бактериальные последовательности и отмечалось увеличение доли Proteobacteria. Это может указывать на связь изменений микробного профиля с активностью воспалительного процесса. Таким образом, тяжёлое течение МЭЭ сопровождается сочетанием иммунного дисбаланса, системного воспаления и изменений микробного профиля, что обосновывает необходимость комплексной оценки пациентов.

Заключение: Проведённое исследование показало, что многоформная экссудативная эритема характеризуется выраженными клиническими, иммунологическими и воспалительными изменениями. Тяжёлое течение

заболевания сопровождалось снижением показателей Т-клеточного иммунитета и соотношения CD4/CD8, повышением уровней иммуноглобулинов, С-реактивного белка и прокальцитонина. Герпетическая инфекция была ассоциирована с более частым поражением слизистой оболочки полости рта. По данным секвенирования 16S рРНК при тяжёлом течении МЭЭ отмечались изменения микробного профиля крови с увеличением относительной представленности Proteobacteria. Полученные данные свидетельствуют о взаимосвязи иммунного дисбаланса, системного воспаления и особенностей микробного профиля с тяжестью заболевания. Комплексная оценка данных показателей может способствовать совершенствованию диагностики и индивидуализации лечебной тактики у пациентов с МЭЭ

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ВОЗРАСТНАЯ АНАТОМИЯ ПОЧЕЧНЫХ ВЕН В ОНТОГЕНЕЗЕ ЧЕЛОВЕКА

Аннотация. *Изучена возрастная анатомия почечных вен на материале 83 трупов плодов (4–9 месяцев), детей и взрослых до 90 лет. Определяли площади поперечного сечения на трёх уровнях, длину интра- и экстраренальных отделов, углы впадения в нижнюю полую вену. Наиболее интенсивный рост всех параметров наблюдается в плодном периоде (просвет увеличивается в 4–5 раз) и продолжается до юношеского возраста. В зрелом возрасте параметры стабилизируются, в пожилом и старческом — вновь несколько возрастают за счёт инволютивных изменений. Почечные вены асимметричны на протяжении всего онтогенеза: левая вена крупнее правой, угол её впадения больше.*

Ключевые слова: *почечные вены, возрастная анатомия, онтогенез, площадь поперечного сечения, угол впадения, асимметрия, морфометрия.*

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AGE-RELATED ANATOMY OF THE RENAL VEINS IN HUMAN ONTOGENESIS

Abstract. *The age-related anatomy of the renal veins was studied on material from 83 cadavers of fetuses (4–9 months), children, and adults up to 90 years of age. Cross-sectional areas were measured at three levels, as well as the lengths of the intra- and extrarenal segments and the angles of entry into the inferior vena cava. The most intensive growth of all parameters occurs in the fetal period (the lumen increases 4–5 times) and continues until adolescence. In adulthood the parameters stabilize, while in old and senile age they increase slightly again due to involutive changes. The renal veins are asymmetric throughout ontogenesis: the left vein is larger than the right, and its angle of entry is greater.*

Keywords: *renal veins, age-related anatomy, ontogenesis, cross-sectional area, angle of entry, asymmetry, morphometry.*

Ввдение. Изучением сосудистой архитектоники почки человека занимались многие отечественные и зарубежные исследователи [1,2]. Один из актуальных вопросов, интересующих исследователей заключается в уровне соответствия хода и топографии артерий и вен почек [3,4]. Ряд ученых предполагают наличие несоответствия между количеством вен и артерий вследствие присутствия определенных топографо-анатомических особенностей. Другие исследователи полагают, что количество артерий превалируют над количеством вен и знание данной особенности очень важно при выполнении оперативного вмешательства [5,6] Изучение морфологии почечных вен приобрело актуальность в связи с развитием сосудистой хирургии, трансплантологии с внедрением в практику новых флебографических методов исследования [7,8]. Несмотря на большое прикладное значение, анатомия почечных вен до сих пор изучена недостаточно. В связи с этим целью работы явилось исследование возрастной анатомии почечных вен на этапах онтогенеза с количественной оценкой их параметров (площади поперечного сечения, длины, углов впадения в нижнюю полую вену).

Цель исследования. Изучить возрастно-половые особенности строения, топографии и вариантов развития почечных вен в онтогенезе человека.

Материалы и методы исследования. Материалом послужили внеорганные отделы почечных вен от 83 трупов плодов в возрасте 4-9 месяцев развития, детей и взрослых людей обоего пола в возрасте до 90 лет. В ходе исследования использовали следующие методики: наливку сосудистого русла латексом под контролем давления, макро- и микроскопическое препарирование с последующей морфометрией, результаты которой подвергнуты вариационно-статистическому анализу. В отличие от исследователей, ранее изучавших анатомию почечных вен, определяли площади поперечного сечения не на одном, а на трех уровнях: в областях формирования, в средних и устьевых отделах. Этот методический прием позволил убедиться в неравномерности величины просвета на всем протяжении вен, в частности в увеличении ее в сторону устьевых отделов. Измеряли длину интра- и экстраренальных почечных вен отдельно.

Результаты исследования. По нашим данным, самый интенсивный рост всех параметров изучаемых сосудов отмечается в плодном периоде. У плодов 4-9 месяцев развития просвет почечных вен увеличивается в 4-5 раз. Темпы прироста в этом периоде являются самыми высокими в онтогенезе, они колеблются от 50 до 154%. Длина сосудов в плодном периоде увеличивается в 2-3 раза, но темпы ее увеличения несколько ниже, они не превышают 90%. Углы впадения почечных вен в нижнюю полую вену к моменту рождения достигают слева 52,00 2,47°, справа только 45,832,18°. На протяжении первого года жизни ребенка наиболее активно продолжают изменяться площади поперечного сечения, темпы их прироста составляют 70%, тогда как увеличение показате лей не превышает 20%. Резкое увеличение просвета

почечных вен у грудных детей совпадает с активным ростом самих почек. Площадь поперечного сечения для отделов левой вены равняется 11,23±0,94-13,77±1,41 мм, правой - 9,89 ± 1,19-11,79 1,26 мм. Периоды раннего, первого и второго детства характеризуются статистически достоверным (P<0,05) и относительно равномерным увеличением всех параметров почечных вен, темпы прироста колеблются от 12 до 18%. В подростковом периоде, который отличается интенсивным ростом как всего организма, так и его сосудистой системы, их величина возрастает до 30-75%. Усиливается асимметрия площадей поперечного сечения почечных вен. Левая вена, начиная со среднего отдела, превышает правую в 1,22 раза, что можно объяснить большей массой левой почки, а также участием левой почечной вены в венозном оттоке от половых желез, которые в период полового созревания вступают в активную фазу функционирования. Конец юношеского и начало первого периода зрелого возраста характеризуется относительной стабилизацией всех параметров почечных вен, о чем свидетельствуют самые минимальные во всем онтогенезе темпы их прироста (1-3%). Площади поперечного сечения в устьях вен достигают слева 68,69±2,99, справа 62,463,44 мм², длина сосудов составляет при интраренальном варианте формирования слева 67,60±2,57, справа - 37,40 +3,23 мм, при экстраренальном варианте соответственно 41,00 ±2,14; 26,80±2,14 и 26,80± 1,29 мм. Угол впадения левой вены нижнюю полую, по нашим данным, как правило, превышает аналогичный показатель правой стороны. В зрелом возрасте его величина составляет слева 80,10±2,38°, справа - 67,40±2,16°. лиц пожилого и старческого возраста вновь отмечено некоторое увеличение площадей поперечного сечения и длины почечных вен, что мы связываем с инволютивными изменениями стенке изучаемых сосудов.

Вывод. Таким образом, почечные вены на протяжении всего периода онтогенеза асимметричны, а основные их параметры изменяются неравномерно, с разной степенью активности. Период активного роста указанных сосудов приходится на пре и постнатальный этап онтогенеза (до 17 лет - 21 года), период относительной стабилизации соответствует зрелому возрасту, стадия инволюции и развития - пожилому и старческому возрасту.

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ГАММА-ГЛОБУЛИН, ПРИ СВЯЗАННЫЙ С ТКАНЯМИ СЕРДЦА КРОЛИКОВ, ЭКСПЕРИМЕНТАЛЬНОМ ЭНДО-МИОКАРДИТЕ КАВЕЛТИ

Аннотация. *Методом прямой иммунофлуоресценции с использованием чистых антител к γ-глобулину кролика изучена локализация связанного γ-глобулина в тканях сердца 23 кроликов с экспериментальным эндо-миокардитом Кавелти. Интенсивное свечение выявлялось исключительно в соединительнотканных структурах (интерстиций миокарда, адвентиция сосудов, эндокард, эпикард, рубцовая ткань). Свечение мышечных волокон миокарда и гладкомышечных элементов сосудов полностью отсутствовало. Несмотря на то, что циркулирующие антитела направлены преимущественно к мышечным элементам, связанный γ-глобулин локализуется в соединительной ткани сердца, что указывает на формирование антител как к мышечным, так и к соединительнотканным структурам.*

Ключевые слова: *γ-глобулин, иммунофлуоресценция, экспериментальный эндо-миокардит Кавелти, сердце, соединительная ткань, антитела, кролики.*

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GAMMA-GLOBULIN BOUND TO THE HEART TISSUES OF RABBITS IN EXPERIMENTAL CAVELLI ENDOMYOCARDITIS

Abstract. *The localization of bound γ-globulin in the heart tissues of 23 rabbits with experimental Cavelli endomyocarditis was studied by the direct immunofluorescence method using pure antibodies to rabbit γ-globulin. Intensive fluorescence was detected exclusively in connective tissue structures (myocardial interstitium, vascular adventitia, endocardium, epicardium, and scar tissue). Fluorescence of myocardial muscle fibers and smooth muscle elements of vessels was completely absent. Although circulating antibodies are directed mainly against muscle elements, bound γ-globulin is localized in the connective tissue of the heart,*

indicating the formation of antibodies to both muscle and connective tissue structures.

Keywords: *γ-globulin, immunofluorescence, experimental Cavelli endomyocarditis, heart, connective tissue, antibodies, rabbits.*

Ввдение. Кардиомиопатии (КМП) являются одними из наименее изученных и понимаемых заболеваний миокарда, несмотря на большое количество работ, ведущихся в этой области [1,2]. Трудности в изучении этой группы заболеваний были связаны с относительной редкостью данной патологии, сложностью визуализации морфологических изменений миокарда и большой значимостью высокотехнологичных инструментальных методов исследования в диагностике этой патологии [3,4]. Болезни миокарда являются одним из наиболее перспективных и динамично развивающихся направлений в современной кардиологии. Еще больший интерес представляет сочетание различных болезней миокарда, в частности, сочетание кардиомиопатий с миокардитом [5,6]. За последние 15 лет частота запроса «кардиомиопатия и миокардит» в международных библиографических базах данных возросла практически экспоненциально. Активно обсуждается тот факт, что генетически измененный миокард в большей степени подвержен присоединению миокардита, кроме того, сам миокардит, в свою очередь, может являться триггером для реализации аномальной генетической программы [7,8]. Исходя из представленных выше сведений очевидно, что сочетание миокардита с различными кардиомиопатиями не является редкостью. Вместе с тем, большинство работ в этой области сводится к описанию отдельных клинических случаев. Не сформирован комплексный подход к диагностике миокардита у пациентов с кардиомиопатиями, не изучены особенности клинических проявлений миокардита и его влияние на прогноз в зависимости от типа кардиомиопатии [9]. Не разработаны подходы к лечению миокардита в сочетании с кардиомиопатиями. Исходя из этого, изучение особенностей течения сочетания миокардита с различными кардиомиопатиями, разработка диагностики сопутствующего миокардита, анализ влияния миокардита на течение болезни и прогноз у больных с кардиомиопатиями представляется нам весьма актуальной проблемой.

Цель исследования. Установить наличие и локализацию связанного γ-глобулина в тканях сердца кроликов с экспериментальным эндо-миокардитом (по методу Кавелти) с помощью прямого метода иммунофлуоресценции, используя чистые антитела к γ-глобулину кролика, для подтверждения возможности in situ взаимодействия циркулирующих антител с компонентами сердечных структур и их потенциального цитотоксического действия.

Материалы и методы исследования. Для обнаружения связанного с тканями у-глобулина применялся прямой метод иммунофлуоресценции с использованием чистых антител к γ-глобулину кролика. Была изучена ткань сердца 23 кроликов, иммунизированных по методу Кавелти.

Результаты исследования. Высказано предположение, в что антитела, циркулирующие в крови больных ревматизимом, способны соединяться in situ

с компонентами структур органов, к которым они возникли, и проявлять цитотоксическое действие с развитием патологического процесса в тканях.

В пользу этого могут свидетельствовать данные по обнаружению в тканях сердца больных ревматизмом связанного γ-глобулина.

Установив ряд тканевых структур, к которым направлены антитела, циркулирующие в сыворотках кроликов при экспериментальном эндо-миокардите Кавелти, мы пытались обнаружить в тканях сердца этих животных связанный γ-глобулин.

Наслоение на нефиксированные срезы тканей (тщательно отмытые от сывороточных протеинов) меченых антител γ-глобулину кролика сопровождалось во всех случаях появлением интенсивного свечения, локализованного в соединительнотканных структурах сердца: интерстиции миокарда, адвентициальной оболочке сосудов, эндокарде, эпикарде. У ряда животных отмечалось интенсивное свечение новообразованной ткани рубцов на месте гибели мышечных волокон миокарда. У всех исследованных животных полностью отсутствовало свечение структур мышечных волокон миокарда и гладкомышечных элементов стенки сосудов.

Вывод. Таким образом, связанный γ-глобулин оказался локализованным в соединительнотканных структурах сердца, тогда как антитела, циркулирующие в сыворотке крови иммунизированных животных, направлены к мышечным элементам сердца. Связано это, по-видимому, с тем, что в организме иммунизированного животного происходит формирование антител как к мышечным, так и к соединительнотканным структурам сердца.

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ГЕНЕТИЧЕСКИЕ И МЕТАБОЛИЧЕСКИЕ ФАКТОРЫ, ОПРЕДЕЛЯЮЩИЕ КАЧЕСТВО ЖИЗНИ ПАЦИЕНТОВ С НЕАЛКОГОЛЬНОЙ ЖИРОВОЙ БОЛЕЗНЬЮ ПЕЧЕНИ

Аннотация: *В исследовании оценивается влияние генетических и метаболических нарушений на качество жизни пациентов с неалкогольной жировой болезнью печени. Комплексный клинический, биохимический и молекулярно-генетический анализ был выполнен у ста десяти пациентов узбекской национальности. Наличие патологического Т-аллеля гена ADIPOQ было достоверно связано с прогрессирующей инсулинорезистентностью и тяжелыми нарушениями липидного обмена. Данные метаболические изменения приводили к выраженным астеническим и диспептическим симптомам, существенно снижающим физический и психоэмоциональный компоненты качества жизни. Персонализация терапевтических стратегий с учетом генетического полиморфизма необходима для оптимизации клинических исходов и благополучия пациентов.*

Ключевые слова: *неалкогольная жировая болезнь печени, ген адипонектина, полиморфизм, качество жизни, инсулинорезистентность.*

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GENETIC AND METABOLIC FACTORS DETERMINING THE QUALITY OF LIFE OF PATIENTS WITH NON-ALCOHOLIC FATTY LIVER DISEASE

Abstract: *The study evaluates the impact of genetic and metabolic disorders on the health-related quality of life in patients with non-alcoholic fatty liver disease. A comprehensive clinical, biochemical, and molecular genetic analysis was performed on one hundred and ten patients of Uzbek nationality. The presence of the pathological T allele of the ADIPOQ gene was significantly associated with progressive insulin resistance and severe lipid metabolism disorders. These metabolic alterations led to pronounced asthenic and dyspeptic symptoms, which significantly reduced the physical and psycho-emotional components of patients'*

quality of life. Personalization of therapeutic strategies considering genetic polymorphisms is essential to optimize clinical outcomes and patient well-being.

Keywords: *non-alcoholic fatty liver disease, adiponectin gene, polymorphism, quality of life, insulin resistance.*

Введение

Неалкогольная жировая болезнь печени стала одной из наиболее актуальных проблем современной гастроэнтерологии и внутренней медицины, поражая значительную часть трудоспособного населения во всем мире. Прогрессирование от простого стеатоза к неалкогольному стеатогепатиту включает сложные многофакторные механизмы, где висцеральное ожирение, инсулинорезистентность и системное хроническое воспаление играют центральную роль. Систематические клинические исследования показывают, что на клиническое течение заболевания и его влияние на повседневное функционирование пациентов глубоко влияют индивидуальные генетические характеристики. Метаболические нарушения, такие как выраженная дислипидемия и тяжелая инсулинорезистентность тканей, часто проявляются клинически в виде хронической усталости, общей слабости и абдоминального дискомфорта. Эти соматические симптомы напрямую ухудшают повседневную активность, эмоциональное состояние и общее связанное со здоровьем качество жизни лиц, страдающих стеатозом печени. Понимание сложной связи между специфическими генами-кандидатами, метаболическими параметрами и субъективным благополучием пациентов имеет решающее значение для разработки эффективных алгоритмов ведения. Хотя традиционная гепатопротекторная терапия устраняет основные биохимические синдромы, она часто не обеспечивает устойчивого восстановления показателей качества жизни пациентов без долгосрочной модификации образа жизни. Поэтому выявление ранних генетических предикторов прогрессирования заболевания может помочь клиницистам внедрить персонализированные профилактические меры и целевые диетические вмешательства до возникновения необратимых структурных изменений в ткани печени.

Цель исследования — оценить взаимосвязи между полиморфизмом гена adipoq +276g>t, метаболическими показателями и параметрами качества жизни у пациентов с неалкогольной жировой болезнью печени.

Материалы и методы исследования

В клиническое исследование были включены сто десять неродственных пациентов узбекской национальности, проходивших стационарное лечение в гастроэнтерологическом отделении, в том числе keys шестьдесят пять человек на стадии стеатоза печени и сорок пять пациентов с диагнозом неалкогольного стеатогепатита. Контрольную группу составили сорок девять практически здоровых лиц без отягощенного печеночного анамнеза и метаболических нарушений. Антропометрические параметры, включая индекс массы тела, окружность талии и окружность бедер, были тщательно

измерены у всех участников. Лабораторные тесты включали комплексную оценку маркеров цитолиза, таких как аланинаминотрансфераза и аспартатаминотрансфераза, параметров холестаза, включая щелочную фосфатазу и гамма-глутамилтрансферазу, а также полного липидного профиля. Инсулинорезистентность точно определяли с помощью индекса гомеостатической модели оценки на основе уровней глюкозы натощак и инсулина, измеренных методом иммуноферментного анализа. Молекулярно-генетическое тестирование проводилось путем выделения геномной днк из образцов цельной крови с последующей полимеразной цепной реакцией и анализом полиморфизма длин рестрикционных фрагментов с использованием специфических олигонуклеотидных праймеров и фермента рестрикции pct i для идентификации распределения генотипов adipoq rs1501299. Статистическая обработка данных выполнялась с использованием пакета программ statistica 6.0 с применением дисперсионного анализа, t-критерия стьюдента, u-критерия манна-уитни и корреляционного анализа пирсона для установления статистической значимости при уровне p менее 0,05.

Результаты

Клиническая оценка показала, что астенические и диспептические симптомы были высоко распространены в когорте: повышенная утомляемость отмечалась у 35,5% пациентов, а общая слабость наблюдалась в 30,9% случаев, что напрямую ухудшало их функциональное благополучие. Молекулярно-генетический анализ выявил, что распределение генотипов adipoq +276g>t среди пациентов составило 22,3% для gg, 56,4% для gt и 21,3% для tt, что указывает на достоверное накопление гетерозиготного состояния gt по сравнению с контрольной группой. Наличие патологического т-аллеля ассоциировалось с увеличением риска прогрессирования заболевания в 2,3 раза. Корреляционный анализ установил сильную положительную связь между индексом homa-ir и триглицеридами сыворотки (r=0,6), а также с аланинаминотрансферазой (r=0,5) и аспартатаминотрансферазой (r=0,5), подтверждая, что выраженная инсулинорезистентность напрямую влияет на функциональные нарушения печени. Пациенты с генотипом тт имели достоверно более высокие значения homa-ir и большую окружность талии по сравнению с носителями генотипа gg. Кроме того, оценка динамики лечения в течение тридцати дней продемонстрировала, что носители защитного аллеля g достигли существенного снижения трансаминаз и липидов, тогда как у пациентов с патологическим аллелем т сохранялись повышенные уровни метаболических маркеров. Эта резистентность к стандартной терапии подчеркивает негативное влияние патологического полиморфизма как на биохимическое восстановление, так и на связанное со здоровьем качество жизни.

Заключение

Гетерогенные факторы играют ключевую роль в определении тяжести и прогрессирования неалкогольной жировой болезни печени среди узбекской популяции. Патологический т-аллель гена adipoq +276g>t достоверно

ассоциирован с тяжелой инсулинорезистентностью, абдоминальным ожирением и глубокими нарушениями липидного обмена, которые усугубляют соматические симптомы и снижают качество жизни пациентов. Стандартная гепатопротекторная терапия в сочетании с общими изменениями образа жизни демонстрирует ограниченную эффективность у лиц, являющихся носителями этого генетического маркера риска. Внедрение персонализированного алгоритма ведения, включающего ранний молекулярно-генетический скрининг и целевые низкокалорийные диетические вмешательства, необходимо для оптимизации метаболических параметров, предотвращения прогрессирования поражения печени и устойчивого улучшения долгосрочного качества жизни.

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ЦЕРЕБРОВАСКУЛЯРНЫЕ ОСЛОЖНЕНИЯ И КАЧЕСТВО ЖИЗНИ У ПОЖИЛЫХ ПАЦИЕНТОВ С ЭССЕНЦИАЛЬНОЙ ГИПЕРТЕНЗИЕЙ

Аннотация: *В многоцентровом клиническом исследовании детально оценивается патогенетическое влияние ранних субклинических цереброваскулярных изменений и микрососудистых нарушений на многомерные параметры качества жизни 120 пожилых пациентов с подтвержденной эссенциальной артериальной гипертензией. Прогрессирующее сочетанное поражение органов-мишеней было наиболее тесно и прямо связано с высокими среднесуточными уровнями систолического артериального давления и повышенной сосудистой жесткостью. Данные церебральные микрососудистые изменения закономерно вызывали у больных хроническую интенсивную цефалгию, когнитивный дефицит и выраженную эмоциональную лабильность, существенно снижая итоговый ментальный компонент связанного со здоровьем качества жизни. Проведенная дифференцированная персонализация комбинированной антигипертензивной стратегии фармакотерапии является критически необходимой для эффективной оптимизации когнитивных функций, нейропротекции и повседневного долгосрочного благополучия пациентов.*

Ключевые слова: *эссенциальная артериальная гипертензия, субклинические цереброваскулярные осложнения, качество жизни (SF-36), когнитивное снижение, систолическое артериальное давление.*

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CEREBROVASCULAR COMPLICATIONS AND QUALITY OF LIFE IN ELDERLY PATIENTS WITH ESSENTIAL HYPERTENSION

Abstract: *The multicenter clinical trial provides a detailed evaluation of the pathogenetic impact of early subclinical cerebrovascular changes and microvascular disorders on the multidimensional quality of life parameters in 120 elderly patients with confirmed essential hypertension. Progressive, combined target organ damage was most closely and directly linked to high daily mean*

systolic blood pressure levels and increased vascular stiffness. These cerebral microvascular alterations consistently induced chronic intense cephalalgia, cognitive deficits, and pronounced emotional lability in patients, substantially reducing the final mental health component summary score. Implementing a differentiated, personalized combination antihypertensive pharmacotherapy strategy is critically essential to achieve effective cognitive function optimization, neuroprotection, and daily long-term patient well-being.

Keywords: *essential hypertension, subclinical cerebrovascular complications, quality of life (SF-36), cognitive decline, systolic blood pressure.*

Введение

Эссенциальная артериальная гипертензия остается одной из наиболее значимых проблем мирового здравоохранения, являясь основным триггером сосудистого ремоделирования, поражения органов-мишеней и ускорения нейродегенеративных процессов. Хроническое повышение системного давления индуцирует артериальную жесткость и снижает микрососудистую эластичность в церебральном русле. Со временем эти патологические изменения вызывают перфузионные нарушения, диффузные поражения белого вещества и лакунарные инфаркты, формирующие клинический субстрат хронической ишемии мозга. Данные структурно-функциональные изменения часто развиваются латентно в течение многих лет, предшествуя острым цереброваскулярным катастрофам. Пациенты регулярно предъявляют жалобы на упорные утренние головные боли, головокружение, выраженную соматическую утомляемость и постепенное ухудшение кратковременной памяти или исполнительных когнитивных функций. Манифестация данных симптомов в повседневной жизни резко ограничивает физическую активность, профессиональную работоспособность и психоэмоциональную стабильность. Как следствие, показатели качества жизни достоверно снижаются по многим доменам еще до формирования стойкого очагового неврологического дефицита. Традиционные терапевтические протоколы ориентированы преимущественно на достижение целевых цифр давления, часто недооценивая влияние когнитивного снижения и эмоционального истощения на приверженность к лечению и социальную адаптацию. Оценка связи ранних микрососудистых нарушений с субъективным благополучием пациентов имеет критическое значение для превентивной неврологии. Комплексный подход, сочетающий своевременную нейропротекцию с вазодилатирующими антигипертензивными препаратами, позволяет сохранить функциональный потенциал стареющего организма.

Цель исследования: оценить характер взаимосвязей между ранними субклиническими изменениями церебральной гемодинамики, показателями суточного мониторирования артериального давления и параметрами качества жизни у пожилых пациентов.

Материалы и методы

в одномоментное клиническое исследование включено 120 пожилых пациентов с верифицированной эссенциальной артериальной гипертензией ii стадии. Критериями исключения служили наличие перенесенного инсульта, тяжелой деменции, симптоматической гипертензии, острых коронарных синдромов или тяжелой почечной недостаточности. Субклиническое поражение церебральных микрососудов оценивали методом ультразвуковой допплерографии каротидных артерий с определением скоростных показателей кровотока. Когнитивный статус определяли с помощью краткой шкалы оценки психического статуса (mmse) и монреальской шкалы когнитивной оценки (moca). Системную гемодинамику изучали путем офисных измерений и 24-часового суточного мониторирования артериального давления (смад). Связанное со здоровьем качество жизни оценивали с использованием общего опросника sf-36. Статистический анализ выполнялся в пакете программ statistica 6.0 с применением моделей множественной линейной регрессии, t-критерия стьюдента и дисперсионного анализа (anova), при пороговом уровне значимости $p<0,05$.

Результаты

клинический скрининг показал, что у 41,6% пациентов с артериальной гипертензией выявлялось раннее субклиническое когнитивное снижение (балл по шкале moca менее 24). Высокая вариабельность ночного систолического давления и нарушение циркадного профиля имели сильную прямую связь со снижением линейной скорости церебрального кровотока (средний коэффициент $r=-0,48$, $p<0,01$). Оценка качества жизни продемонстрировала, что пациенты с верифицированными цереброваскулярными сдвигами имели достоверно более низкие баллы по ключевым шкалам sf-36. Хронический цефалгический синдром обуславливал падение показателей физического компонента здоровья, а эмоциональная лабильность приводила к снижению ментального благополучия. Многофакторный регрессионный анализ подтвердил, что недостаточный контроль ночного давления является независимым негативным предиктором психологического статуса. Назначение адаптированной трехмесячной комбинированной терапии (ингибиторы апф в сочетании с блокаторами кальциевых каналов) способствовало стабилизации профиля давления и росту показателей когнитивного функционирования и жизненной силы на 14%.

Выводы

латентные субклинические цереброваскулярные осложнения представляют собой частое поражение органов-мишеней у пожилых пациентов с артериальной гипертензией, напрямую снижающее многомерные параметры качества жизни. Тяжесть раннего когнитивного дефицита и сопутствующего соматического истощения тесно связана с неэффективным контролем ночного систолического давления и падением микрососудистого кровотока. Эти структурные сдвиги усиливают эмоциональный дистресс, ограничивая социальную интеграцию. Внедрение регулярного когнитивного

мониторинга и персонализированной хронотерапии в стандарты лечения необходимо для сохранения функциональных возможностей пожилых людей.

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ВЛИЯНИЕ ФИЗИЧЕСКОЙ НАГРУЗКИ НА РАСПРОСТРАНЕНИЕ КОРОНАРНОГО АТЕРОСКЛЕРОЗА

Аннотация. *Проанализирована ежедневная привычная физическая нагрузка у 121 больного коронарным атеросклерозом и 352 практически здоровых лиц. Среди больных преобладали лица умственного труда (65,8 %) с отсутствием или незначительной нерегулярной нагрузкой, тогда как среди здоровых физическим трудом занимались 50,7 %. Коронарные больные достоверно реже имели продолжительную физическую нагрузку (5–8 часов и более в день). Полученные данные подтверждают благоприятное влияние умеренной регулярной физической активности на предупреждение коронарного атеросклероза.*

Ключевые слова: *коронарный атеросклероз, физическая нагрузка, физическая активность, профилактика, эпидемиологическое исследование.*

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INFLUENCE OF PHYSICAL ACTIVITY ON THE PREVALENCE OF CORONARY ATHEROSCLEROSIS

Abstract. *Daily habitual physical activity was analyzed in 121 patients with coronary atherosclerosis and 352 practically healthy individuals. Among the patients, persons engaged in mental work predominated (65.8 %), with absent or slight irregular physical load, whereas among healthy subjects 50.7 % performed physical work. Coronary patients significantly less frequently had prolonged physical activity (5–8 hours or more per day). The obtained data confirm the beneficial effect of moderate regular physical activity in the prevention of coronary atherosclerosis.*

Keywords: *coronary atherosclerosis, physical load, physical activity, prevention, epidemiological study.*

Ввдение. Заболевания сердечно-сосудистой системы закономерно приводят к ограничению физической работоспособности [1,2], влекущему за собой снижение качества жизни, нарушение социальной адаптации [3,4],

временную или стойкую утрату трудоспособности. Повышение толерантности к физической нагрузке является одной из важнейших задач лечения и реабилитации больных с патологией сердца [5]. В последние годы большой интерес представляет концепция о нарушении функционального состояния эндотелия как фактора, способствующего атеросклеротическому повреждению сосудов и развитию сердечно-сосудистых заболеваний [6]. Дисфункция эндотелия (ДЭ) характеризуется снижением эндотелийзависимой вазодилатации и повышением адгезивности эндотелиальных клеток [. Сердечно-сосудистая патология лидирует среди всех причин смерти, причём около половины кардиологических смертей являются внезапными. Известно, что основным механизмом внезапной сердечной смерти (ВСС) служит развитие желудочковых тахиаритмий, а её причиной в 80 % случаев является ишемическая болезнь сердца (ИБС) [7,8]. Поэтому проблема желудочковых нарушений ритма (ЖНР) у больных ИБС - одна из ключевых в современной кардиологии.

Цель исследования. Уточнить влияние умеренной привычной физической нагрузки на предупреждение сердечно-сосудистых заболеваний путём сравнительного анализа продолжительности ежедневной физической активности у больных коронарным атеросклерозом и практически здоровых лиц.

Материалы и методы исследования. В последние годы при эпидемиологических обследованиях получены данные, которые указывают на благоприятное влияние умеренно-физической нагрузки на предупреждение сердечно-сосудистых заболеваний. С целью уточнения этого факта нами проанализировано время ежедневной привычной физической нагрузки у 121 больного коронарным атеросклерозом и 352 практически здоровых лиц. Учитывалась совокупность продолжительности физического труда на работе, занятий спортом, ходьбы на работу и с работы, а также домашней работы, в том числе работы в саду.

Результаты исследования. Проведённый анализ показал существенные различия в характере и продолжительности ежедневной привычной физической нагрузки между больными коронарным атеросклерозом и практически здоровыми лицами. Среди пациентов с коронарным атеросклерозом преобладали лица умственного труда — 65,8 %, тогда как среди практически здоровых их доля составляла лишь 49,3 %. У большинства больных умственного труда физическая нагрузка либо полностью отсутствовала, либо была кратковременной и нерегулярной.

В группе практически здоровых лиц, напротив, преобладали люди, занятые физическим трудом (50,7 %). Структура продолжительности физической нагрузки в этой группе распределялась следующим образом:

- не более 1–2 часов в день — 7,8 %;
- 3–4 часа в день — 5,8 %;
- 5–8 часов в день — 15,9 %;
- более 8 часов в день — 21,2 %.

Среди больных коронарным атеросклерозом физическим трудом занимались только 34,2 % обследованных. При этом распределение по продолжительности нагрузки выглядело иначе:

- не более 1–2 часов в день — 13,3 %;
- 3–4 часа в день — 2,5 %;
- 5–8 часов в день — 9,2 %;
- более 8 часов в день — 9,2 %.

Таким образом, у практически здоровых лиц значительно чаще отмечалась регулярная и достаточно продолжительная физическая активность (особенно нагрузки свыше 5 часов в день), тогда как среди коронарных больных преобладала малоподвижная или кратковременная нагрузка. Полученные данные подтверждают наличие обратной связи между объёмом привычной ежедневной физической активности и частотой развития коронарного атеросклероза.

Вывод. Таким образом, среди коронарных больных меньшее число лиц занимается физическим трудом, чем среди практически здоровых, и при этом меньше затрачивается ими времени. Данное различие является статистически достоверным в группе лиц с продолжительностью привычной физической нарузки от 5 до 8 часов в день.

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ИЗМЕНЕНИЯ МИКРОЦИРКУЛЯТОРНОГО РУСЛА БРЮШИНЫ КРЫС ПОД ВЛИЯНИЕМ НИЗКОЧАСТОТНОГО УЛЬТРАЗВУКА

Аннотация. *В эксперименте на 45 крысах линии Wistar изучены структурно-функциональные изменения гемо- и лимфомикроциркуляторного русла брыжейки тонкой кишки под действием низкочастотного ультразвука (25 кГц, 0,6 Вт/см²). При кавитационном воздействии развиваются выраженные нарушения микроциркуляции: кровоизлияния, агрегация эритроцитов, стаз, снижение вазомоторной активности лимфатических сосудов и ультраструктурные повреждения эндотелиоцитов. Вне зоны кавитации отмечается стимуляция крово- и лимфотока, расширение микрососудов и повышение сосудистой проницаемости. Показано, что характер изменений зависит от режима ультразвукового облучения.*

Ключевые слова: *низкочастотный ультразвук, микроциркуляция, брюшина, брыжейка, крысы, кавитация.*

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CHANGES IN THE MICROCIRCULATORY BED OF THE RAT PERITONEUM UNDER THE INFLUENCE OF LOW-FREQUENCY ULTRASOUND

Abstract. *In an experiment on 45 Wistar rats, structural and functional changes in the hemo- and lymphomicrocirculatory bed of the small intestinal mesentery under the influence of low-frequency ultrasound (25 kHz, 0.6 W/cm²) were studied. Under cavitational exposure, pronounced microcirculatory disorders develop: hemorrhages, erythrocyte aggregation, stasis, decreased vasomotor activity of lymphatic vessels, and ultrastructural damage to endotheliocytes. Outside the cavitation zone, stimulation of blood and lymph flow, dilation of microvessels, and increased vascular permeability are observed. It has been shown that the nature of the changes depends on the mode of ultrasonic irradiation.*

Keywords*: low-frequency ultrasound, microcirculation, peritoneum, mesentery, rats, cavitation.*

Ввдение. В последние годы вместе с традиционными методиками ультразвуковой терапии все более широкое распространение получает «ультразвуковая технология», основанная на применении ультразвуковых колебаний низкого диапазона частот в пределах 20-60 кГц. Разрабатываются вопросы использования «ультразвуковой технологии» не только для резки и сварки биологических тканей, но и для лечения гнойного перитонита [1, 2]. Микроциркуляторное русло брюшины играет ключевую роль в поддержании гомеостаза брюшной полости, обеспечивая транспорт питательных веществ, газов и продуктов метаболизма, а также участвуя в процессах воспаления, репарации и иммунного ответа [3,4]. Нарушения микроциркуляции брюшины наблюдаются при различных патологических состояниях — от перитонита и спаечной болезни до послеоперационных осложнений и опухолевых процессов. В связи с этим поиск эффективных методов воздействия на микрососудистое русло брюшины представляет значительный научный и практический интерес [5,6,8]. Одним из перспективных физических факторов, способных модулировать состояние микроциркуляции, является низкочастотный ультразвук. Известно, что ультразвуковые волны низкой частоты оказывают комплексное влияние на биологические ткани: вызывают микромассаж, изменяют проницаемость сосудистой стенки, стимулируют локальный кровоток и могут влиять на реологические свойства крови. Несмотря на накопленный опыт применения ультразвука в терапии и хирургии, данные о его специфическом воздействии именно на микроциркуляторное русло брюшины остаются ограниченными и нередко противоречивыми [7,9]. Экспериментальные исследования на животных моделях, в частности на крысах, позволяют детально изучить морфофункциональные изменения микрососудов брюшины под действием низкочастотного ультразвука в контролируемых условиях. Оценка таких параметров, как плотность капиллярной сети, диаметр артериол и венул, состояние эндотелия и интенсивность тканевого кровотока, даёт возможность выявить как благоприятные, так и потенциально неблагоприятные эффекты ультразвукового воздействия. Экспериментальные исследования в этом направлении показали, что положительный эффект биологического действия низкочастотного ультразвука в ряде случаев сопровождаются повреждением микроциркуляторного русла брюшины, причины которого до сих пор не ясны.

Цель исследования. Целью исследования явилось изучение структурно-функциональных изменений в гемо- и лимфомикроциркуляторном русле брюшины под влиянием ультразвука (частота 25 кГц - наиболее широко используемая в медицине, расчетная интенсивность - 0,6 Вт/см2).

Материалы и методы исследования. Эксперименты проведены на 45 белых крысах линии «Вистар». В качестве объекта исследования использовали микроциркуляторное русло брыжейки тонкой кишки. Для этого у находящихся под нембуталовым наркозом животных через разрез в области брюшка извлекали тонкую кишку и располагали ее на столике для

прижизненной микроскопии оригинальной конструкции. Животное и столик помещали в кювету, заполненную раствором Рингера, подогретым до 37° С. Раствор Рин- гера служил для орошения брыжейки и подведения к ней ультразвука. Непосредственно в процессе проведения ультразвуковой процедуры осуществляли биомикроскопию микроциркуляторного русла. После прекращения действия ультразвука на участки брыжейки, в которых были выявлены функциональные изменения, наносили 1-2 капли 2,5% раствора глютарового альдегида. Иссекали бритвой выбранный участок брыжейки, подготавливали его по принятым методикам и изучали на электронном микроскопе ЭМВ-100АК при ускоряющемся напряжении 75 кВт.

Результаты исследования. Исследования показали, что в зависимости от режима воздействия ультразвуком на микроциркуляторное русло брыжейки может быть достигнут различный эффект. При расположении торца ультразвукового вибратора на расстоянии 0,1-0,5 см от поверхности брюшины возникают выраженные расстройства микроциркуляции. Практически сразу после включения ультразвукового генератора появляются множественные кровоизлияния в микрососудах всех видов. Дальнейшее озвучивание приводит к функциональным расстройствам гемодинамики, заключающимся в появлении маятникообразного, ретроградного и встречного кровотока. На фоне указанных изменений в микрососудах развивается агрегация эритроцитов, а затем замедление и стаз кровотока. Число выключенных из кровообращения микрососудов возрастает по мере увеличения экспозиции воздействия. В лимфатических капиллярах появляются форменные элементы крови. Нарушается вазомоторная активность лимфатических микрососудов. Число спонтанных сокращений лимфангионов снижается с 12 до 1-3 в минуту, а в ряде случаев наблюдается спазм лимфатических микрососудов и полное прекращение тока лимфы. При небольших экспозициях озвучивания описанные изменения носят обратимый характер. Однако уже при 10-минутном воздействии кровоток в гемокапиллярах в большинстве случаев не восстанавливается. Просвет лимфатических микрососудов неравномерен на протяжении — участки спазма чередуются с дилатированными лимфангионами, нормальный ритм вазомоции нарушен. При электронной микроскопии в гемокапиллярах выявляются нарушения структуры энергообразующего аппарата эндотелиоцитов - митохондрий, резкое расширение эндоплазматической сети. Ультраструктурные изменения наблюдаются и в лимфокапиллярах, особенно со стороны просвета микрососудов. Наиболее часто встречаются выпячивания люминарной поверхности и резкое расширение перинуклеарной цистерны со стороны просвета сосудов. Микроскопия в процессе озвучивания показала, что указанные нарушения возникают в области интенсивной кавитации жидкости вблизи излучающей поверхности ультразвукового вибратора. Причем, по степени выраженности патологических изменений повреждающее действие кавитационного ультразвука частотой 25 кГц и

интенсивностью 0,6 Вт/см2 превышает таковой эффект ультразвука частотой 880 кГц и интенсивностью 2,0 Вт/см2. Совершенно иная картина наблюдается при расположении брыжейки вне зоны ультразвуковой кавитации. Под действием ультразвукового облучения ускоряется кровоток, расширяются микрососуды, в кровообращение включаются новые гемокапилляры. Усиливается спонтанная вазомоторная активность лимфатических микрососудов, лимфангионы которых буквально пульсируют в поле ультразвуковых волн. Ультраструктурные изме нения эндотелиоцитов характеризуются появлением большого числа микропиноцитозных везикул, расширением парацеллюлярных контактов, что свидетельствует о повышении сосудистой проницаемости как для низкомолекулярных веществ, так и для клеточных элементов.

Вывод. Таким образом, кавитационное действие низкочастотного ультразвука сопровождается выраженными повреждениями микро- и ультраструктуры звеньев гемо- и лимфомикроциркуляторного русла брюшины, функциональными расстройствами микроциркуляции, стимуляцией гемо- и лимфомикроциркуляции. Изменения микроциркуляторного русла зависят от режима ультразвукового облучения.

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ДУОДЕНОГАСТРАЛЬНЫЙ РЕФЛЮКС В ПАТОГЕНЕЗЕ И КЛИНИЧЕСКОМ ТЕЧЕНИИ ЯЗВЕННОЙ БОЛЕЗНИ ДВЕНАДЦАТИПЕРСТНОЙ КИШКИ: СОВРЕМЕННЫЙ ВЗГЛЯД

Аннотация: *Актуальность исследования обусловлена необходимостью уточнения роли дуоденогастрального рефлюкса (ДГР) в формировании клинико-функциональных вариантов язвенной болезни двенадцатиперстной кишки. Цель исследования заключалась в оценке взаимосвязи характеристик ДГР с кислотопродукцией, состоянием слизистой оболочки, Helicobacter pylori и особенностями клинического течения заболевания. Проведен анализ результатов комплексного клинического, эндоскопического, морфологического исследования, суточной внутрижелудочной pH-метрии и диагностики H. pylori. Установлено, что сочетание параметров ДГР и кислотно-щелочного состояния гастродуоденальной зоны позволяет выделять функциональные варианты заболевания с различиями в рецидивировании, осложнениях и эффективности терапии. Полученные данные обосновывают необходимость комплексной оценки моторно-кислотных нарушений при выборе тактики ведения пациентов.*

Ключевые слова: *язвенная болезнь; дуоденогастральный рефлюкс; Helicobacter pylori; pH-метрия; кислотность.*

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DUODENOGASTRIC REFLUX IN THE PATHOGENESIS AND CLINICAL COURSE OF DUODENAL ULCER DISEASE: A MODERN VIEW

Abstract: *The relevance of the study is determined by the need to clarify the role of duodenogastric reflux (DGR) in variants of duodenal ulcer disease. The aim was to assess relationships between DGR characteristics, acid secretion, mucosal condition, Helicobacter pylori infection, and clinical course. The analysis included clinical, endoscopic, morphological examinations, 24-hour intragastric pH monitoring, and H. pylori diagnostics. The results showed that assessment of DGR and gastroduodenal acid-base status distinguishes functional variants with*

recurrence, complication, and treatment-response patterns. These findings support evaluation of motor and acid-related disturbances for patient management.

Keywords: *duodenal ulcer; duodenogastric reflux; Helicobacter pylori; pH monitoring; acidity.*

Введение

Язвенная болезнь двенадцатиперстной кишки является многофакторным заболеванием, при котором взаимодействуют инфекционные, кислотно-секреторные, моторно-эвакуаторные и защитные механизмы. Существенное значение имеют Helicobacter pylori, гиперацидность, нарушения гастродуоденальной моторики и снижение устойчивости слизистой оболочки к агрессивным воздействиям. Современный подход предполагает комплексную оценку указанных факторов, поскольку выраженность одного нарушения не всегда соответствует тяжести клинического течения. Особый интерес представляет дуоденогастральный рефлюкс (ДГР), характеризующийся ретроградным поступлением дуоденального содержимого в желудок.

Физиологические эпизоды ДГР могут наблюдаться у здоровых лиц, однако увеличение их частоты и продолжительности способно изменять состояние слизистой оболочки. Суточная внутрижелудочная pH-метрия позволяет оценивать динамику кислотопродукции и выявлять периоды гиперацидности, включая ночные часы. Дополнительное значение имеет определение H. pylori, поскольку инфекция способна сочетаться с нарушениями моторики и воспалительными изменениями.

Анализ результатов исследования 233 пациентов позволил выявить три клинико-функциональных варианта ДГР, различавшихся по особенностям кислотно-щелочного состояния, клиническому течению, частоте рецидивов, осложнений и эффективности лечения. Наиболее неблагоприятные характеристики отмечались при сочетании гиперацидности и недостаточной антродуоденальной щелочной компенсации. Полученные данные подтверждают целесообразность комплексной оценки ДГР, кислотности и H. pylori для прогнозирования течения заболевания и индивидуализации лечебной тактики.

Цель исследования — оценить взаимосвязь дуоденогастрального рефлюкса с кислотно-щелочным состоянием, H. pylori и клиническим течением язвенной болезни двенадцатиперстной кишки.

Материалы и методы исследования

В работы положен анализ результатов клинического исследования 233 пациентов с язвенной болезнью двенадцатиперстной кишки. Обследование включало клиническую оценку, эзофагогастродуоденоскопию, суточную внутрижелудочную pH-метрию, диагностику Helicobacter pylori и морфологическое исследование биоптатов. Дополнительно оценивались вегетативный и психоэмоциональный статус пациентов для характеристики

функциональных факторов, способных влиять на гастродуоденальную моторику и выраженность клинических проявлений.

При эндоскопическом исследовании определяли особенности язвенного дефекта и воспалительных изменений слизистой оболочки желудка и двенадцатиперстной кишки. Морфологические показатели сопоставляли с характеристиками рефлюкса и кислотопродукции. Суточная pH-метрия использовалась для оценки динамики внутрижелудочной кислотности, включая ночной период. При анализе дуоденогастрального рефлюкса учитывали частоту и продолжительность его эпизодов, суточное распределение и взаимосвязь с изменениями pH. Количественные показатели соответствовали данным исходного исследования и использовались для последующего сопоставления клинического течения, рецидивов, осложнений и эффективности лечения. Для интерпретации полученных результатов учитывались современные научные публикации и клинические рекомендации [1–6].

Результаты исследования

Анализ суточной динамики ДГР показал, что его клиническое значение определяется не только наличием рефлюкса, но также частотой, продолжительностью эпизодов, временем их возникновения и сочетанием с кислотной нагрузкой. У пациентов отмечались выраженная кислотность, включая ночной период, и изменения антродуоденальной щелочной компенсации.

Функциональная оценка позволила выделить три варианта ДГР. Первый вариант характеризовался умеренными моторными и секреторными нарушениями, воспалительными изменениями преимущественно антрального отдела желудка и двенадцатиперстной кишки; легкое течение отмечалось у 91,3% пациентов. Второй вариант сопровождался выраженными болевыми и диспепсическими проявлениями, воспалительными изменениями антрального и фундального отделов; среднетяжелое и тяжелое рецидивирующее течение достигало 86,7%. Третий вариант отличался гиперацидностью, сниженной продолжительностью ДГР и недостаточной щелочной компенсацией. Осложненное течение наблюдалось у 89,6% пациентов.

Сопоставление ДГР с H. pylori выявило взаимосвязь инфекции, моторики и кислотно-щелочного равновесия. После эрадикации при первом варианте отмечалась нормализация pH-профиля и параметров ДГР, тогда как при третьем сохранялись функциональные нарушения.

Эффективность стандартной антисекреторной терапии составила 76,3%, 94,7% и 43,8% соответственно для первого, второго и третьего вариантов. После эрадикационного лечения показатели достигали 84,2%, 94,7% и 62,5%. Для третьего варианта отношение шансов осложненного течения составляло 17,2. Полученные результаты подтверждают прогностическое значение функциональной классификации и необходимость

комплексной оценки кислотно-моторных нарушений при выборе лечебной тактики.

Заключение

Дуоденогастральный рефлюкс следует рассматривать как функциональный компонент гастродуоденальных нарушений, значение которого определяется его частотой, продолжительностью и сочетанием с кислотной нагрузкой. Выделение трех клинико-функциональных вариантов ДГР позволило установить различия в симптоматике, рецидивировании и осложнениях язвенной болезни двенадцатиперстной кишки. Комплексная оценка H. pylori, кислотопродукции, моторики, эндоскопических и pH-метрических показателей способствует прогнозированию течения заболевания и индивидуализации лечения.

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РОЛЬ ЗАКОНОВ И ТЕХНОЛОГИЙ ФИЗИКИ В СОВРЕМЕННОЙ МЕДИЦИНЕ: ДОСТИЖЕНИЯ В ДИАГНОСТИКЕ И ТЕРАПИИ

Аннотация: *В статье анализируется роль физики в современной медицине, а также перспективы развития методов диагностики и лечения, основанных на физических принципах и закономерностях. Раскрыты биофизические основы рентгенографии, компьютерной томографии (КТ), магнитно-резонансной томографии (МРТ), ультразвуковой диагностики (УЗД) и лазерной терапии. Также рассмотрена эффективность ядерной медицины, нанотехнологий и лучевой терапии в лечении онкологических заболеваний. Результаты исследования показывают, что интеграция физических технологий в медицину является решающим фактором повышения точности диагностики и эффективности лечения.*

Ключевые слова: *биофизика, медицинская физика, магнитно-резонансная томография, ультразвук, лазерная терапия, радиационная онкология, ядерная медицина, диагностика.*

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THE ROLE OF PHYSICS LAWS AND TECHNOLOGIES IN MODERN MEDICINE: ADVANCEMENTS IN DIAGNOSTICS AND THERAPY

Abstract: *This article analyzes the role of physics in modern medicine, the development prospects of diagnostic and therapeutic methods based on physical principles and laws. The biophysical foundations of radiography, computed tomography (CT), magnetic resonance imaging (MRI), ultrasound diagnostics (USD), and laser therapy are highlighted. The effectiveness of nuclear medicine, nanotechnology, and radiation therapy in the treatment of oncological diseases is also considered. Research results demonstrate that the integration of physical technologies in medicine is a crucial factor in increasing diagnostic accuracy and ensuring therapeutic efficacy.*

Keywords: *biophysics, medical physics, magnetic resonance imaging, ultrasound, laser therapy, radiation oncology, nuclear medicine, diagnostics.*

Введение

Современная медицинская наука развивается в тесной взаимосвязи с фундаментальными науками, в частности с достижениями физики и техники. В xxi веке процессы медицинской диагностики и терапии невозможно представить без физических принципов. Человеческий организм, являясь сложной биологической системой, одновременно подчиняется физическим законам: все физиологические процессы — кровообращение, проведение нервных импульсов, обмен веществ, разность потенциалов на клеточных мембранах — подчиняются законам механики, гидродинамики, электродинамики и оптики.

Формирование области медицинской физики позволило выявлять заболевания на ранних стадиях и лечить их минимально инвазивными методами. Открытие вильгельмом рентгеном х-лучей, а также исследования луи де бройля и других учёных-физиков в области квантовой механики заложили основу для технологий визуализации, которые сегодня являются одним из важнейших инструментов врачей.

Цель данного исследования — систематизировать основные физические принципы, применяемые в медицине, проанализировать с биофизической точки зрения механизмы работы диагностической и терапевтической аппаратуры, а также осветить современные тенденции в данной области.

Материалы и методы исследования

В процессе исследования использовались методы научно-теоретического анализа, системного подхода, сравнительно-сопоставительного и библиометрического анализа. Были изучены научные источники по медицинской физике и биофизической диагностике, опубликованные за последние 10 лет в базах данных pubmed, scopus и web of science. Объектом исследования стали физико-технические характеристики диагностического и терапевтического медицинского оборудования, а также механизмы его взаимодействия с биологическими тканями.

Результаты и их обсуждение

Области применения законов физики в медицине чрезвычайно широки и условно могут быть разделены на два основных направления: диагностическое и терапевтическое.

1. Методы визуальной диагностики и их физические основы:

— рентгенография и компьютерная томография (кт): основаны на различии степени поглощения и рассеяния электромагнитного излучения при прохождении через вещества и ткани (закон бугера–ламберта–бера). В кт источник рентгеновского излучения и детекторы вращаются вокруг тела пациента, формируя послойные (томографические) 3d-изображения.

— магнитно-резонансная томография (мрт): основана на явлении ядерного магнитного резонанса (ямр). В сильном постоянном магнитном поле ядра водорода (протоны) в тканях организма взаимодействуют с радиоволнами резонансной частоты. Благодаря различиям времени

релаксации протонов (t1 и t2) в разных тканях получают изображения мягких тканей высокой точности.

— ультразвуковая диагностика (узд): основана на пьезоэлектрическом эффекте. Высокочастотные акустические волны (1–15 мгц) отражаются от границ тканей, имеющих различный акустический импеданс (эхолокация). Эффект доплера позволяет определить скорость и направление движения форменных элементов крови в кровеносных сосудах.

Заключение

Данное исследование показывает, что интеграция физики и медицины приводит к существенным изменениям в области охраны здоровья человека. Современные физиологические и медицинские диагностические устройства основываются на точных физических законах и математическом моделировании.

Развитие области медицинской физики охватывает следующие перспективные направления:

1. Повышение точности и чувствительности диагностических методов вплоть до молекулярного уровня;

2. Оптимизация дозы радиационного и другого инвазивного воздействия и минимизация побочных эффектов;

3. Расширение применения физических принципов в нанотехнологиях и системах адресной доставки лекарственных препаратов.

Таким образом, глубокие знания будущих и практикующих врачей о физических процессах играют решающую роль в постановке правильного диагноза и выборе эффективной тактики лечения в медицинской практике.

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ГИСТОХИМИЧЕСКОЕ ИССЛЕДОВАНИЕ МУКОПОЛИСАХАРИДОВ И ГЛИКОГЕНА ПРИ ЭКСПЕРИМЕНТАЛЬНОМ С-ГИПОВИТАМИНОЗЕ

Аннотация. *В данной статье изучалось содержание мукополисахаридов в стенках сосудов внутренних органов и гликогена у морских свинок при С-гиповитаминозе. На 60 день гиповитаминоза животные забивались путем воздушной эмболии, внутренние органы фиксировались в 10% нейтральном формалине, жидкости Карнуа и по Шабадашу. Применялись гистохимические методики: толуидиновый синий при различных значениях pH, по Хейлу, ШИК-реакция с постановкой соответствующих контролей. При гиповитаминозе С выражена дезорганизация основного вещества соединительной ткани в стенках сосудов, резко понижено содержание гликогена, что обусловливает снижение реактивности организма.*

Ключевые слова: *Экспримент, морских свинок, гиповитаминозе С, гистохимические методы, гликоген, метахромазия, реактивности организма.*

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HISTOCHEMICAL STUDY OF MUCOPOLYSACCHARIDES AND GLYCOGEN IN EXPERIMENTAL C-HYPOVITAMINOSIS

Abstract. *This article examines the content of mucopolysaccharides in the vascular walls of internal organs and the content of glycogen in guinea pigs with C-hypovitaminosis. On day 60 of hypovitaminosis, the animals were sacrificed by*

air embolism. The internal organs were fixed in 10% neutral formalin, Carnoy's fluid, and according to Shabadash. The following histochemical methods were applied: toluidine blue at different pH values, Hale's reaction, and the PAS reaction with appropriate controls. In C-hypovitaminosis, pronounced disorganization of the ground substance of connective tissue in the vascular walls and a sharp decrease in glycogen content were observed, which accounts for the reduced reactivity of the organism.

Keywords: *experiment, guinea pigs, C-hypovitaminosis, histochemical methods, glycogen, metachromasia, organism reactivity.*

Введение. Всемирная организация здравоохранения является инициатором реализации программ повышения качества рациона питания детей, как ведущего фактора здоровья в старших возрастных группах [2,3]. По мнению ведущих специалистов-нутрициологов, реальная коррекция мультимикронутриентной недостаточности у детей возможна лишь при включении в рацион питания витаминизированных пищевых продуктов массового потребления, использования специализированной продукции детского питания, обогащенной микронутриентами [4,5]. В организме человека витамины выполняют многообразные функции, участвуют в синтезе коферментов и ферментов [6,7], являются универсальными регуляторами практически всех видов обмена, ответственны за механизм ферментативного катализа [8], выступают в качестве прогормонов, предшественников простетических групп ферментов, антиоксидантов, принимают активное участие в формировании специфического иммунного ответа и регулируют активность реакций неспецифической резистентности. Несмотря на преобладание у детей дошкольного и школьного возраста именно полигиповитаминозных состояний, С-витаминизация по-прежнему продолжает оставаться основным способом коррекции.

Цель исследования. Изучить особенности гистохимического распределения мукополисахаридов и гликогена в тканях при экспериментальном гиповитаминозе С.

Материалы и методы исследования. Изучалось содержание мукополисахаридов в стенках сосудов внутренних органов и гликогена у морских свинок при С-гиповитаминозе. Животные получали скорбутогенную диету и 2 мг аскорбиновой кислоты в сутки - гиповитаминозная группа животных (30 морских свинок). Контролем служили животные, находящиеся на том же режиме, но получавшие не обходимое количество витамина С в сутки (25 мг). На 60 день гиповитаминоза животные забивались путем воздушной эмболии, внутренние органы фиксировались в 10% нейтральном формалине, жидкости Карнуа и по Шабадашу. Применялись гистохимические методики: толуидиновый синий при различных значениях pH, по Хейлу, ШИК-реакция с постановкой соответствующих контролей.

Результаты исследования. При окраске толуидиновым синим коронарные сосуды обнаруживали хорошо выраженную метахромазию. В

сосудах легких артериального и венозного типа, в сосудах печени, почек кислые мукополисахариды при окраске толуидиновым синим характеризовались в-метахромазией. Наиболее выражена метахромазия при pH ниже 4,0. Основное вещество соединительной ткани при окрашивании толуидиновым синим давало сиренево-фиолетовое окрашивание под эндотелием, в среднем слое и в адвентиции сосудов внутренних органов в виде глыбок и волоконец. В сосудах свинок, получавших необходимое количество витамина С в сутки, при окраске толуидиновым синим метахромазию выявить не удалось. Под действием бактериальной гиалуронидазы метахромазия почти полностью исчезала, что свидетельствовало о присутствии в стенках сосудов гиповитаминозной группы животных значительного количества гиалуроновой кислоты и гепарина. Сульфатирование почти не изменяло окраску препаратов, что указывало на некоторую редукцию хондроитинсульфатов в условиях гиповитаминоза С. При окраске по Хейлу голубовато-зеленоватое окрашивание сопровождает волокнистые пучки во всех слоях стенок сосудов при гиповитаминозе С. Обнаруживаются и ШИК-позитивные вещества в стенках сосудов этой группы животных. Амилаза не изменяла малиново-красного окрашивания, что подтверждает наличие нейтральных мукополисахаридов в стенках сосудов. Количество гликогена в миокарде, печени (органах, наиболее богатых этим полисахаридом) при гистохимическом исследовании в условиях гиповитаминоза С резко понижено по сравнению с контрольной группой животных.

Вывод. Таким образом, при гиповитаминозе С выражена дезорганизация основного вещества соединительной ткани в стенках сосудов, резко понижено содержание гликогена, что обусловливает снижение реактивности организма.

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АНТИТЕЛА, НАПРАВЛЕННЫЕ К КОМПОНЕНТАМ ТКАНЕЙ СЕРДЦА, В СЫВОРОТКАХ КРОЛИКОВ ПРИ ЭКСПЕРИМЕНТАЛЬНОМ ЭНДО-МИОКАРДИТЕ КАВЕЛТИ

Аннотация. *Непрямым методом иммунофлуоресценции изучены сыворотки кроликов с экспериментальным эндо-миокардитом Кавелти. Во всех случаях обнаружены антитела, направленные к мышечным структурам миокарда (субсарколемма, I-диски) и гладкомышечным элементам сосудов. Реакция была видоспецифичной и воспроизводилась на срезах сердца кролика, крысы и морской свинки. Сыворотки неиммунизированных животных и контрольных групп давали слабую или отрицательную реакцию. Выявленные антитела являются аутоантителами к неизменённым антигенным компонентам сердца. Полученные данные свидетельствуют об участии аутоиммунных реакций в патогенезе экспериментального эндо-миокардита Кавелти.*

Ключевые слова: *антитела, аутоантитела, иммунофлуоресценция, экспериментальный эндо-миокардит Кавелти, миокард, сердце, кролики.*

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ANTIBODIES DIRECTED AGAINST HEART TISSUE COMPONENTS IN THE SERA OF RABBITS WITH EXPERIMENTAL CAVELLI ENDOMYOCARDITIS

Abstract. *Sera of rabbits with experimental Cavelli endomyocarditis were studied by the indirect immunofluorescence method. In all cases antibodies directed*

against myocardial muscle structures (subsarcolemma, I-discs) and smooth muscle elements of vessels were detected. The reaction was species-nonspecific and was reproduced on heart sections of rabbit, rat and guinea pig. Sera of non-immunized animals and control groups gave weak or negative reactions. The revealed antibodies are autoantibodies to unaltered antigenic components of the heart. The obtained data indicate the participation of autoimmune reactions in the pathogenesis of experimental Cavelli endomyocarditis.

Keywords: *antibodies, autoantibodies, immunofluorescence, experimental Cavelli endomyocarditis, myocardium, heart, rabbits.*

Введение. В клинической практике большинство аритмий у пациентов моложе 60 лет без ишемической болезни и пороков сердца относятся к «идиопатическим» (ИА) и могут стать причиной внезапной сердечной смерти у лиц молодого возраста [1]. По данным литературы, в основе таких аритмий лежат некоронарогенные заболевания миокарда (НКЗМ), представляющие собой гетерогенную группу патологий миокарда, не связанных с ишемической болезнью сердца [2,3]. Экспериментальный эндо-миокардит, воспроизводимый по методу Кавелти, является классической моделью для изучения иммунопатологических механизмов повреждения сердечной мышцы. В основе данной модели лежит иммунизация животных гомогенатом тканей гомологического сердца в сочетании с культурой стрептококка, что позволяет моделировать процессы, сходные с ревматическим поражением сердца [4,5]. Несмотря на длительное изучение данной модели, вопросы о роли аутоиммунных реакций в патогенезе экспериментального эндо-миокардита остаются недостаточно изученными. Особый интерес представляет выявление циркулирующих антител, направленных к компонентам мышечных структур миокарда, и определение их иммунологической специфичности [6,7]. Метод непрямой иммунофлуоресценции является высокочувствительным инструментом для выявления таких антител и оценки их взаимодействия с тканевыми антигенами.

Цель исследования. Целью настоящего исследования явилось изучение наличия, локализации и иммунологической специфичности антител к мышечным структурам миокарда в сыворотке кроликов при экспериментальном эндо-миокардите, воспроизведённом по методу Кавелти, с использованием метода непрямой иммунофлуоресценции.

Материалы и методы исследования. Непрямым методом иммунофлуоресценции изучены сыворотки кроликов при экспериментальном эндо-миокардите, воспроизведенном по методу Кавелти (иммунизация гомогенатом тканей гомологического сердца в смеси с культурой стрептококка). В контроле использовались сыворотки неиммунизированных животных, а также сыворотки кроликов, иммунизированных раздельно гомогенатом ткани и культурой стрептококка. Сыворотки испытывались на

срезах тканей сердца нормальных животных: кролика, крысы, морской свинки.

Результаты исследования. В результате проведенных исследований было установлено, что все сыворотки кроликов при экспериментальном эндо-миокардите содержат антитела, направленные к компонентам мышечных структур миокарда. При последовательном наслоении на срезы тканей сердца исследуемой сыворотки и чистых меченых антител к v-глобулину кролика отмечалось яркое свечение мышечных волокон в районе субсарколеммы по I-дискам (узким в фазово-контрастном микроскопе). Интенсивное свечение наблюдалось во всех случаях и в цитоплазме гладкомышечных элементов стенки сосудов. Эти результаты были однозначными при использовании срезов тканей сердца ряда животных (кролика, крысы, морской свинки). С паренхиматозными элементами других органов (печень, почка) указанные сыворотки не реагировали. Сыворотки неиммунизированных животных с мышечными структурами тканей сердца в реакцию не вступали. Сыворотки других контрольных животных, иммунизированных гомогенатом ткани или культурой стрептококка, реагировали с I-дисками мышечных волокон миокарда, однако в небольшом числе случаев и с незначительной интенсивностью. Иммунологическая специфичность реакций была показана в ряде к контролей: предварительной адсорбции меченых антител кролика препаратом чистого кроличьего v-глобулина, -глобулину ингибиции свечения немеченными антителами v-глобулину кролика. Изученные антитела, циркулирующие в сыворотке кроликов при экспериментальном эндо-миокардите Кавелти, рассматриваться могут как аутоантитела, так как направлены к неизмененным антигенным компонентам тканей сердца, общим для нескольких видов животных (кролик, крыса, морская свинка). При микроскопическом изучении тканей сердца кроликов с экспериментальным кардитом отмечены значительные альтеративно-экссудативные и пролиферативные изменения. При этом в селезенке и лимфатических узлах значительно увеличивалось количество клеток плазматического ряда.

Вывод. Результаты, полученные в данном исследовании, свидетельствуют - об участии в патогенезе экспериментального эндо-миокардита Кавелти аутоиммунных реакций.

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ГИСТОХИМИЧЕСКИЕ ИЗМЕНЕНИЯ ЛИМФОРЕТИКУЛЯРНОЙ ТКАНИ И ПЕЧЕНИ ПРИ БРУЦЕЛЛЁЗЕ В УСЛОВИЯХ ЭКСПЕРИМЕНТАЛЬНОГО С-ГИПОВИТАМИНОЗА

Аннотация. *Изучены гистохимические изменения печени, селезёнки и лимфатических узлов морских свинок при бруцеллёзе в условиях экспериментального С-гиповитаминоза. Применены ШИК-реакция, окраска толуидиновым синим, реакция по Хейлу, метод Браше и выявление суммарного белка. У животных с С-гиповитаминозом отмечено резкое снижение гликогена в гепатоцитах, уменьшение содержания суммарного белка и РНК в клетках печени, селезёнки и лимфоузлов, а также увеличение кислых мукополисахаридов в селезёнке. Полученные данные свидетельствуют о снижении реактивности лимфоретикулярной ткани при сочетании бруцеллёза и С-гиповитаминоза.*

Ключевые слова: *бруцеллёз, С-гиповитаминоз, гистохимия, печень, селезёнка, лимфатические узлы, мукополисахариды, гликоген.*

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HISTOCHEMICAL CHANGES IN LYMPHORETICULAR TISSUE AND LIVER IN BRUCELLOSIS UNDER EXPERIMENTAL C-HYPOVITAMINOSIS

Abstract. *Histochemical changes in the liver, spleen and lymph nodes of guinea pigs with brucellosis under experimental C-hypovitaminosis were studied using the PAS reaction, toluidine blue, Hale's reaction, Brachet's method and total*

protein staining. Animals with C-hypovitaminosis showed a sharp decrease in glycogen in hepatocytes, reduced total protein and RNA content in liver, spleen and lymph node cells, and an increase in acidic mucopolysaccharides in the spleen. The findings indicate decreased reactivity of lymphoreticular tissue under the combined effect of brucellosis and C-hypovitaminosis.

Keywords:*brucellosis, C-hypovitaminosis, histochemistry, liver, spleen, lymph nodes, mucopolysaccharides, glycogen.*

Введение. Бруцеллез (Brucellosis) - инфекционная, зооантропонозная, преимущественно хронически протекающая болезнь, вызываемая бактериями рода Brucella, проявляющаяся абортами, задержанием последа, эндометритами и расстройством опорно-двигательной системы [1,7]. Известно, что такое инфекционное заболевание как бруцеллёз, имеет не только ветеринарное, но и медико-санитарное значение [2,8]. Одновременно с развитием человеческого общества искоренение бруцеллёза является одной из актуальных проблем. По данным ВОЗ и МЭБ за последние годы произошли существенные изменения в эпизоотической ситуации по бруцеллезу во многих странах мира. 38 государств освободились от этой болезни, в 5 странах болезнь встречается как исключение, в 50 - в виде единичных вспышек, в 38 - как эпизоотия [3,4]. Ослабление контроля за проведением противобруцеллезных мероприятий на животноводческих объектах, несоблюдение руководителями животноводческих хозяйств и владельцами скота в частном секторе, ветеринарного законодательства способствует появлению и распространению скрытых очагов инфекции, о чем свидетельствует регистрация больных людей на территориях, где выявлены больные бруцеллезом сельскохозяйственные животные [5,6]. Сохранение высокой степени риска распространения бруцеллеза, социальная значимость проблемы определили основные направления наших исследований.

Цель исследования. Изучить гистохимические изменения лимфоретикулярной ткани и печени при бруцеллёзе в условиях экспериментального с-гиповитаминоза

Материалы и методы исследования. Изучены гистохимические изменения в печени, селезенке и лимфатических узлах морских свинок, зараженных бруцеллезом в условиях гиповитаминоза С. При этом использовались ШИК-реакция, окраска толуидиновым синим, по Хейлу, по Браше, на суммарный белок.

Результаты исследования. При гистохимическом определении гликогена у свинок, зараженных бруцеллезом в условиях гиповитаминоза С, в гепатоцитах обнаружено резкое падение содержания этого полисахарида по сравнению с животными, зараженными бруцеллезом в условиях нормального витаминного режима. В некротических участках иногда выявлялись нейтральные мукополисахариды. В клетках гранулем как в той, так и в другой группе животных кислые мукополисахариды не определялись. При окраске сулемовым раствором бромфенолового синего у животных контрольной

группы отмечено уменьшение содержания суммарного белка в цитоплазме печеночных клеток, увеличение его концентрации в ядрах. При этом ядра печеночных клеток приобретают фиолетовое окрашивание. Интенсивность реакции насуммарный белок в печеночных клетках как в ядре, так и ци топлазме у подопытной группы животных резко ослабевала. В красной пульпе селезенки ретикулярные клетки, макрофаги содержали значительное количество кислых и нейтральных мукополисахаридов. Количество кислых мукополисахари дов тина гиалуроновой кислоты и хондроитинсульфатов А и С увеличено у свинок, зараженных бруцеллезом в условиях ги повитаминоза С. Резко увеличено содержание кислых мукополисахаридов в клеточных скоплениях вокруг кровеносных сосудов. На 45 день бруцеллезной инфекции в селезенке животных в условиях нормального витаминного режима имелось множество пиронинофильных плазматических клеток разной стадии зрелости, а также ретикулярных клеток. Пиронинофилия снималась рибонуклеазой. У свинок, зараженных бруцеллезом в условиях гиповитаминоза С. в селезенке резко снижено число клеток, богатых РНК. У контрольных животных количество суммарного белка уменьшено в цитоплазме ретикулярных, плазматических клеток и лимфоцитах. Ядра этих клеток приобретали фиолетовое окрашивание. В нейтральных лейкопитах, ретикулярных клетках и макрофагах лимфатических узлов имелись кислые и нейтральные мукополисахариды. Клетки, содержащие мукополисахариды, скапливались в мякотных шнурах и синусах лимфатических узлов. У животных подопытной группы пиронинофильные клетки были в незначительном количестве. В лимфатических узлах контрольной группы животных отмечалось множество лимфоретикулярных и плазматических клеток, богатых РНК. Содержание суммарного белка в клетках лимфатических узлов у животных подопытной группы было незначительным, а в контрольной группе реакция была интенсивной.

Вывод. Данные гистохимических исследований свидетельствуют об интенсивных обменных процессах в органах ретикуло-эндотелиальной системы при бруцеллезной инфекции, протекающей в условиях нормального витаминного режима (наличие муко- полисахаридов, гликогена, плазматизация, пиронинофилия, накопление белка). В условиях гиповитаминоза С наблюдается резкое угнетение функциональной активности клеток лимфоретикулярного аппарата (резкое уменьшение гликогена,

пиронинофильных клеток, ослабление реакции на суммарный белок).

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ВЗАИМОСВЯЗЬ СУТОЧНОГО ПРОФИЛЯ АРТЕРИАЛЬНОГО ДАВЛЕНИЯ С СТРУКТУРНО-ФУНКЦИОНАЛЬНЫМ РЕМОДЕЛИРОВАНИЕМ МИОКАРДА ПРИ АРТЕРИАЛЬНОЙ ГИПЕРТОНИИ

Резюме. *В статье изучено особенности суточного профиля артериального давления артериальная гипертония. Обследовано 560 пациентов с артериальной гипертонией в возрасте 30–75 лет, средний возраст составил 56,4±10,8 года. В зависимости от циркадного профиля пациенты были разделены на dipper, non-dipper и night-peaker типы. У большинства больных артериальной гипертонией выявляются нарушения циркадного профиля АД, преимущественно по типу non-dipper и night-peaker. Полученные данные подтверждают необходимость комплексной оценки не только уровня АД, но и его суточной организации для выявления пациентов с повышенным риском поражения миокарда.*

Ключевые слова: *артериальная гипертония, пациентов, dipper, non-dipper, night-peaker, допплер-ЭхоКГ, корреляционный анализ, гемодинамическая нагрузка.*

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THE RELATIONSHIP BETWEEN THE 24-HOUR BLOOD PRESSURE PROFILE AND STRUCTURAL AND FUNCTIONAL MYOCARDIAL REMODELING IN PATIENTS WITH ARTERIAL HYPERTENSION

Abstract. *The study investigated the relationship between the 24-hour blood pressure profile and structural and functional myocardial remodeling in patients with arterial hypertension. A total of 560 patients with arterial hypertension aged 30–75 years were examined, with a mean age of 56.4 ± 10.8 years. According to their circadian blood pressure profile, the patients were divided into dipper, non-dipper, and night-peaker groups. Abnormal circadian blood pressure patterns were identified in the majority of patients with arterial hypertension, predominantly in the form of the non-dipper and night-peaker patterns. The findings confirm the need for a comprehensive assessment not only of blood pressure levels but also of its 24-hour pattern to identify patients at increased risk of myocardial damage.*

Keywords: *arterial hypertension, patients, dipper, non-dipper, night-peaker, Doppler echocardiography, correlation analysis, hemodynamic load.*

Введение. Артериальная гипертония (АГ) остается одним из наиболее значимых факторов развития сердечно-сосудистых осложнений. Современное представление о гипертензивном поражении органов-мишеней предполагает оценку не только офисного уровня артериального давления, но и характера гемодинамической нагрузки в течение суток [1, 2]. Суточное мониторирование артериального давления (СМАД) позволяет оценить среднесуточные, дневные и ночные значения АД, определить характер циркадного ритма и выявить фенотипы, которые невозможно надежно диагностировать при использовании только офисных измерений [1–4]. В физиологических условиях в период сна происходит снижение АД примерно на 10–20% по сравнению с дневными значениями. Данный тип циркадного профиля обозначается как dipper. При снижении ночного АД менее чем на 10% формируется профиль non-dipper, тогда как отсутствие снижения или увеличение АД ночью соответствует профилю reverse-dipper, или night-peaker [4,3]. Нарушение физиологического ночного снижения АД представляет особый интерес, поскольку связано с более продолжительной гемодинамической нагрузкой на сосудистую стенку и миокард. Ночные показатели АД имеют самостоятельное прогностическое значение, а nocturnal hypertension и reverse-dipping ассоциируются с повышенным риском поражения органов-мишеней и сердечно-сосудистых событий [4,5,7]. Одним из основных проявлений гипертензивного поражения сердца является ремоделирование левого желудочка. Хроническая перегрузка давлением приводит к увеличению массы миокарда ЛЖ, изменению относительной толщины стенок и формированию преимущественно концентрических вариантов геометрии. Наряду со структурными изменениями развивается нарушение диастолической функции, которое может возникать задолго до снижения фракции выброса. Повышение давления наполнения ЛЖ, снижение скорости раннего диастолического движения митрального кольца e′ и увеличение отношения E/e′ отражают прогрессирование диастолической дисфункции [8,10]. Исследования показывают, что патологический суточный профиль АД может быть связан не только с гипертрофией ЛЖ, но и с более ранними изменениями механики и функции миокарда [9–11]. В этой связи комплексная оценка данных СМАД и эхокардиографических характеристик может способствовать более точной стратификации риска гипертензивного поражения сердца.

Цель исследования. Изучить особенности суточного профиля артериального давления и оценить взаимосвязь показателей СМАД со структурно-функциональными изменениями миокарда у больных артериальной гипертонией.

Материал и методы исследования. Исследование имело проспективный наблюдательный характер и проводилось на базе

Многопрофильной клиники №1 Самаркандского государственного медицинского университета. В исследование включены 560 пациентов с АГ в возрасте от 30 до 75 лет. Средний возраст обследованных составил 56,4±10,8 года.

Суточное мониторирование артериального давления. СМАД проводили с использованием автоматизированных сертифицированных регистраторов в условиях обычной повседневной активности. Регистрация АД выполнялась в течение 24 часов с интервалами 15–20 минут в дневное время и 30–60 минут ночью. Пациенты сохраняли привычный режим активности и сна и отмечали в дневнике время сна, пробуждения, физической активности и приема лекарственных препаратов.

Анализировали среднесуточное САД, среднесуточное ДАД, дневное САД, дневное ДАД, ночное САД, ночное ДАД, характер ночного снижения АД , циркадный профиль АД. Стандартная трансторакальная эхокардиография включала определение толщины межжелудочковой перегородки (МЖП), задней стенки ЛЖ (ЗСЛЖ), конечно-диастолического и конечно-систолического размеров и объемов ЛЖ.Рассчитывали массу миокарда ЛЖ и ИММЛЖ, а также относительную толщину стенки. Диастолическую функцию оценивали с применением импульсно-волновой и тканевой допплерэхокардиографии с определением скорости раннего диастолического движения митрального кольца e′ и отношения E/e′.

Результаты исследования. При изучении показателей СМАД были выявлены следующие средние значения (табл.1)

Показатель	**Значение, M±SD**
Среднесуточное САД, мм рт. ст.	152±17
Среднесуточное ДАД, мм рт. ст	94±10
Дневное САД, мм рт. ст.	158±18
Дневное ДАД, мм рт. ст	98±11

Таблица 1. Основные показатели суточного мониторирования артериального давления у пациентов с АГ.

Полученные результаты свидетельствуют о сохраняющейся в течение суток выраженной гемодинамической нагрузке.

Несмотря на снижение средних значений АД в ночные часы по сравнению с дневными, ночное САД в исследуемой когорте оставалось повышенным и составляло в среднем 142±16 мм рт. ст.

Пациенты были распределены на типы суточного профиля АД. (табл.2).

Тип профиля АД	**n**	**%**
Dipper	213	38,0
Non-dipper	235	42,0
Night-peaker	112	20,0

Таблица 2. Распределение пациентов по типу суточного профиля АД

Физиологический профиль dipper выявлен менее чем у половины больных — у 38,0%. Наиболее распространенным вариантом являлся non-dipper, установленный у 42,0% обследованных. Профиль night-peaker зарегистрирован еще у 20,0% пациентов. Таким образом, суммарная распространенность неблагоприятных вариантов циркадного профиля — non-dipper и night-peaker — составила 62,0%.Это свидетельствует о высокой частоте нарушений ночной регуляции АД в обследованной когорте пациентов с АГ.

При эхокардиографическом обследовании нами были выявлены признаки структурные изменения ЛЖ. (табл.3)

Показатель	**Значение, M±SD**
МЖП, мм	11,6±1,4
ЗСЛЖ, мм	11,3±1,3
КДР ЛЖ, мм	52,8±4,9
КСР ЛЖ, мм	33,6±4,2
КДО ЛЖ, мл	128±26

Таблица 3. Основные структурные эхокардиографические показатели

Повышение ИММЛЖ и ОТС отражало формирование гипертрофического ремоделирования в условиях хронической перегрузки давлением.

При анализе геометрии ЛЖ нормальная геометрия выявлена у 134 (24,0%) больных, концентрическое ремоделирование — у 101 (18,0%), концентрическая гипертрофия — у 235 (42,0%), эксцентрическая гипертрофия — у 90 (16,0%) пациентов. Следовательно, патологические варианты геометрии ЛЖ регистрировались у 76,0% больных.

При корреляционном анализе выявлена статистически значимая положительная связь между среднесуточным САД и ИММЛЖ: $r=0,44$; $p<0,001$.

Таким образом, увеличение суточной систолической гемодинамической нагрузки сопровождалось увеличением массы миокарда ЛЖ.

Аналогичная направленность связи установлена между уровнем АД и ОТС, что свидетельствовало об участии хронической перегрузки давлением в формировании концентрического компонента структурной перестройки сердца. Полученные результаты подтверждают, что именно длительная, сохраняющаяся на протяжении суток гемодинамическая нагрузка является одним из ключевых факторов гипертрофического ремоделирования ЛЖ.

Особое значение имела взаимосвязь между показателями АД в ночной период и диастолической функцией сердца.Повышение ночного САД и ДАД, а также нарушение физиологического ночного снижения АД сопровождались более неблагоприятными параметрами диастолической функции.У пациентов с нарушенным ночным снижением АД отмечалась тенденция к уменьшению e′, отражающему ухудшение активной релаксации ЛЖ. Средняя скорость e′ в

обследованной группе составляла около 7,2 см/с.Одновременно наблюдалось увеличение E/e′, свидетельствующее о повышении давления наполнения ЛЖ.

Таким образом, нарушение ночного профиля АД было связано не только со структурной перегрузкой миокарда, но и с ухудшением его диастолических свойств.

Обсуждение. Результаты настоящего исследования демонстрируют высокую распространенность нарушений циркадного профиля АД среди больных артериальной гипертонией.

У 62% пациентов выявлены прогностически неблагоприятные варианты — non-dipper или night-peaker. При этом наиболее распространенным являлся профиль non-dipper, зарегистрированный у 42% обследованных.

Полученные результаты имеют клиническое значение, поскольку офисное измерение АД не позволяет оценить особенности ночного периода и может недооценивать реальную гемодинамическую нагрузку.

Современные рекомендации ESC и ESH подчеркивают значение внеофисной оценки АД, включая СМАД, для диагностики фенотипов гипертонии и более полной оценки контроля заболевания [1, 2].

В настоящем исследовании среднесуточное САД составило 152±17 мм рт. ст., а ночное САД оставалось на уровне 142±16 мм рт. ст., что указывает на сохранение значительной нагрузки давлением в течение суток.

Одним из наиболее важных результатов является корреляция среднесуточного САД с ИММЛЖ ($r=0,44$; $p<0,001$).

Данная взаимосвязь отражает кумулятивное воздействие повышенного АД на миокард и подтверждает ключевую роль хронической перегрузки давлением в формировании гипертрофии ЛЖ.

Связь между амбулаторным, особенно ночным, АД и гипертрофией ЛЖ подтверждена многочисленными клиническими исследованиями. Повышенное ночное АД ассоциировалось с большей вероятностью гипертрофии ЛЖ, причем в отдельных исследованиях ночное АД демонстрировало более выраженную связь с поражением органов-мишеней, чем офисные значения [5–7].

Значимый интерес представляет распространенность патологического ночного профиля. Физиологический механизм ночного снижения АД связан с уменьшением симпатической активности и гемодинамической нагрузки в период сна. Отсутствие такого снижения означает, что миокард подвергается перегрузке практически непрерывно. Профиль non-dipper и особенно night-peaker рассматриваются как неблагоприятные фенотипы. Современные обзоры подтверждают связь нарушенного dipping-pattern с повышенным сердечно-сосудистым риском, хотя прогностическое значение абсолютного ночного АД может быть еще более существенным [4–7].

Наши результаты также показали связь ночной гемодинамической нагрузки с диастолической функцией. Повышение ночного САД и ДАД и нарушение физиологического снижения АД сопровождались уменьшением e′ и повышением E/e′. Такой характер изменений патофизиологически

закономерен. Длительная перегрузка давлением приводит к гипертрофии кардиомиоцитов, увеличению жесткости ЛЖ и ухудшению активной релаксации. В результате повышается давление наполнения и постепенно формируется диастолическая дисфункция.

Результаты других исследований подтверждают, что non-dipper-профиль ассоциирован с более выраженными нарушениями механики ЛЖ. В исследовании Tadic и соавт. у пациентов non-dipper отмечалось ухудшение продольной и других компонентов деформации миокарда по сравнению с пациентами dipper [9]. Аналогичные результаты получены Sayed и соавт., которые продемонстрировали связь non-dipping-профиля с субклинической дисфункцией ЛЖ по данным speckle-tracking эхокардиографии [10].

У пациентов с сочетанием АГ и сахарного диабета Kalaycıoğlu и соавт. также выявили ухудшение GLS и увеличение E/e′ при non-dipper-профиле, причем параметры ночной гемодинамики и ИММЛЖ независимо ассоциировались с продольной функцией ЛЖ [11,12]. Таким образом, результаты настоящего исследования согласуются с современными представлениями о том, что поражение сердца при АГ определяется не только абсолютной величиной АД, но и длительностью гемодинамической нагрузки, ее сохранением в ночные часы и нарушением физиологического циркадного ритма.

С практической точки зрения это означает, что у пациентов с признаками гипертрофии или диастолической дисфункции при АГ оценка только офисного АД может быть недостаточной.

СМАД позволяет выделить пациентов с non-dipper и night-peaker-профилями и тем самым уточнить характер гемодинамической нагрузки, потенциально связанной с прогрессированием поражения миокарда.

Заключение. У пациентов с артериальной гипертонией нарушения циркадной организации АД встречаются с высокой частотой.

Неблагоприятные типы суточного профиля non-dipper и night-peaker выявлены у 62% больных. Среднесуточное САД имеет статистически значимую положительную связь с ИММЛЖ, что подтверждает роль хронической суточной гемодинамической нагрузки в формировании структурного ремоделирования ЛЖ. Повышенные ночные уровни АД и отсутствие физиологического ночного снижения ассоциируются с ухудшением показателей диастолической функции. Комплексное использование СМАД и эхокардиографии позволяет одновременно оценить гемодинамическую нагрузку и сформировавшееся поражение сердца и может способствовать более точной стратификации пациентов с АГ.

Выводы:

1. У больных артериальной гипертонией среднесуточные значения САД и ДАД составили соответственно 152±17 и 94±10 мм рт. ст., а ночное АД оставалось повышенным — 142±16/86±19 мм рт. ст.

2. Физиологический профиль dipper выявлен у 38,0% пациентов, тогда как неблагоприятные профили non-dipper и night-peaker зарегистрированы

соответственно у 42,0% и 20,0% больных; их суммарная распространенность составила 62,0%.

3. Среднесуточное САД статистически значимо коррелировало с ИММЛЖ (r=0,44; p<0,001), что отражает взаимосвязь хронической гемодинамической нагрузки и структурного ремоделирования ЛЖ.

4. Повышение АД также сопровождалось увеличением ОТС, подтверждая роль перегрузки давлением в формировании концентрического компонента гипертензивного ремоделирования.

5. Повышенные ночные значения САД и ДАД и нарушение физиологического ночного снижения АД ассоциировались с ухудшением диастолической функции ЛЖ — снижением e′ и повышением E/e′.

6. СМАД в сочетании с эхокардиографической оценкой структурно-функционального состояния сердца позволяет более полно характеризовать гипертензивное поражение миокарда, чем изолированная оценка уровня офисного АД.

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ПРОБЛЕМНОЕ ОБУЧЕНИЕ В ОБРАЗОВАТЕЛЬНОМ ПРОЦЕССЕ

Аннотация*: В статье раскрывается сущность проблемного обучения и его роль в развитии самостоятельного и творческого мышления учащихся. Рассматриваются особенности создания проблемных ситуаций и организации поиска их решений. Показано значение проблемного обучения в формировании знаний, умений и профессиональных навыков.*

Ключевые слова: Проблемное обучение, личностно-ориентированная технология обучения, проблемная ситуация, проблемная интерпретация учебного материала.

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PROBLEM-BASED LEARNING IN THE EDUCATIONAL PROCESS

Abstract: *The article reveals the essence of problem-based learning and its role in developing students' independent and creative thinking. It examines the features of creating problem situations and organizing the search for solutions. The importance of problem-based learning in developing knowledge, skills, and professional competencies is highlighted.*

Key words: *Problem-based learning, personality-oriented learning technology, problem situation, problem interpretation of educational material.*

Проблемное обучение основывается на теоретических положениях американского философа, психолога и педагога Дж.Дьюн и получило распространение в 20-30 х годах XX века. Дж.Дьюн выделял 4 инстинкта для обучения: социальный, конструирование, художественное выражение, исследовательский. Для удовлетворения их представлялись в качестве инстинктов познания: слово, произведения искусства, технические устройства, игры и труд.

Сегодня под проблемным обучением понимается – создание педагогом проблемных ситуаций на занятиях и активную самостоятельную деятельность учащихся по их разрешению, в результате чего и происходит творческое овладение профессиональными знаниями, навыками, умениями и развитие мыслительных способностей.

Проблемное обучение относится к личностно-ориентированным технологиям, так как личность здесь является субъектом, а цель проблемных ситуаций – особым видом мотивации в педагогическом процессе.

Оптимальной структурой учебного материала является традиционное изложение с включением проблемных ситуаций.

Педагог создаёт проблемную ситуацию, направляет учащегося на ее решение, организует поиск решения (рис. 1).

Управление проблемным обучением требует педагогического мастерства, так как возникновение проблемной ситуации - акт индивидуальный, поэтому требуется использование дифференцированного и индивидуального подхода.

Проблемное обучение как творческий процесс представляется как решение нестандартных научно-учебных задач нестандартными же методами. Если тренировочные задачи предлагаются учащимся для закрепления знаний и отработки навыков, то проблемные задачи – это всегда поиск нового способа решения.

Суть проблемной интерпретации учебного материала состоит в том, что преподаватель не сообщает знаний в готовом виде, но ставит перед учащимися проблемные задачи, побуждая искать пути и средства их решения. Проблема сама прокладывает путь к новым знаниям и способам действия.



Рис. 1. Блок-схема «Проблемного обучения»

Принципиально важен тот факт, что новые знания даются не для сведений, а для решения проблемы или проблем. При традиционной педагогической стратегии – от знаний к проблеме – учащиеся не могут выработать умений и навыков самостоятельного научного поиска, поскольку им даются для усвоения его готовые результаты.

Решение проблемы требует включения творческого мышления. Репродуктивные психические процессы, связанные с воспроизведением усвоенных шаблонов, в проблемной ситуации просто неэффективны.

Если человека постоянно приучить усваивать знания и умения в готовом виде, можно и притупить его природные творческие способности: «разучить» думать самостоятельно. В максимальной степени процесс мышления проявляется и развивается при решении проблемных задач.

Психологический механизм происходящих процессов при проблемном обучении следующий: сталкиваясь с противоречивой, новой, непонятной проблемной (проблема – сложный теоретический или практический вопрос, содержащий в себе скрытое противоречие, вызывающий разные, порой противоположные позиции при его решении), у человека возникает состояние недоумения, удивления, возникает вопрос: в чем суть?

И человек либо самостоятельно осуществляет мыслительный поиск открытия неизвестного, либо с помощью преподавателя. Активизации творческого мышления способствуют субъект-объект-субъектные отношения, возникающие при коллективном решении проблемы.

Важнейшей чертой содержательного аспекта проблемного обучения является отражение объективных противоречий, закономерно возникающих в процессе научного знания, учебной или любой другой деятельности, которые и есть источник движения и развития в любой сфере. Именно в связи с этим проблемное обучение можно назвать развивающим, ибо его цель - формирование знания, гипотез, их разработки и решений. При проблемном обучении процесс мышления включается лишь с целью разрешения проблемной ситуации, оно формирует мышление, необходимое для решения нестандартных задач.

Таким образом, проблемное обучение обеспечивает более прочное и осознанное усвоение знаний, умений и навыков в процессе активного поиска и самостоятельного решения проблем, развивает мышление, творческие способности и познавательную активность учащихся, формируя самостоятельную и инициативную личность, способную выявлять, ставить и эффективно решать нестандартные проблемы.

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ИНДИВИДУАЛЬНАЯ МУЗЫКАЛЬНАЯ ТРАЕКТОРИЯ: ТЕХНОЛОГИИ ТЬЮТОРСКОГО СОПРОВОЖДЕНИЯ В ОБУЧЕНИИ МУЗЫКЕ ДЕТЕЙ С РАС (МОДЕЛЬ «ПЕДАГОГ – ТЬЮТОР – РЕБЕНОК»)

***Аннотация**: данная статья развивает идеи музыкального воспитания детей с расстройствами аутистического спектра, смещая фокус с групповой коррекционно-развивающей работы на формат индивидуальных занятий. Рассматривается специфика построения образовательного процесса в диаде «педагог – ребенок» при активном участии тьютора. Акцент делается на использовании современных технологий для создания контролируемой сенсорной среды и распределения ролей между специалистами.*

***Ключевые слова**: РАС, музыкальная терапия, тьюторское сопровождение, адаптивные технологии, индивидуальное обучение, сенсорная интеграция.*

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INDIVIDUAL MUSICAL TRAJECTORY: TUTOR SUPPORT TECHNOLOGIES IN TEACHING MUSIC TO CHILDREN WITH ASD (THE "TEACHER – TUTOR – CHILD" MODEL)

***Abstract**: This article advances the concepts of musical education for children with Autism Spectrum Disorder (ASD), shifting the focus from group-based correctional and developmental work to an individual lesson format. The specifics of constructing the educational process within the "teacher-child" dyad are examined under the active participation of a tutor. Emphasis is placed on utilizing modern technologies to create a controlled sensory environment and delineate professional roles among specialists.*

***Keywords**: ASD, music therapy, tutor support, adaptive technologies, individualized instruction, sensory integration.*

Введение

Актуальность. Несмотря на доказанную эффективность музыки для социализации детей с РАС, большинство методик ориентировано на групповые занятия. Однако сенсорная насыщенность коллектива часто вызывает у таких обучающихся тревогу и поведенческие сбои, что формирует острый запрос на разработку технологий строго индивидуального музыкального сопровождения.

Проблема и цель исследования. Существует противоречие между высоким потенциалом музыки при РАС и дефицитом ресурсов педагога в формате «один на один», где учитель вынужден совмещать функции музыканта и тьютора, что ведет к снижению эффективности уроков. Цель работы – разработать модель распределенного взаимодействия «Педагог – тьютор – ребенок» с интеграцией цифровых технологий для построения безопасной персональной образовательной траектории.

Трансформация пространства: от группы к индивидуальному модулю

В предыдущей работе [5] подчеркивалась важность социализации в малых группах. Однако для многих детей с РАС именно группа становится источником флуктуаций внимания и сенсорных перегрузок. Переход к формату один на один позволяет создать полностью контролируемую микросреду. Роль тьютора здесь заключается не в пассивном присутствии, а в мониторинге физиологических маркеров ребенка до начала занятия. Пока педагог настраивает оборудование, тьютор отслеживает уровень саморегуляции ученика. Если фиксируется перевозбуждение, занятие начинается не с активного музицирования, а с совместного конструирования «сенсорного кокона» вокруг цифрового пианино или планшета с использованием утяжеленного пледа и приглушенного света [1]. Это реализует мысль о важности сохранения привычной обстановки [4], но делает ее мобильной.

Разделение педагогических функций: Музыкант и Модератор

Индивидуальное занятие требует четкого ролевого разграничения:

- *Учитель музыки* концентрируется исключительно на звуке, мелодии, гармонии и технике звукоизвлечения. Он находится напротив ребенка, устанавливая тот самый эмоциональный контакт через совместное дыхание и игру [2].
- *Тьютор* выступает технологическим ассистентом и буфером. Он находится сбоку или чуть позади ребенка. В его задачи входит управление интерфейсом (смена паттернов на MIDI-контроллере, переключение треков), физическая помощь в правильной постановке рук на инструмент и предотвращение самостимуляции (стимов).

Это исключает ситуацию, когда педагог разрывается между необходимостью показать аппликатуру и необходимостью успокоить ребенка. Тьютор берет на себя поведенческую регуляцию, позволяя учителю оставаться в роли музыканта-наставника.

Адаптивные алгоритмы вместо социального подражания

В группе дети учатся согласовывать действия и разрешать конфликты. При индивидуальном обучении этот механизм отсутствует. Его заменяет адаптивное программное обеспечение. Данная методика предполагает использование ИИ-секвенсоров. Педагог играет гармоническую основу, а алгоритм в реальном времени анализирует ритм ударов ребенка по пэду. Если ребенок замедляется из-за утомления, секвенсор автоматически упрощает партию фоновых инструментов, подстраиваясь под его возможности. Успех достигается не за счет усилий ребенка догнать группу, а за счет того, что технология сама спускается на его уровень темпа.

Мультисенсорная замена невербальной коммуникации

В условиях индивидуального занятия педагог лишается поддержки других детей, которые в группе служат социальными моделями. Для неговорящего ребенка передача инструкции ложится на плечи педагога и техники. Здесь эффективно применение биофидбек-интерактивности: пульс ребенка выводится на экран в виде меняющего цвет круга. Педагог дает инструкцию: «Давай сделаем твой огонек спокойным и синим». Единственный способ достичь этого – синхронизировать свое дыхание с медленным темпом колыбельной, которую играет учитель. Тьютор в это время помогает ребенку удерживать корпус в правильном положении, незаметно фиксируя снижение мышечного напряжения. Так решается задача обучения пониманию состояний другого человека через проекцию собственного тела на музыку.

Технология зеркальных нейронов в формате записи-ответа

Ориентация в пространстве, ранее достигавшаяся через карточки со стрелочками, в индивидуальном формате трансформируется в технологию «зеркала». Педагог исполняет короткий ритмический рисунок на ксилофоне справа от себя. Задача ребенка – точно повторить его слева. Камера над инструментом фиксирует точность попадания. Ошибка не проговаривается вербально (что может вызвать отказ от деятельности), а визуализируется: если удар пришелся мимо пластины, звук окрашивается в серый цвет, если точно – в золотой. Тьютор лишь мягко направляет руку ребенка в нужную зону, не прерывая музыкальный диалог с педагогом.

Динамическая партитура как инструмент совместного контроля

Обучение игре на инструментах строится на создании личной истории успеха. Вместо статичных схематических партитур используется планшет, лежащий между педагогом и ребенком. Партитура разделена пополам. Верхняя часть контролируется учителем (он вводит гармонию), нижняя – ребенком (он выбирает высоту звука из предложенных трех вариантов). Когда ребенок касается своего варианта, тьютор легонько похлопывает его по плечу, давая тактильное подтверждение правильного выбора без слов. В конце занятия эта уникальная дуэт-партитура сохраняется. Она становится материальным доказательством того, что ребенок создал настоящую музыку

вместе со взрослым, что закрепляет положительную динамику развития музыкальных способностей.

Методологические рекомендации для модели «Педагог – тьютор – ребенок»

1) Музыкальное приветствие: проводится только акустически (фраза учителя – вокальный ответ ребенка) для установления первичного раппорта без гаджетов.

2) Сенсорный чек (роль тьютора): оценка текущего уровня возбуждения перед включением аппаратуры.

3) Блок управляемого хаоса: педагог предлагает ребенку играть на любом инструменте любым способом (реализация идеи о праве на необычное звукоизвлечение), а тьютор записывает эти звуки в лупер, превращая стимы в зацикленный бит [3].

4) Целевой блок (роль педагога): работа над конкретной техникой или песней с использованием адаптивного ПО.

5) Совместное сведение: финальный этап, где педагог, ребенок и тьютор вместе крутят ручки микшера, регулируя громкость дорожек. Это обучает контролю и завершает цикл взаимодействия.

6) Музыкальное прощание: сохраняется как неизменный ритуал-якорь, сигнализирующий нервной системе о безопасности завершения интенсивного контакта.

Заключение

Индивидуальный формат с привлечением тьютора переводит музыкальное обучение детей с РАС из плоскости социальной адаптации в плоскость точной настройки когнитивных и сенсомоторных процессов. Присутствие второго специалиста снимает с музыкального руководителя бремя поведенческого менеджмента. Это позволяет сохранить главную задачу – обучение музыке – на качественно новом уровне, где каждый элемент технологии служит не развлечению, а выстраиванию устойчивой связи между внутренним миром ребенка и звучащей реальностью [6].

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МОДЕЛЬ ПОЭТАПНОГО ВНЕДРЕНИЯ VR- И ИИ-АДАПТИВНОЙ ОБУЧАЮЩЕЙ СИСТЕМЫ В МЕДИЦИНСКОМ ВУЗЕ И ОЦЕНКА ЕЁ ЭФФЕКТИВНОСТИ

Аннотация: *В статье предложена модель поэтапного внедрения адаптивной обучающей системы на основе виртуальной реальности и искусственного интеллекта в медицинском вузе, а также методика комплексной оценки её эффективности по уровням Киркпатрика. Обоснованы четыре этапа внедрения - пилот, расширение, масштабирование и институционализация - с критериями перехода между ними. Оценка на пилотном этапе показала положительные результаты на всех измеренных уровнях: удовлетворённость 4,3/5, прирост знаний +25,8 балла, перенос навыков в клинику (d = 0,71). Рассмотрены организационные и этические риски и меры их снижения.*

Ключевые слова: *внедрение, модель Киркпатрика, оценка эффективности, управление изменениями, виртуальная реальность, медицинское образование, ROI*

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MODEL FOR THE PHASED IMPLEMENTATION OF VR-AND AI-ADAPTIVE TRAINING SYSTEMS IN MEDICAL UNIVERSITIES AND EVALUATION OF THEIR EFFECTIVENESS

Abstract: *Even a technically sound learning system yields no benefit unless it is embedded in the real educational process, where success depends more on the deployment model and change management than on the system itself, and this paper proposes a stepwise deployment model for a VR and AI - based adaptive learning system in a medical university together with a framework for evaluating its effectiveness. An incremental four-stage model - pilot, expansion, scaling, and institutionalisation - is defined with explicit transition criteria between stages, effectiveness is evaluated using the four-level Kirkpatrick model augmented by a return-on-investment calculation, and a risk register with mitigation measures is compiled, with the model applied in an eight-week pilot within the discipline of internal-medicine propaedeutics.*

The pilot produced positive results at all measured levels: satisfaction of 4.3/5 and a System Usability Scale score of 81.4, a knowledge-test gain of +25.8 points in the experimental group versus +14.7 in the control group, and observed transfer of skills to clinical practice with an effect size of d = 0.71, while key risks such as staff resistance, cybersickness, technical failures, data privacy, and over-reliance on the algorithm were identified with concrete mitigations. Together with the preceding studies of the series, the deployment model and its evaluation framework form a coherent methodological basis for introducing adaptive VR technologies into higher medical education, with multi-centre research and long-term retention assessment identified as priority next steps.

Keywords: *deployment, Kirkpatrick model, effectiveness evaluation, change management, virtual reality, medical education, return on investment.*

Введение

Даже технически совершенная обучающая система не приносит пользы, если она не встроена в реальный учебный процесс. Опыт внедрения образовательных технологий показывает, что успех определяется не столько качеством самой системы, сколько продуманностью организационной модели её внедрения и управлением изменениями [1, 2]. В предыдущих статьях цикла обоснованы модель, алгоритмы, данные и метод оценки компетентности разрабатываемой системы; настоящая работа завершает цикл, отвечая на практический вопрос: как поэтапно внедрить такую систему в медицинском вузе и как объективно измерить эффект от внедрения. Цель работы - предложить модель поэтапного внедрения и методику её оценки, апробировав их на пилотном этапе.

Модель поэтапного внедрения

Внедрение предлагается проводить в четыре последовательных этапа (рис. 1) - от ограниченного пилота до полной институционализации. Такой инкрементальный подход снижает риски и позволяет накапливать доказательства эффективности перед каждым расширением [2]. Переход к следующему этапу допускается только при выполнении заранее заданных критериев готовности, что превращает внедрение в управляемый, измеримый процесс.

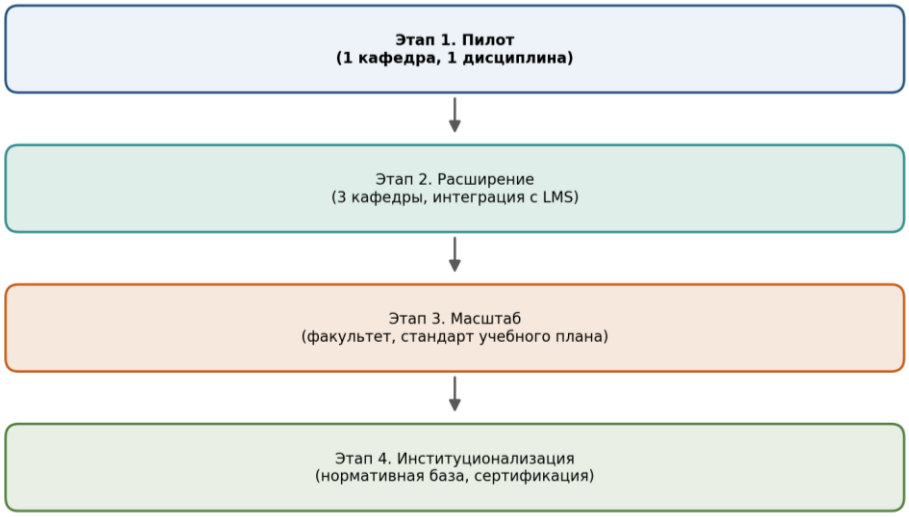


Рис. 1. Четырёхэтапная модель внедрения системы

Таблица 1. Этапы внедрения и критерии перехода

Этап	Охват	Критерий перехода
1. Пилот	1 кафедра, 1 дисциплина, 1 группа	d ≥ 0,5 по знаниям; SUS ≥ 70
2. Расширение	3 кафедры, интеграция с LMS	стабильность ПО; согласие преподавателей
3. Масштабирование	факультет, часть учебного плана	положительный ROI; обучен персонал
4. Институционализация	нормативная база, сертификация	приказ вуза; регламент сопровождения

Методика оценки эффективности

Для комплексной оценки применена четырёхуровневая модель киркпатрика [3], дополненная расчётом окупаемости. Уровень 1 (реакция) измеряется удовлетворённостью и шкалой удобства использования sus; уровень 2 (обучение) - приростом результатов теста знаний; уровень 3 (поведение) - переносом навыков в реальную клиническую практику; уровень 4 (результаты) - организационными показателями. Экономическая целесообразность оценивается коэффициентом окупаемости:

$$ROI = \frac{B_{eff} - C_{impl}}{C_{impl}} \times 100\% \quad (1)$$

где B_{eff} - денежная оценка выгод (экономия времени преподавателей, снижение стоимости ошибок), C_{impl} - затраты на внедрение и сопровождение. Соответствие уровней Киркпатрика конкретным инструментам измерения приведено в табл. 2.

Таблица 2. Модель оценки эффективности по уровням Киркпатрика

Уровень Киркпатрика	Инструмент измерения	Целевой показатель
1. Реакция	SUS, анкета удовлетворённости	SUS ≥ 70; удовл. ≥ 4/5
2. Обучение	пред/пост-тест знаний, OSCE	d ≥ 0,5
3. Поведение	наблюдение в клинике, Mini-CEX	перенос навыка, d > 0
4. Результаты	частота ошибок, удовлетв. пациентов	снижение ошибок

Результаты пилотного этапа

Пилотный этап (одна кафедра, дисциплина «пропедевтика внутренних болезней», 8 недель) дал положительные результаты на всех измеренных уровнях (рис. 2). На уровне реакции средняя удовлетворённость составила 4,3/5, а показатель sus - 81,4 балла. На уровне обучения прирост результатов теста в экспериментальной группе (+25,8 балла) значимо превысил прирост в контрольной (+14,7 балла). На уровне поведения независимое наблюдение в

клинике выявило перенос сформированных навыков с величиной эффекта d = 0,71. Уровень результатов на пилоте оценивался прогнозно.

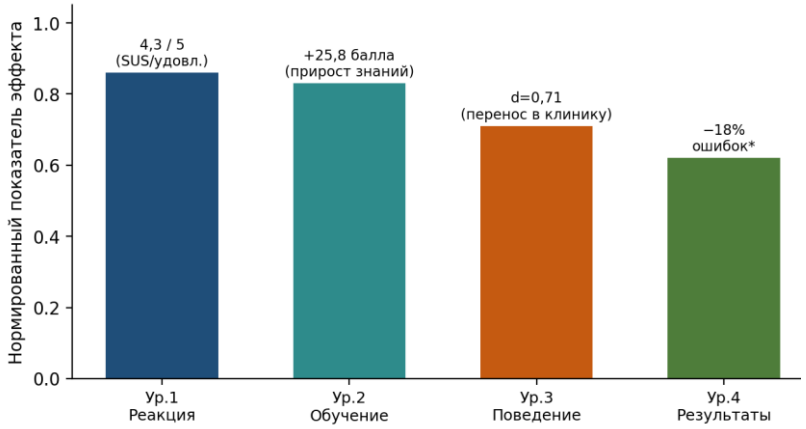


Рис. 2. Результаты пилотного этапа по четырём уровням модели Киркпатрика

Риски и меры их снижения

Внедрение сопряжено с рядом рисков, которые необходимо учитывать заранее (табл. 3). Организационное сопротивление преподавателей снижается через их раннее вовлечение и обучение; риск кибер-укачивания в vr - через ограничение длительности сессий и выбор комфортных сценариев [4]; этические риски, связанные с обработкой учебных данных и алгоритмической оценкой, - через локальное хранение данных, прозрачность алгоритмов и сохранение решающей роли преподавателя в ответственных решениях [5].

Таблица 3. Реестр рисков внедрения и меры их снижения

Риск	**Вероятность / влияние**	**Мера снижения**
Сопротивление преподавателей	средняя / высокое	раннее вовлечение, обучение, амбассадоры
Кибер-укачивание в VR	средняя / среднее	лимит сессии, комфортные сценарии
Технические сбои ПО	низкая / высокое	резервирование, лок. развёртывание
Приватность учебных данных	низкая / высокое	локальное хранение, псевдонимизация
Чрезмерное доверие алгоритму	средняя / высокое	оценка ИИ носит совещательный характер

Заключение

Предложены модель поэтапного внедрения vr и ии-адаптивной обучающей системы в медицинском вузе и методика оценки её эффективности по уровням киркпатрика с расчётом окупаемости. Апробация на пилотном этапе подтвердила положительный эффект на уровнях реакции, обучения и поведения, а реестр рисков задаёт практические ориентиры для управления изменениями. В совокупности с предыдущими работами цикла - концептуальной моделью, алгоритмами, моделью данных и методом оценки компетентности - полученные результаты образуют целостную научно-методическую основу для внедрения адаптивных vr-технологий в высшее медицинское образование. Перспективными направлениями являются многоцентровое исследование и долгосрочная оценка сохранения навыков.

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АВТОМАТИЧЕСКАЯ ОЦЕНКА КЛИНИЧЕСКОЙ КОМПЕТЕНТНОСТИ СТУДЕНТОВ - МЕДИКОВ ПО ДАННЫМ ТЕЛЕМЕТРИИ ВИРТУАЛЬНОЙ РЕАЛЬНОСТИ

Аннотация: *Традиционная оценка клинических навыков, такая как OSCE и Mini-CEX, является ресурсоемкой и неизбежно субъективной, в то время как среды виртуальной реальности фиксируют каждое действие обучающегося как высокочастотную объективную телеметрию, и данное исследование предлагает и проверяет метод автоматической оценки клинической компетентности студентов-медиков на основе поведенческих данных VR. Четырехступенчатый трубопровод получает телеметрический поток частотой 60 Гц (положение рук, направление взгляда, время реакции), извлекает четыре группы признаков - точность процедур, коммуникацию, экономию движения и безопасность - объединяет их через взвешенную сумму и оценивает уровень доверия с помощью логистической регрессии; метод был протестирован на 90 сессиях, каждая из которых была независимо оценена двумя экзаменаторами ОБСЕ по шкале 1-5. Согласованность между автоматическим баллом и усредненными экспертными рейтингами была высокой (Pirson r = 0,86; внутриклассовая корреляция ICC = 0,84; средняя абсолютная ошибка 0,34 балла), а межрейтерское согласие между двумя экспертами (Cohen's к = 0,79) было сопоставимо с системой - экспертным соглашением, что свидетельствует о том, что автоматизированное оценивание выполняется в пределах нормальной межрейтерной вариабельности. Эти результаты показывают, что поведенческая телеметрия содержит достаточную информацию для объективной, воспроизводимой оценки компетентности на уровне, приемлемом для*

формирующей оценки, снижая нагрузку на рутинное оценивание и обеспечивая немедленную обратную связь, сохраняя при этом консультативную значимость при принятии важных решений, где преобладает экспертное суждение.

Ключевые слова: *автоматическая оценка, телеметрия, виртуальная реальность, клиническая компетентность, извлечение признаков, логистическая регрессия, OSCE*

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AUTOMATIC ASSESSMENT OF MEDICAL STUDENTS' CLINICAL COMPETENCE BASED ON VIRTUAL REALITY TELEMETRY DATA

Abstract: *Conventional assessment of clinical skills such as OSCE and Mini-CEX is resource-intensive and inevitably subjective, whereas virtual-reality environments record every learner action as high-frequency objective telemetry, and this study proposes and validates a method for the automatic assessment of medical students' clinical competency from behavioural VR data. A four-stage pipeline acquires a 60 Hz telemetry stream (hand position, gaze direction, reaction times), extracts four feature groups - procedural accuracy, communication, movement economy, and safety - combines them through a weighted sum, and estimates the entrustment level by logistic regression; the method was tested on 90 sessions, each independently rated by two OSCE examiners on a 1-5 scale. Agreement between the automatic score and averaged expert ratings was high (Pearson r = 0.86; intraclass correlation ICC = 0.84; mean absolute error 0.34 points), and inter-rater agreement between the two experts* ***(Cohen's κ = 0.79)*** *was comparable to the system - expert agreement, indicating that automated scoring performs within the range of normal inter-rater variability. These results show that behavioural telemetry carries sufficient information for objective, reproducible competency assessment at a level acceptable for formative evaluation, reducing routine grading load and providing immediate feedback while remaining advisory in high-stakes*

decisions where expert judgement should prevail.

Keywords: *automatic assessment, telemetry, virtual reality, clinical competency, feature extraction, logistic regression, OSCE.*

Введение

Традиционная оценка клинических навыков (osce, mini-cex) требует значительных ресурсов экспертов и неизбежно содержит элемент субъективности [1,2]. Среда виртуальной реальности открывает принципиально новую возможность: каждое действие обучающегося фиксируется в виде объективной телеметрии высокой частоты, которую можно превратить в количественные показатели компетентности. Идея оценивать мастерство по кинематике движений уже подтвердила состоятельность в хирургическом обучении, где параметры траектории инструментов надёжно различают уровни экспертизы [3,4]. Настоящая работа переносит этот подход в более широкий контекст клинической подготовки и описывает метод автоматической оценки компетентности по vr-телеметрии, а также проверяет его согласованность с суждением экспертов.

Метод оценки

Конвейер оценки состоит из четырёх ступеней (рис. 1): сбор сырой телеметрии, извлечение признаков, нормировка и агрегация, вычисление интегрального балла. На вход поступает поток частотой 60 гц, содержащий координаты рук, направление взгляда и временные метки действий.

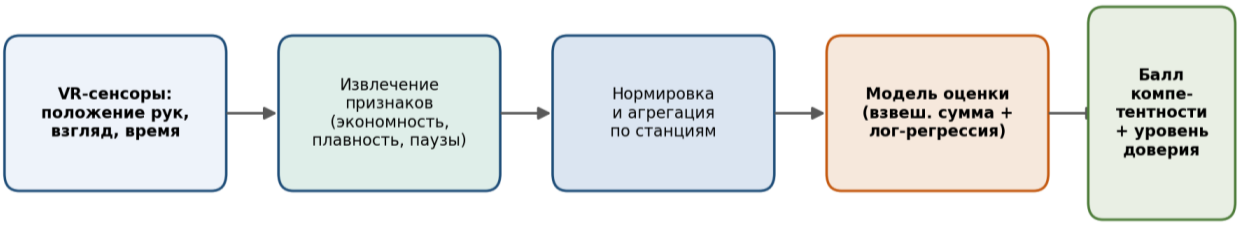


Рис. 1. Блок-схема конвейера автоматической оценки компетентности

Из телеметрии вычисляются четыре группы признаков: процедурная точность A_proc, качество коммуникации A_comm, экономность (эффективность) действий A_effic и безопасность A_safe. Интегральный балл формируется как взвешенная сумма:

$$S = 100(w_1 A_{proc} + w_2 A_{comm} + w_3 A_{effic} + w_4 A_{safe}) \quad (1)$$

Показатель экономности отражает, насколько траектория действий студента близка к оптимальной; он убывает экспоненциально с ростом избыточной длины пути:

$$A_{effic} = \exp\left(-\lambda \frac{L_{path} - L_{opt}}{L_{opt}}\right) \quad (2)$$

где L_{path} - фактическая длина траектории (или число шагов), L_{opt} - эталонная длина, λ - коэффициент чувствительности. Наконец, вероятность того, что студенту можно доверить самостоятельное выполнение задачи (уровень доверия EPA), оценивается логистической регрессией по агрегированным признакам:

$$P(entrust) = \frac{1}{1 + e^{-(\beta_0 + \sum_k \beta_k A_k)}} \quad (3)$$

Веса w_k в (1) и коэффициенты β_k в (3) откалиброваны по обучающей выборке сессий с известными экспертными оценками. Перечень признаков и их источники приведены в табл. 1.

Таблица 1. Признаки, извлекаемые из VR-телеметрии

Группа признаков	Показатель	Источник в телеметрии
Процедурная точность	доля верных шагов, порядок действий	последовательность событий
Коммуникация	своевременность реплик, зрительный контакт	взгляд, аудио-метки
Экономность	длина траектории рук, число лишних действий	координаты рук (60 Гц)
Безопасность	число опасных/пропущенных действий	маркеры сценария
Темп	время до ключевых решений	временные метки

Результаты

Метод апробирован на 90 сессиях, каждая из которых параллельно оценивалась двумя независимыми экспертами по шкале osce (1–5). Согласованность автоматической оценки с усреднённой оценкой экспертов оказалась высокой: коэффициент корреляции пирсона r = 0,86, внутриклассовый коэффициент корреляции icc = 0,84 (рис. 2). Согласие двух экспертов между собой (к коэна = 0,79) было сопоставимо с согласием «система - эксперт», что говорит о том, что автоматическая оценка не уступает межэкспертной вариабельности.

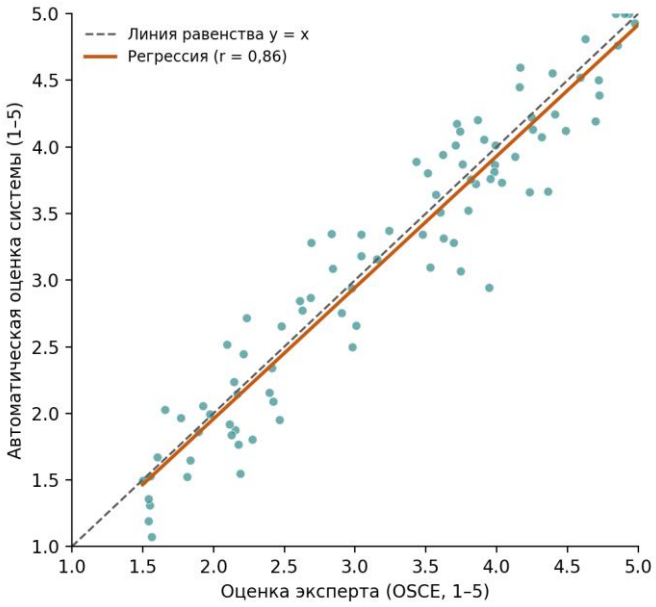


Рис. 2. Согласованность автоматической оценки системы и оценки экспертов (90 сессий)

Показатели согласованности вычислялись по классическим формулам - каппа Коэна для категориальных оценок и внутриклассовый коэффициент для непрерывных:

$$\kappa = \frac{p_o - p_e}{1 - p_e} \tag{4}$$

$$ICC = \frac{\sigma^2_{subj}}{\sigma^2_{subj} + \sigma^2_{err}} \tag{5}$$

Таблица 2. Метрики согласованности автоматической и экспертной оценки

Показатель согласованности	Значение	Интерпретация
Корреляция Пирсона (r)	0,86	сильная связь
ICC (система - эксперт)	0,84	высокое согласие
к Коэна (эксперт - эксперт)	0,79	существенное согласие
Средняя абс. ошибка (MAE)	0,34 балла	в пределах шкалы OSCE

Обсуждение и заключение

Полученные результаты показывают, что поведенческая телеметрия vr-среды несёт достаточную информацию для объективной оценки клинической компетентности: согласованность с экспертами (icc = 0,84) соответствует уровню, приемлемому для формирующего оценивания [4]. Практическая ценность метода в том, что он снимает с преподавателя рутинную нагрузку и

обеспечивает мгновенную, воспроизводимую обратную связь. Вместе с тем следует признать ограничения: выборка охватывала одну клиническую тему, а «эталонная» траектория l_opt задавалась экспертно и может нуждаться в уточнении. Кроме того, автоматическая оценка не должна полностью заменять экспертное суждение в решениях с высокими ставками — она призвана его дополнять. Дальнейшая работа связана с интеграцией метода в целостную систему и её внедрением в учебный процесс, чему посвящена заключительная статья цикла.

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AROPE ИНДЕКСИ ЁРДАМИДА КАМБАҒАЛЛИК ДАРАЖАСИНИ ЎЛЧАШ: МЕТОДОЛОГИК ТАҲЛИЛ ВА ХОРИЖИЙ ТАЖРИБАЛАР

Аннотация: *Ушбу мақолада жаҳон амалиётида кенг қўлланиладиган ва аҳоли камбағаллиги ҳамда ижтимоий чекланганлигини комплекс баҳоловчи AROPE индексининг методологик асослари таҳлил қилинган. Тадқиқотда индекснинг учта асосий компоненти — нисбий даромад бўйича камбағаллик, моддий ва ижтимоий депривация ҳамда меҳнат бозорида фаолликнинг пастлиги кўрсаткичлари ўртасидаги мантиқий боғлиқлик очиб берилган. Шунингдек, хорижий давлатларнинг ушбу индексни қўллаш борасидаги тажрибаси ўрганилиб, ундан Ўзбекистонда фойдаланиш бўйича илмий-амалий таклифлар ишлаб чиқилган.*

Калит сўзлар: *AROPE индекси, кўп ўлчамли камбағаллик, ижтимоий чекланганлик, нисбий камбағаллик, моддий депривация, меҳнат бозоридаги фаоллик, методологик таҳлил, ижтимоий сиёсат.*

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MEASURING POVERTY LEVEL USING THE AROPE INDEX: METHODOLOGICAL ANALYSIS AND FOREIGN EXPERIENCE

Abstract*: This article analyzes the methodological foundations of the AROPE index, which is widely used in global practice and provides a comprehensive assessment of poverty and social exclusion among the population. The study reveals a logical connection between the three main components of the index—indicators of relative income poverty, material and social deprivation, and low labor market activity. The experience of foreign countries in applying this index was also studied, and scientific and practical proposals were developed for its implementation.*

Keywords*: AROPE index, multidimensional poverty, social exclusion, relative poverty, material deprivation, labor market activity, methodological analysis, social policy.*

Кириш

Ўзбекистонда сўнгги йилларда камбағалликни қисқартириш давлат сиёсатининг устувор йўналишига айланди. Ушбу глобал муаммога энг кичик

бошқарув органлари, яъни маҳалла даражасидан мамлакатнинг энг юқори муассасаларигача бирдек ёндашган ҳолда, умуммиллий масала сифатида эътибор қаратилиб келинмоқда.

Умуман олганда камбағаллик фақатгина аҳолининг даромадлари етишмаслиги эмас, балки унинг жамиятда муносиб ҳаёт кечириши учун зарур бўлган ижтимоий ва моддий имкониятлардан маҳрум бўлиши ёхуд чекланганлигини англатувчи кўп ўлчамли ижтимоий-иқтисодий ҳодисадир. XXI асрга келиб камбағалликни фақатгина монетар (даромад ёки истеъмол қиймати орқали) мезонлар билан баҳолаш инсон капитали ва ижтимоий ҳимоя тизимининг асл ҳолатини тўлиқ кўрсата олмаслиги маълум бўлди. Шу боис, халқаро амалиётда камбағаллик ва ижтимоий чекланганликни комплекс баҳолашга хизмат қилувчи замонавий индикаторлар ишлаб чиқилди.

Ана шундай илғор ва дунёда кенг эътироф этилган услублардан бири AROPE (*инг. – "At Risk of Poverty or Social Exclusion" сўзлари қисқартмаси*) индекси, яъни "камбағаллик ёки ижтимоий чекланганлик хавфи остида яшовчи аҳоли улуши" индекси амалиётда қўлланилади. Индекс одатда аҳоли ва уй хўжаликларига оид учта компонент: i) монетар камбағаллик даражаси; ii) моддий депривацион камбағаллик даражаси ва iii) меҳнат салоҳиятининг пастлиги даражаси кўрсаткичларини комплекс бирлаштирган ҳолда ҳисоблаш орқали аниқланади.

Ушбу кўрсаткич Европа Иттифоқининг барқарор ривожланиш мақсадлари, шунингдек "Европа 2020" ва "ЕИ 2030" стратегияларида аҳоли фаровонлигини мониторинг қилишнинг бош мезонларидан бири сифатида белгиланган[1]. Хусусан, Европада 2030 йилга бориб AROPE индекси бўйича камбағал ҳисобланадиган аҳоли сонини ҳозирги 92,0 млн нафардан[2] 15,0 млн нафаргача пасайтириш кўзда тутилган.

Мамлакатимизда ҳам бугунги кунда миллий эҳтиёжларни ҳисобга олган ҳолда кўп ўлчамли камбағаллик индексларини жорий этиш ва хориж тажрибасини тизимли ўрганиш долзарб аҳамият касб этмоқда. Шу нуқтаи назардан ушбу мақола AROPE индексининг методологик асослари, ундан фойдаланиш бўйича халқаро тажрибалар ва мамлакатимизда амалиётда жорий этиш имкониятларини таҳлил қилишга бағишланади.

Адабиётлар таҳлили

Хорижий илмий адабиётлар ҳамда амалга оширилган тадқиқотлар таҳлилидан келиб чиқиб, AROPE индексини ўрганиш ва бу борада ўтказилган тадқиқотларни икки даврга бўлиш мумкин: 21 асргача ва ундан кейинги даврда амалга оширилган илмий ишланмалар.

Умуман индексни илк бор ҳисоблаш ва амалиётга киритиш аниқ бир олим томонидан амалга оширилмаган, балки Европа Иттифоқи Статистика қўмитаси (Eurostat) томонидан ишлаб чиқилган ҳамда 2010 йилда расмий равишда муомалага киритилган[3]. 2021 йилга келиб эса у ҳар томонлама такомиллаштирилган ҳолда, кўрсаткичларни янада аниқроқ ифодалаш мақсадида методологик ўзгартиришлар киритилиб эълон қилинди.

Индекс ва унинг компонентлари бўйича ўзига хос “классик” тадқиқотлар 1970-80 йилларга бориб тақалади. Хусусан, инглиз олими Питер Таунсенд (1979) биринчи бўлиб камбағалликни фақат даромад эмас, балки жамиятда одатий ва кундалик ҳаёт тарзида зарур бўлган имкониятлардан маҳрум бўлиш (deprivation) сифатида таърифлаган [4].

Бундан ташқари инсон тараққиёти ва камбағаллик борасида қатор илмий ютуқлар ҳамда ўзига хос мактаб яратган яна бир олим Амартея Сен (2000) камбағаллик даражасини ҳисоблашнинг кўп ўлчамли ва депривацион моделларига алоҳида эътибор қаратиш зарурлигини алоҳида таъкидлайди [5].

Бироқ юқорида қайд этилган олимлар ўз тадқиқотларида AROPE индексининг айрим компонентлари бўйича тадқиқотлар олиб боришган. Индекснинг барча компонентлари, хусусан ижтимоий индикаторлар бўйича кенг кўламли тадқиқотлар олиб борган ҳамда кейинчалик индекс ишлаб чиқишда асос бўлиб хизмат қилган назариялар муаллифи Тони Аткинсон (2002) тенгсизлик ва камбағаллик каби ижтимоий индикаторлар инсон ҳаёт кечириши даражасини аниқлашда муҳим роль ўйнайди, деган фикрни олға суради [6]. Шунингдек, Б.Нолан ва С.Уилан (2011) каби олимлар Европада камбағаллик ва ижтимоий депривация бўйича амалга оширган тадқиқотларида монетар камбағаллик ва депривацион чекланганлик доим ҳам бир бирига мос келмаслигини, яъни даромадлари белгиланган чегарадан баланд бўлган инсон ёки оила жамиятдаги айрим ижтимоий имкониятларга эга бўлмасдан, чегараланган ҳолда турмуш кечириши мумкинлигини билдирган [6]. Ёки аксинча даромадлари кам бўлган оилалар ўзларини жамиятда чекланган ҳисобламасликлари мумкин. Шу нуқтаи назардан олимлар AROPE индексига ўхшаш махсус ва комплекс баҳолаш имконига эга кўрсаткичларни амалиётга жорий этиш зарурлигини асослашган.

AROPE индексини жорий этиш ва ундан фойдаланиш зарурлиги ҳамда индексни янада такомиллаштириш борасида кўплаб назарий таҳлилларни амалга оширган А.Гио, Д.Гордон, Э.Марлье (2016-2017) классик депривацион камбағаллик даражасини аниқлаш индикаторларини 9 тадан 13 тагача ошириш ва ҳар бир оиланинг AROPE индексини аниқлашда индивидуал ёндашув зарурлигини, шунингдек, индексни ҳисоблашда сўровномаларнинг нақадар муҳимлигини асослаб беришган [7].

Юқоридагилардан ташқари П.Коупленд ва М.Дели амалга оширган тадқиқотларида “Europe 2020” стратегиясида AROPE индекси орқали камбағалликни 20 миллионга камайтириш мақсади қўйилганини, аммо бу мақсад иттифоқдаги мамлакатлар учун миллий даражада қатъий мажбуриятга айланмагани сабабли 2020 йилга келиб кутилган натижани бермаганини иқтисодий-сиёсий нуқтаи назардан таҳлил қилишган[8].

Шу билан бирга, AROPE индекси мамлакатларда миллий даражада ҳисобланганда ҳудудлараро катта тафовутлар вужудга келиши, хусусан марказий ва йирик шаҳарлар билан чекка ва олис ҳудудлар учун ягона индекс

ҳисобланишини танқид қилган олимлар (Д.Дапена ва бошқ 2021) микро даражада индексни ҳисоблаш методологиясини таклиф қилишади[9].

AROPE индексини ўрганиш бўйича адабиётлар таҳлилига кўра умумий хулосалар қуйидагилардир.

1. Ушбу индекс камбағаллик даражасини ўлчашнинг нисбатан такомиллашган варианти бўлиб, у нисбатан иқтисодий-ижтимоий ривожланган давлатлар ва ҳудудлар учун мос келади. Чунки, индекс таркибида ҳам монетар, ҳам кўп ўлчамли индикаторларнинг мавжудлиги аҳоли турмуш фаровонлиги даражасини кенг миқёсда қамраб олиш имконини беради.

2. Индексни қўллаш ва ҳисоблашда ҳудудлардаги кекса ва меҳнатга лаёқатли ёшдагилар учун алоҳида камбағаллик даражасини аниқлаш тўғри натижа бермаслиги мумкин, зеро ушбу тоифадаги инсонлар меҳнат бозорида тўлиқ меҳнат ресурслари таркибига киритилмаслиги учун уларнинг меҳнат фаоллигини ҳам ҳисоблаб бўлмайди.

3. AROPE индекси ҳудудлардаги ташқи ва ички фавқулотда вазиятлар, кутилмаган молиявий, иқтисодий, техноген ва экологик шоклар рўй берган шароитда тез ўзгариши мумкин. Шундан келиб чиқиб, индекснинг барча компонентларини вазиятдан келиб чиқиб ўзгартириш мумкин. Мисол учун, Европадаги 2008-2011 йиллардаги молиявий инқироз даврида айрим жанубий Европа давлатларида AROPE индекси қандай кескин ошгани ва бунда монетар кўрсаткичлардан кўра моддий депривация вазиятни аниқроқ кўрсатиб бергани таҳлил қилинган [10]. Ёки 2019-2020 йиллардаги пандемия даврида жаҳоннинг аксар мамлакатларида индекснинг меҳнат бозоридаги фаоллик компоненти кескин тушиб кетгани билан алоҳида тавсифланади.

4. Индексни ишлаб чиқиш ва уни такомиллаштириш борасида тадқиқот ўтказган олимларнинг умумий ягона хулосасига кўра, мамлакатларда БРМ мақсадларига ҳамоҳанг ҳамда миллий камбағаллик чегараларини ҳисоблаш ва қабул қилишга мукобил тарзда AROPEдан фойдаланиш мумкин. Бироқ индекс ва унинг субиндикаторлари бўйича аҳоли ва оилалардан маълумотларни тўплаш, таҳлил қилиш ҳамда аниқ натижаларга эришиш кенг кўламли ва сифатли танлама кузатувларни талаб этади. Тадқиқотлар эса ўз-ўзидан молиявий ва инсон ресурсларига боғлиқдир.

Тадқиқот методологияси

Мақолада аҳоли камбағаллик даражасини ҳисоблашда анаъанавий усуллардан фарқли AROPE индексида ҳисоблаш методологияси таҳлил қилинган. Унда умумий, қиёсий ва SWOT таҳлил (индекснинг ижоюий ва салбий жиҳатларини баҳолаш) усулларидан фойдаланилган. Шу билан бирга, индекснинг амалиётда қўлланилиши, монетар ва депривацион камбағалликни қисқартириш, меҳнат бозоридаги фаоллик ҳамда бандлик имкониятларини ошириш бўйича Германия, Бельгия, Скандинавия мамлакатлари тажрибаси ўрганилди. Бундан ташқари, мақолада Европа статистика бюроси, Жаҳон банки, Ўзбекистондаги вазирлик ва идоралар маълумотларидан фойдаланилди.

Асосий қисм

AROPE индекси — инсонлар ёки оилалар турмуш даражасининг турли жабҳаларини қамраб олувчи ҳамда яшаш шароитини баҳоловчи мураккаб кўрсаткич бўлиб, у одатда қуйидаги формула бўйича 3 та субиндикатордан иборатдир.

AROPE = MP+SD+WI;

Бунда, формулада акс этган субиндикаторлар қуйидагича тавсифланади:

1. **MP (At Risk of Monetary Poverty) –** *"монетар камбағаллик хавфи"* маъносини англатувчи нисбий камбағаллик чегараси ҳисобланади. Одатда Европа мамлакатларида индекснинг ушбу субиндикатори аҳоли жон бошига тўғри келадиган ўртача миллий даромад (медиана даромад)нинг 60 фоизидан кам даромад олувчи уй хўжаликларини улушидан келиб чиқиб ҳисобланади. Бироқ индексни турли ижтимоий-демографик гуруҳларга татбиқ этиш мақсадида монетар камбағаллик даражасини эквивалентлик шкаласи бўйича тақсимлаб ҳисобланади. Бу шкала бўйича оиладаги биринчи катта ёшли аъзога 1.0, кейинги катта ёшлиларга 0.5 ва 14 ёшгача бўлган болаларга 0.3 коэффициент берилган ҳолда даромадлар аниқланади.

2. **SD (Severe Material and Social Deprivation) -** *чуқур моддий ва ижтимоий маҳрумлик (ёки депривация)*. Субиндикатор орқали уй хўжалиги ёки шахснинг жамиятда нормал яшаш учун зарур бўлган моддий неъматлар ва ижтимоий хизматлардан фойдалана олмаслик ҳолати ўлчанади. Одатда Европа иттифоқи мамлакатларида ушбу субиндикаторни ҳисоблаш учун 13 та (6 таси индивидуал-шахсий ва 7 таси оила ёки хонадонга оид) элементдан фойдаланилади. Улар қуйидагилардир:

1. Интернетга уланиш имкониятининг мавжудлиги;

2. Эскирган кийимини янгисига алмаштириш имконининг мавжудлиги;

3. Шахсий ўлчамга мос келадиган икки жуфт пойабзалнинг мавжудлиги;

4. Шахсий эҳтиёж учун ҳафталик харажатга сарфланадаиган маблағнинг бўлиши;

5. Ҳордиқ чиқариш тадбирларида доимий қатнаш олиш имконияти;

6. Бир ойда бир марта дўстлар/оила аъзолари билан учрашган ҳолда тушлик ёки кечки овқатни биргаликда тановул қилиш имкониятининг мавжудлиги.

1. Оиланинг кутилмаган молиявий харажатлари учун имкониятнинг мавжудлиги;

2. Бир йилда бир ҳафтага уйдан узоқда ҳордиқ чиқариш имконияти мавжудлиги;

3. Тўловлардан (ипотека кредитлари, ижара, коммунал ва бошқалар) қарз бўлмаслик;

4. Ҳар икки кунда бир марта гўштли (товуқли, балиқли ва бошқа юқори калорияли) таомлар истеъмол қилиш имкониятининг мавжудлиги;

5. Хонадонида етарли иссиқликни таъминлаш имкониятининг мавжудлиги;

6. Шахсий автомобил ёки фургонга эга бўлиш;

7. Эскирган мебелларни янгисига алмаштириш имкониятининг мавжудлиги [11];

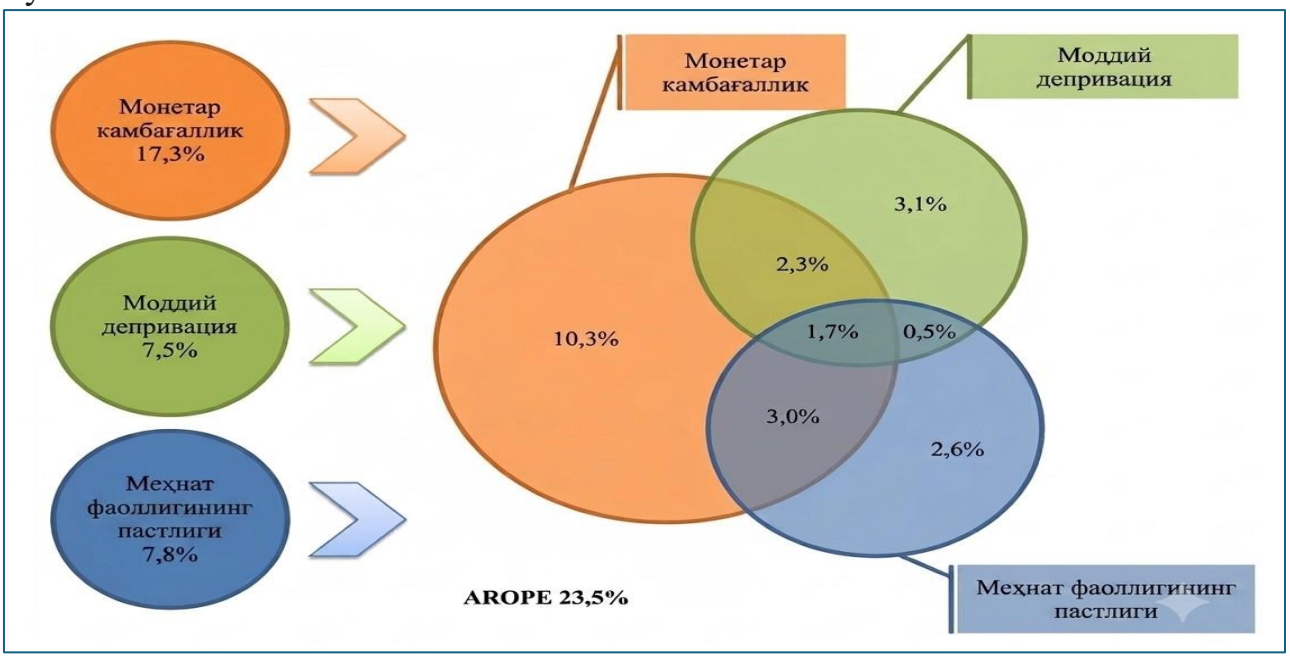
3. **WI (Very Low Work Intensity)** - *меҳнат фаоллигининг ўта пастлиги:* Уй хўжалигидаги меҳнатга лаёқатли аъзоларнинг йил давомида ўз салоҳиятига нисбатан қанчалик кам банд бўлганини (20 фоиздан кам) кўрсатадиган учинчи субиндикатор. Ушбу субиндикаторни янада кенгроқ тавсифлаш учун Евростат методологиясидан фойдаланиш мумкин:

Меҳнат фаоллиги паст бўлган уй хўжаликларида яшайдиган 65 ёшгача бўлган шахслар, яъни ўтган йилдаги умумий потенциал иш вақтининг 20 фоизи ва ундан кам бўлган иш вақтида банд бўлган уй хўжаликларида яшовчи меҳнатга лаёқатли ёшдаги катталар (18-24 ёшдаги талабалар, ёшга доир пенсияга чиққан ёки ҳар қандай пенсия оладиган шахслардан ташқари 18-64 ёшдагилар, шунингдек, 60-64 ёшдаги нофаол ва асосий даромади пенсия бўлган уй хўжалигида яшайдиган шахслар ҳисобга олинмайди) улуши[12].

Юқоридагидан келиб чиқиб, бирор шахс ёки уй хўжалиги ушбу учта мезоннинг камида биттасида белгиланган чегара, мезон ёки ўлчамдан кам бўлса, у AROPE индекси бўйича “камбағал” деб таснифланади.

Шу билан бирга, AROPE тизими ҳар бир шахс ва оиланинг ижтимоий ҳолатини тўлиқ баҳолаш имконини беради. Агар бирор шахс ҳам кам даромадли, ҳам моддий чегланганлик ҳолатида яшаса, у индексда фақат бир марта ижтимоий заиф сифатида қайд этилади. Айрим адабиётларда индекснинг барча субиндикаторлари бўйича камбағаллик мезонидан паст даражада яшаётган аҳоли нисбатан камбағалликнинг қуйи даражасида яшаётган деб тавсифлаш мумкинлиги қайд этилган.

Субиндикаторларнинг ўзаро боғлиқлигини қуйидаги расмда кўриш мумкин.



1-расм. 2025 йилда Европа Иттифоқи мамлакатларида АРОПЕ индекси бўйича камбағаллик хавфи остида бўлган аҳоли улуши. Манба: Eurostat (ilc_pees01n).

1-расмдан кўриш мумкинки, Европа Иттифоқида 2025 йилда аҳолининг 23,5%и AROPE индекси бўйича камбағаллик хавфи остида яшаётганлар ташкил этади. Аслида бу катта кўрсаткич, бироқ фақат монетар камбағлик даражасидан пастда яшаётганлар 10,3%ни ташкил этса, қолган субиндикаторлар билан бирга 17,3%ни ташкил этган. Шу ўринда, ўтган йилда ЕИ мамлакатларида индекс бўйича камбағал аҳолининг салкам 44,0%и монетар камбағаллик даражасидан пастда яшаганлигини қайд этиш зарур.

AROPE индексини янада аниқроқ ва содда тавсифлаш учун қуйидаги 1-жадвалга эътибор қаратиш зарур (1-жадвал). Айтайлик, кетма-кет 10 та хонадондан сўров асосида ҳар учта субиндикатор бўйича ҳолат аниқланди. Сўров ўтказилган 10 та оиланинг 5 таси ҳар 3 та субиндикатор бўйича камбағаллик даражасидан юқори яшамоқда. Шундан келиб чиқиб, ўрганилган ҳудудда АРОПЕ индекси бўйича камбағаллик даражаси 50,0%ни ташкил этади, дейиш мумкин. Аммо индекс бўйича энг камбағал аҳоли улуши сифатида ҳар 3 та субиндикаторда белгиланган мезонлардан паст даражада яшовчилар, хусусан жадвалда улар фақат 1 та оилада кузатилгани боис 10,0%ни ташкил этса, 3 та оилада 2 та субиндикатор бўйича ва яна 1 та оилада битта субиндикатор бўйича камбағаллик кузатилган.

1-жадвал

АРОПЕ индексини аниқлашга қаратилган сўров натижалари (намуна)

Сўров ўтказилган оиланинг тартиб рақами	Монетар камбағаллик	Моддий депривация	Меҳнат фаоллигининг пастлиги	АРОПЕ индекси бўйича камбағалми?
1	Бор	Бор	Бор	Ҳа
2	Йўқ	Йўқ	Йўқ	Йўқ
3	Йўқ	Бор	Йўқ	Ҳа
4	Йўқ	Йўқ	Йўқ	Йўқ
5	Бор	Бор	Йўқ	Ҳа
6	Бор	Йўқ	Бор	Ҳа
7	Йўқ	Йўқ	Йўқ	Йўқ
8	Йўқ	Йўқ	Йўқ	Йўқ
9	Йўқ	Йўқ	Йўқ	Йўқ
10	Йўқ	Бор	Бор	Ҳа

**муаллиф ишланмаси.*

Халқаро амалиётда, айниқса Европа мамлакатларида AROPE индекси ижтимоий ҳимоя сиёсатида кучли воситалардан ҳисобланади. Қуйида айрим мамлакатларнинг ушбу индексни қўллаш тажрибасини кўриш мумкин:

2-жадвал

Мамлакат	Асосий жиҳатлар	Амалдаги ҳолат	Натижалар
Германия	Ижтимоий трансфертлар ва субиндикаторлар мониторинги	Аҳолининг тахминан 20,0% индекс бўйича камбағаллик хавфи остида яшайди.	Нафақалар тўланиши натижасида монетар камбағаллик хавфи 30-40% га камаяди.
Бельгия	Субъектив камбағаллик ва AROPE ўртасидаги боғлиқлик	SD бўйича аҳолининг 85,0%дан ортиғи ўзини субъектив равишда камбағал ҳисоблайди.	Комплекс баҳоланади ва мақсадли ижтимоий дастурлар ишлаб чиқилади.
Скандинавия давлатлари	Иш билан бандлик ва WI индикаторини пасайтириш	AROPE индекси ЕИ бўйича энг паст кўрсаткичлардан биридир (13-16%).	Оилавий МТМлар ва фаол меҳнат бозори сиёсати орқали меҳнат фаоллиги юқори даражада сақланади.

**муаллиф ишланмаси.*

Ўзбекистонда ҳам сўнгги йилларда камбағалликни аниқлаш ва баҳолашда катта қадамлар ташланди. 2021 йилдан бошлаб мамлакатда минимал истеъмол харажатлари (МИХ) қиймати жорий этилиб, у мутлақ камбағаллик чегараси сифатида қўлланилмоқда[13]. Шунингдек, “Ижтимоий ҳимоя ягона реестри” ва “Инсон” ижтимоий хизматлар марказлари орқали камбағал оилаларнинг рўйхати ва уларга кўрсатиладиган ёрдамлар тизимлаштирилди. Кейинчалик кўп ўлчамли индекс усулида умумий ва болалар камбағаллиги ҳисоблаб эълон қилинди.

Бироқ, мамлакатнинг ижтимоий-иқтисодий салоҳияти ривожлангани сари камбағалликни фақатгина МИХ асосида мутлақ ўлчаш етарли бўлмай қолади. Шу боис, халқаро AROPE индекси тажрибасини миллий хусусиятларни инобатга олган ҳолда босқичма-босқич амалиётга жорий қилиш ёки амалдаги миллий мезонларга муқобил тарзда ҳисоблаш фойдадан ҳоли эмас.

Ҳалқаро тажрибалар ва таҳлиллиландан келиб чиқиб Ўзбекистонда ҳам AROPE индексини амалиётга жорий этиш учун қуйидаги имкониятлар мавжуд.

1. **МР бўйича муқобил вариант.** Мамлакатда бугунги даврда мутлақ камбағаллик мезони (МИХ) миллий камбағаллик чегараси сифатида қабул қилинганлиги ва шу ўлчамда камбағаллик даражаси эълон қилинаётганлигидан келиб чиқиб, нисбий камбағаллик чегараси ўрнида мутлақ камбағалликдан фойдаланиш мумкин, бирор келгусида албатта нисбий камбағаллик (медиана даромаднинг 50 ёки 60 фоизи миқдорида) индикаторини ҳам статистик баҳолашга ўтиш зарур. Бу иқтисодий тенгсизлик ва ўрта қатламнинг шаклланиш жараёнини кузатишга ёрдам беради.

2. SD рўйхатини жорий этиш. Мамлакатда амалда қўлланилаётган кўп ўлчамли индекс усулида камбағаллик даражасини аниқлаш методологиясига қўшимча равишда депривация усулидан фойдаланиш мумкин. Бунинг учун,

Европа мамлакатлари учун хос бўлган баъзи элементларни (масалан, таътилни уйдан ташқарида ўтказиш) Ўзбекистон шароитига мослаштириш зарур. Бундан ташқари, AROPE индексидаги 13 та депривация компонентига қўшимча сифатида қуйидагиларни ҳам киритиш мақсадга мувофиқ:

– Тоза ичимлик суви ва канализация тизимига эгалик.

– Узлуксиз электр энергияси ва табиий газ (ёки барқарор муқобил иситиш маҳсулотлари) билан таъминланганлик.

– Сифатли тиббий хизмат ва зарур дори-дармонларни сотиб олиш имконияти.

– Болаларнинг сифатли мактабгача ва мактаб таълими олиш имконияти.

3. WI бўйича кўрсаткичларни шакллантириш. Юқоридаги иккита субиндикаторга нисбатан мамлакатда меҳнат бозоридаги фаолликни аниқлаш ва ундан индексда фойдаланиш имконияти ҳозирча бироз пастроқ. Бунга яширин бандлик ва мавсумий меҳнатнинг улуши юқорилиги ҳам қисман сабаб бўлади. Бироқ келгусида ушбу кўрсаткични мунтазам аниқлаш ва эълон қилиш амалиёти тўлиқ йўлга қўйилса, уни расмий бандлик билан биргаликда, уй хўжалигининг "барқарор даромад келтирувчи бандлик даражаси" сифатида қайта ишлаб чиқиш мумкин бўлади. Ҳозирча мантиқан WI ўрнида индексни ҳисоблаш учун расмий ишсизлик кўрсаткичидан фойдаланиш мумкин.

Таҳлил этилган имкониятлардан келиб чиқиб ҳамда мавжуд статистика маълумотлардан фойдаланган ҳолда Ўзбекистон учун AROPE индекси қийматини шартли ёндашув сифатида ҳисоблаш орқали (2025 йил якунига кўра) 7,5-8,0%ни ташкил этади, дейиш мумкин. Бунда монетар камбағаллик 5,8%ни[14], расмий ишсизлик 4,8% ва Жаҳон банки маълумотларига кўра эса кўп ўлчамли камбағаллик даражаси 2,3 %ни ташкил этган [15].

Бироқ индексни ҳисоблаш методологияси бўйича барча субиндикаторларни умумий қўшган ҳолда ҳисоблаганда, Ўзбекистонда 2025 йил якунларига кўра AROPE индекси бўйича камбағал аҳоли улуши 12,9%ни ташкил этади. Чунки, 7,5-8,0%ли кўрсаткич бу назарий шартли рақамлар ҳисбланади. Амалиётда эса монетар камбағал инсон ёки оила аъзоларининг депривацион чекланганлиги ва ишсиз эканлиги бир вақтда бўлиши бевосита унинг AROPE бўйича камбағаллик даражасида қолишига замин яратади.

Хулоса ва таклифлар

Камбағалликни AROPE индекси усулида ўлчаш халқаро миқёсда, айниқса ривожланган давлатларда ижтимоий сиёсатни режалаштиришнинг энг самарали тизими эканлигини аниқ. Ушбу усул фақатгина инсоннинг даромадини эмас, балки унинг жамиятнинг тўлақонли аъзоси сифатида эркин ва барча учун тенг шароитларда яшаш имкониятларини баҳолайди.

Шу билан бирга, ишлаб чиқиладиган ушбу усул амалиётда қўлланилаётган усулларга муқобил тарзда ва айрим мақсадли дастурларни амалга оширишда фойдаланиши мақсадга мувофиқдир.

Хорижий тажрибалар таҳлили ва Ўзбекистоннинг бугунги ижтимоий-иқтисодий ислоҳотларидан келиб чиқиб, қуйидагиларни илгари суриш мумкин:

1. 2030 йилгача босқичма босқич Ўзбекистон Республикаси Президенти ҳузуридаги Ижтимоий ҳимоя миллий агентлиги ва Статистика қўмитаси ҳамкорлигида AROPE индексига асосланган “Миллий камбағаллик индекси” методологик асосларини яратиш зарур. Бунда ўша давргача барча субинидакторларни ишлаб чиқиш ва амалиётга киритиш бўйича мос йўналишдаги илмий-тадқиқот муассасаларини жалб этиш ҳамда илмий-тадқиқотларни амалга ошириш зарур.

2. Статистика қўмитаси томонидан ўтказиладиган “Уй хўжаликлари бюджети кузатувлари” сўровномаларига шахслар ва оилаларнинг моддий ва ижтимоий маҳрумликлари (депривация) ҳамда меҳнат фаоллигини AROPE индекси услубиёти бўйича баҳоловчи махсус бўлимлар киритиш лозим.

3. Мамлакатда аҳоли камбағаллик даражасини қисқартириш бўйича давлат дастурларини ишлаб чиқишда фақат молиявий инструментлардан эмас, балки меҳнат фаоллиги паст бўлган уй хўжаликларини бандлиги оширишга қаратилган тизимли муаммоларни ҳал этиш лозим.

Умумий олганда, AROPE индекси усулининг амалиётга жорий этилиши Ўзбекистонда “ҳеч ким эътибордан четда қолмаслиги” тамойилининг реал ижросини таъминлашга ҳамда ижтимоий ҳимояга йўналтирилаётган бюджет маблағларининг манзиллилигини кескин оширишга хизмат қилади.

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THE MODERN SYSTEM OF STANDARDIZATION OF MEDICINAL PRODUCTS IN THE REPUBLIC OF UZBEKISTAN: REGULATORY AND INSTITUTIONAL FOUNDATIONS

Abstract. *The article examines the regulatory and institutional foundations of the modern system of standardization of medicinal products in the Republic of Uzbekistan. It analyzes the legal framework of standardization, the system of authorized bodies, and their role in establishing, implementing, and ensuring compliance with requirements for the quality, safety, and efficacy of medicinal products. The article substantiates the comprehensive nature of the standardization system as an element of state regulation of the pharmaceutical sector.*

Keywords: *medicinal products, standardization, quality, safety, state regulation, regulatory framework, technical regulation, pharmaceutical sector.*

Medicinal products constitute a special type of product, the quality of which is directly related to the protection of public health and, in some cases, to the preservation of human life. Accordingly, state regulation of their production and circulation, as well as the assurance and control of the quality of medicinal products, are of particular public importance. One of the key instruments of such regulation is standardization, through which uniform requirements for the quality characteristics of medicinal products are established, appropriate methods for their assessment are determined, and conditions are created to ensure the uniformity of requirements at various stages of the product life cycle.

The significance of standardization in the pharmaceutical sector is determined not only by the need to ensure the quality and safety of medicinal products. It is directly related to the protection of public health, pharmaceutical security, consumer protection, the development of production, and the enhancement of the competitiveness of pharmaceutical products. The scientific and educational literature notes that standardization is aimed at ensuring pharmaceutical, environmental, and technological safety, as well as the rational use of resources[34].

In the Republic of Uzbekistan, the importance of standardization is increasing in the context of the development of the national pharmaceutical industry and the expansion of foreign economic activity. According to official data, in 2024 the volume of pharmaceutical products manufactured amounted to UZS 5.1 trillion,

[34] Министерство здравоохранения Республики Узбекистан. Центр развития медицинского образования. Ташкентский фармацевтический институт. Стандартизация и сертификация лекарственных средств. Методич. разработ. для студентов 5 курса по выполнению лаб. раб. – Ташкент, 2014. – С. 2.

while exports of pharmaceutical products and services amounted to USD 180.1 million[35]. The increase in the volume of pharmaceutical production and exports objectively enhances the importance of establishing uniform and reproducible requirements for the quality, safety, and efficacy of pharmaceutical products.

Under these conditions, standardization acquires not only technical but also legal and organizational-administrative significance. Through the normative establishment of quality requirements, the state formulates criteria for the conformity of medicinal products with established requirements, determines the rules for their assessment, and creates the regulatory and organizational conditions necessary for state control. Therefore, the modern system of standardization of medicinal products should be considered in conjunction with the legislation governing medicinal products and pharmaceutical activities, legislation on standardization, quality-related regulatory documents, and the activities of authorized state bodies.

Standardization of medicinal products constitutes a mechanism for establishing uniform requirements for the quality characteristics of pharmaceutical products. Its significance is determined by the need to ensure the stability and reproducibility of the characteristics of medicinal products throughout the entire period of their production and circulation. According to **G.U. Tillayeva** and **F.S. Djalilov**, standardization in the field of medicinal product circulation is aimed at ensuring guarantees of the quality of standardization objects, including products, services, and relevant processes[36]. This understanding makes it possible to regard standardization not merely as the establishment of individual technical indicators, but as a system for the consistent formulation of requirements for products and related processes.

Standardization is of particular importance for the protection of consumer rights. The establishment of uniform quality requirements for medicinal products creates objective criteria for assessing their conformity and contributes to the creation of conditions for protecting the population from products whose characteristics do not comply with established requirements.

In the pharmaceutical sector, standardization is also associated with ensuring the interchangeability and compatibility of medicinal products. The existence of uniform requirements for product characteristics creates conditions for the sustainability of the supply of medicinal products, the prevention of shortages, and the availability of quality pharmaceutical products.

At the same time, the significance of standardization of medicinal products should not be limited exclusively to the technical assurance of quality. The specific nature of medicinal products as goods directly associated with human life and health determines their particular public significance. In this context, standardization acquires a public-law dimension, since, by establishing uniform requirements, the

[35] Официальный сайт «Dori-Darmon»: Режим доступа: https://doridarmon.uz/ru/news/v-2024-godu-proizvedeno-farmatsevticheskoj-produktsii-na-51-trln-sumov.

[36] Тиллаева Г.У., Жалилов Ф.С. Стандартизация и сертификация медицинской и фармацевтической продукции. Учебное пособие. – Ташкент, 2021. – С. 10.

state determines the criteria that medicinal products must meet, forms the regulatory basis for their assessment, and creates conditions for the exercise of state control.

Thus, standardization performs interrelated regulatory, assurance, organizational, and control functions. The regulatory function is expressed in establishing requirements for the quality characteristics of products and related processes; the assurance function consists in creating conditions for the stability and reproducibility of quality; the organizational function lies in determining the procedure for the development, approval, registration, and application of the relevant documents; and the control function is manifested in the use of established requirements as criteria for conformity assessment. This understanding makes it possible to regard the standardization of medicinal products as an integral element of state regulation of the pharmaceutical sector.

The modern system of standardization of medicinal products in the Republic of Uzbekistan is based on a multi-level regulatory framework. It includes legislation governing medicinal products and pharmaceutical activities, legislation on standardization, regulatory quality documents, the State Pharmacopoeia, and subordinate regulatory legal acts. The combination of sector-specific and cross-sectoral sources is обусловлено by the comprehensive nature of the standardization of medicinal products: on the one hand, the requirements applicable to such products are determined by their pharmaceutical characteristics; on the other hand, standardization is carried out within the framework of the unified national system of technical regulation and standardization.

The Law of the Republic of Uzbekistan **“About Medicines and Pharmaceutical Activity”** is of key importance within the system of legal regulation. This legislative act establishes the legal and organizational foundations for regulating the circulation of medicinal products and sets requirements for their quality, safety, and efficacy. Of particular importance is the legislative linkage between the authorization of medicinal products for medical use and compliance with quality requirements[37].

This provision is of fundamental importance for determining the place of standardization within the system of state regulation. In this context, a standard is not merely a technical document but one of the instruments for establishing criteria for the conformity of a medicinal product with the applicable requirements. By establishing quality requirements and the relevant assessment procedures, legislation creates the legal basis for state control over the quality of medicinal products. Thus, standardization and quality control have a direct functional relationship: standardization establishes the substance and criteria of the requirements, while control ensures verification of compliance with them.

The application of Good Practices (GxP), including Good Manufacturing Practice (GMP), Good Distribution Practice (GDP), and other relevant approaches, is also of substantial importance within the regulatory system. The integration of

[37] Закон Республики Узбекистан ЗРУ №-399 «О лекарственных средствах и фармацевтической деятельности» от 04.01.2016 г. – Ст. 8.

these requirements into the national system demonstrates its orientation toward internationally recognized approaches to ensuring the quality of medicinal products. As a result, the regulatory framework combines national legal mechanisms with internationally oriented requirements, making it possible to regard standardization simultaneously as an instrument of domestic state regulation and as one of the mechanisms for integrating the national pharmaceutical system into the international regulatory framework.

The State Pharmacopoeia of the Republic of Uzbekistan occupies a special place in the regulatory framework for ensuring the quality of medicinal products. The Pharmacopoeia contains requirements for the quality indicators of medicinal products, testing methods, storage conditions, packaging, and quality control. Accordingly, it constitutes a regulatory source ensuring uniform approaches to the assessment of the quality of pharmaceutical products.

The legal significance of the State Pharmacopoeia is primarily associated with the establishment of uniform criteria for quality assessment. The specification of quality indicators and testing methods makes it possible to use them in determining whether medicinal products comply with established requirements. At the same time, pharmacopoeial requirements are relevant not only at the production stage but also in the exercise of state control and supervision, since they provide an objective regulatory basis for determining the conformity of the quality of medicinal products.

Another essential element of the regulatory framework is the Law of the Republic of Uzbekistan **“About Standardization”**. Unlike the legislation governing medicinal products and pharmaceutical activities, this law is cross-sectoral in nature and establishes the general legal and organizational foundations of activities in the field of standardization. Its scope extends to various sectors of the economy, including the pharmaceutical industry.

The significance of the Law **“About Standardization”** lies in establishing a unified legal approach to the development, approval, application, and improvement of standards. Of particular importance is the distinction between mandatory requirements established by technical regulations and regulatory legal acts, and standards as instruments for ensuring compliance with established requirements. This distinction makes it possible to determine the legal nature of a standard. Formally, a standard and a mandatory requirement may differ in their legal nature; however, in the field of medicinal products, standards acquire particular significance due to their direct connection with sector-specific regulatory requirements and quality control procedures.

The specific nature of the pharmaceutical industry lies in the heightened public significance of requirements for the quality of medicinal products. Therefore, the provisions of standards and pharmacopoeial requirements are integrated into the system of state regulation through sector-specific legislation and subordinate regulatory legal acts. As a result, standardization serves as a connecting element between technical requirements for products and administrative-legal mechanisms of state regulation.

Thus, the Law **“About Standardization”** establishes the general legal foundation of the national standardization system, while the legislation governing medicinal products and pharmaceutical activities provides its sector-specific elaboration, taking into account the particular characteristics of medicinal products.

The functioning of the standardization system requires not only the establishment of requirements but also the normative determination of procedures for the development, approval, registration, amendment, and repeal of standards. In this regard, the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan **“On Additional Measures to Improve Standardization Activities”** is of substantial importance. This regulatory act specifies the provisions of the legislation on standardization and establishes the organizational and procedural mechanisms for the functioning of the national standardization system[38].

Of particular importance is the established procedure for the development, approval, registration, repeal, and amendment and supplementation of national standards. Procedural regulation makes it possible to regard a standard not as a static regulatory document but as an element of a continuously functioning system. Its life cycle includes initiation of development, preparation of a draft, review and coordination, registration, application, and, where necessary, amendment or repeal.

For the pharmaceutical industry, this approach is particularly important due to the development of medicinal product manufacturing technologies, changes in analytical methods, and the emergence of new requirements for product quality. Consequently, importance lies not only in the content of a particular standard but also in the existence of an established procedure for its development, application, and subsequent amendment. It is precisely the procedural component that ensures the functioning of standardization as a continuous process.

The normative establishment of requirements in itself does not ensure their practical implementation. The functioning of the standardization system requires a set of state bodies and specialized structures responsible for the development, coordination, application, and control of the relevant requirements. Pursuant to the Law of the Republic of Uzbekistan **“About Standardization”,** the principal participants in the national system include the Uzbek Agency for Technical Regulation, the national standardization body, state and economic administration bodies, and technical committees for standardization[39]. Their interaction forms the institutional foundation of the modern standardization system.

A distinctive feature of this system is the distribution of functions among bodies at different levels. Central structures ensure coordination and organizational support; the national standardization body carries out specialized activities related to the development and application of standards; sectoral bodies ensure the implementation of the relevant requirements in specific fields; and technical committees provide expert and scientific-technical support.

[38] Постановление Кабинета Министров Республики Узбекистан № ПКМ-177 «О дополнительных мерах по совершенствованию деятельности по стандартизации» от 30.03.2024 г.
[39] Закон Республики Узбекистан № ЗРУ-800 «О стандартизации» от 03.11.2022 г. Ст. 5.

A central position in the institutional system is occupied by the Uzbek Agency for Technical Regulation under the Cabinet of Ministers of the Republic of Uzbekistan. Its current organizational status is associated with the implementation of measures provided for by the Decree President of the Republic of Uzbekistan **"On Measures to Further Improve State Administration in the Field of Technical Regulation"**. Within the established framework, the Agency coordinates activities in the fields of technical regulation, standardization, and metrology[40].

The activities of the Agency cover the formulation and implementation of state policy in the field of technical regulation and standardization, organization of the development and implementation of national standards and technical regulations, interaction with state bodies and business entities, as well as ensuring the conformity of the national system with international requirements. An important area of activity is also participation in conformity assessment and certification procedures related to ensuring compliance with established requirements.

Of particular importance is the Agency's role in ensuring interaction among the various participants in the national standardization system. This is of fundamental importance for the pharmaceutical sector, since requirements for medicinal products are formulated and implemented at the intersection of the general standardization system and sector-specific regulation. Therefore, the coordinating function of the Agency makes it possible to ensure a link between the general mechanisms of technical regulation and the special requirements applicable to medicinal products.

Another important area of activity is the orientation of the national system toward international harmonization. The Agency participates in ensuring the conformity of national regulation with international requirements, including relevant international standards and approaches of the World Trade Organization. The material under study also notes the importance of digitalization of technical regulation processes and the expansion of public services in this field, as well as professional training and advanced qualification of specialists.

The second important element of the institutional system is the Uzbek Institute of Standards under the Uzbek Agency for Technical Regulation. The legal status and organization of the Institute's activities are determined by the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan **"On the Organization of the Activities of the Uzbek Institute of Standards of the Agency for Technical Regulation of Uzbekistan"**.

The Institute acts as the national standardization body and carries out specialized activities related to the development, application, and improvement of national standards. One of its principal functions is the development of draft national standards in accordance with the applicable legislation and approved standardization work plans.

[40] Указ Президента Республики Узбекистан № УП-41 «О мерах по дальнейшему совершенствованию государственного управления в области технического регулирования» от 27.02.2024 г.

Scientific and methodological research in the fields of standardization, metrology, and conformity assessment is of substantial importance. Scientific support makes it possible to take into account developments in the relevant fields and ensure the necessary substantiation of the regulatory documents being developed. An equally important function is the establishment and maintenance of a unified information database of national standards, since the accessibility of regulatory information constitutes a condition for transparency of the standardization system and uniform application of established requirements.

The Institute also participates in preparing proposals for the inclusion of international, interstate, and regional standards in the national standardization system. This is of particular importance for the pharmaceutical industry, since the development of medicinal product manufacturing is directly associated with international approaches to the quality and safety of pharmaceutical products.

Other areas of the Institute's activities include the preparation of methodological recommendations, retraining and advanced training of specialists, as well as international cooperation and exchange of experience with national standardization bodies of other states. Thus, the Institute of Standards performs primarily specialized regulatory-methodological and scientific-technical functions, complementing the coordinating activities of the Agency for Technical Regulation.

State and economic administration bodies responsible for the practical implementation of standard requirements in the relevant fields occupy a special place in the national system. In the pharmaceutical sector, the principal participants include the Ministry of Health of the Republic of Uzbekistan, the Agency for the Development of the Pharmaceutical Industry, the Center for Good Practices, and the Center for Pharmaceutical Product Safety.

These structures perform specialized functions related to ensuring the quality, safety, and efficacy of medicinal products. The Ministry of Health, as the relevant state authority, participates in the implementation of state policy in the field of medicinal product circulation, the formulation of quality requirements, and interaction with other participants in the system. Its participation in organizing processes related to quality control and inspection control is of substantial importance, as it ensures the connection between the national standardization system and sector-specific regulation of medicinal products.

The Agency for the Development of the Pharmaceutical Industry, in turn, performs a coordinating role in interaction with manufacturers and distributors. The material under study notes its participation in the implementation of standards and ensuring compliance with GMP and GLP requirements, modernization of production, and implementation of relevant quality approaches.

The specialized structures—the Center for Good Practices and the Center for Pharmaceutical Product Safety—perform functions directly related to control and conformity assessment. In particular, they participate in inspections, examination of manufacturing processes and documentation, as well as assessment of the conformity of pharmaceutical operations with established requirements. Thus,

sectoral bodies ensure the practical link between the general standardization system and specific processes of manufacturing and circulation of medicinal products.

Technical committees for standardization constitute an important element of the institutional system, and their activities are provided for by the Law of the Republic of Uzbekistan **“About Standardization”**. Their significance is determined by the need for scientific and expert support in the development of standards. Specialists and representatives of the scientific community possessing the necessary knowledge in specific fields participate in the relevant activities.

For the pharmaceutical sector, expert support is particularly important due to the complexity of medicinal products as objects of standardization. The development of quality requirements for pharmaceutical products requires consideration of technological, chemical, biological, and other characteristics. Therefore, regulatory documents should be based not only on legal requirements but also on an appropriate level of scientific and technical development.

According to official data, 33 technical committees for standardization operate in the Republic of Uzbekistan[41]. Their activities constitute an important element of the expert support of the national system. The results of the work of technical committees undergo the relevant stages of review and approval with the participation of the national standardization body and the Uzbek Agency for Technical Regulation. Thus, technical committees provide the expert component of standardization, while state bodies ensure its legal and organizational formalization.

Overall, the modern system of standardization of medicinal products represents an interconnected set of regulatory and institutional elements. The regulatory component includes the legislation **“About Medicines and Pharmaceutical Activity”, the Law “About Standardization”,** the State Pharmacopoeia, and subordinate regulatory legal acts. The institutional component is represented by the Uzbek Agency for Technical Regulation, the Uzbek Institute of Standards, sectoral bodies, and technical committees. Their interaction ensures the practical implementation of the established requirements.

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МЕСТО МЕДИАЦИИ В СИСТЕМЕ АЛЬТЕРНАТИВНОГО РАЗРЕШЕНИЯ ГРАЖДАНСКО-ПРАВОВЫХ СПОРОВ

***Аннотация**: В статье рассматривается место медиации в системе альтернативного разрешения гражданско-правовых споров в сравнении с третейским судом и переговорами. Автор анализирует ключевые критерии разграничения указанных процедур, акцентируя внимание на отсутствии у медиатора властных полномочий и интегративной природе медиации, направленной на сохранение отношений сторон. Обосновывается, что медиация является качественно иной моделью урегулирования конфликтов, ориентированной не на установление юридической правоты, а на поиск взаимовыгодного соглашения. В заключении делается вывод о приоритетном значении медиации для снижения судебной нагрузки и предоставления сторонам гибкого, экономичного и более комфортного механизма разрешения споров.*

Ключевые слова: медиация, третейский суд, переговоры.

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THE PLACE OF MEDIATION IN THE SYSTEM OF ALTERNATIVE CIVIL DISPUTE RESOLUTION

***Abstract**: This article examines the place of mediation in the system of alternative civil dispute resolution, comparing it to arbitration and negotiation. The author analyzes the key criteria for distinguishing between these procedures, emphasizing the mediator's lack of authority and the integrative nature of mediation, aimed at preserving the parties' relationships. It is argued that mediation is a fundamentally different model of conflict resolution, focused not on establishing legal correctness, but on finding a mutually beneficial agreement. The article concludes by emphasizing the primary importance of mediation in reducing the litigation burden and providing parties with a flexible, cost-effective, and more convenient dispute resolution mechanism.*

***Keywords**: mediation, arbitration, negotiation.*

В системе альтернативного разрешения споров медиация занимает одно из центральных, а в определенных категориях дел - приоритетное место [5]. В российской юридической практике уже сложился достаточно широкий спектр таких процедур [2], однако мировой опыт внесудебного решения конфликтов показывает, что он осуществляется в трех основных формах:

– «третейский суд или арбитраж (arbitration) - разрешение спора с помощью независимого, беспристрастной лица - арбитра (или группы арбитров), который уполномочен вынести обязательное для сторон решение;

– медиация (mediation), предусматривающая урегулирование правового конфликта посредством независимого, беспристрастного посредника, способствующего сторонам в достижении соглашения;

– переговоры - способ урегулирования спора непосредственно сторонами без участия иных лиц» [5].

Критериями такого деления является участие в урегулировании разногласий третьего лица или его полномочия. Элементы этих трех «чистых» форм разрешения конфликта входят составной частью во многие другие примирительные процедуры [9].

Ключевым отличием медиации от третейского разбирательства (арбитража) выступает не только отсутствие у медиатора властных полномочий по вынесению обязательного для сторон решения, но и сама целевая направленность процедуры. Если третейский суд, подобно государственному суду, разрешает спор по существу, вынося решение, которое, как правило, имеет обязательную силу для сторон [7; 11], то медиация ориентирована не на формальное установление юридической правоты той или иной стороны, а на организацию такого переговорного процесса, в рамках которого стороны самостоятельно, под руководством медиатора, определяют проблемы, анализируют возможные пути их решения и вырабатывают соглашение, максимально полно учитывающее их взаимные интересы [3]. В этом смысле медиация представляет собой не просто альтернативу третейскому суду, а качественно иную, интегративную модель разрешения конфликта, направленную на сохранение или восстановление конструктивных отношений между сторонами [3; 1]. Другим отличительным признаком арбитража является то, что такая процедура является более формализованной, чем процедура медиации [5].

В научной доктрине до настоящего времени сохраняется дискуссионный характер вопроса относительно определения переговоров в качестве самостоятельного способа альтернативного разрешения споров [4]. Достаточно часто встречается позиция, согласно которой переговоры рассматриваются не в качестве самостоятельного способа альтернативного разрешения споров, а лишь как технический прием или вспомогательный инструмент, который используется в рамках иных альтернативных способов решения споров (медиации, третейского разбирательства, судебного примирения и других). Согласно данной точке зрения, переговоры могут выступать элементом даже судебного рассмотрения спора, например, при

проведении сторонами консультаций в целях заключения мирового соглашения или при обсуждении условий досудебного урегулирования [5].

Ключевое отличие процедуры переговоров от процедуры медиации состоит в том, что переговоры, в отличие от медиации, не предусматривают участия независимого третьего лица (посредника, медиатора), которое профессионально содействовало бы сторонам в организации конструктивного диалога, выявлении их глубинных интересов и поиске взаимовыгодного решения спора [6]. В переговорах стороны взаимодействуют непосредственно друг с другом, самостоятельно определяя повестку, стратегию, тактику и правила ведения диалога, а также несут полную ответственность за достигнутый результат.

В завершение следует подчеркнуть, что интеграция медиации в систему альтернативного разрешения споров и ее активное внедрение в практику разрешения гражданско-правовых споров рассматриваются в качестве одного из приоритетных направлений судебно-правовой реформы в Российской Федерации [10]. Как справедливо отмечается в литературе, развитие альтернативных процедур, и медиации в особенности, призвано решить двуединую задачу: с одной стороны, снизить чрезмерную нагрузку на судей, повысив тем самым качество и скорость отправления правосудия [6]; с другой - предоставить участникам спора более гибкий, быстрый, экономичный и, что самое главное, дружественный способ урегулирования конфликта, позволяющий не только разрешить правовой спор, но и сохранить деловые, родственные или иные социально значимые связи [8]. Именно в этом заключается фундаментальное значение медиации как самостоятельного и полноправного института в современной системе альтернативного разрешения споров.

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ПРОКУРОР КАК УЧАСТНИК ГРАЖДАНСКОГО СУДОПРОИЗВОДСТВА В СОВЕТСКИЙ ПЕРИОД

Аннотация: *В статье рассматривается эволюция процессуального статуса и полномочий прокурора как участника гражданского судопроизводства в советский период. Особое внимание уделяется позициям ученых относительно процессуального положения прокурора: от признания его стороной до блюстителя закона. Автор показывает, что на протяжении всего советского периода прокурор сохранял широкий круг полномочий по инициированию дел, вступлению в процесс на любой стадии и принесению протестов, действуя в публичных интересах. В заключении делается вывод о том, что основные черты участия прокурора, сложившиеся в советское время, оставались стабильными вплоть до принятия современного процессуального законодательства.*

Ключевые слова: *прокурор, гражданское судопроизводство, советский период, полномочия.*

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PROSECUTOR AS A PARTICIPANT IN CIVIL PROCEEDINGS IN THE SOVIET PERIOD

Abstract: *This article examines the evolution of the prosecutor's procedural status and powers as a participant in civil proceedings during the Soviet period. Particular attention is given to scholars' positions regarding the prosecutor's procedural status: from recognition as a party to a guardian of the law. The author demonstrates that throughout the Soviet period, prosecutors retained broad powers to initiate cases, intervene in proceedings at any stage, and lodge protests, acting in the public interest. The conclusion concludes that the main features of prosecutorial participation, which developed during the Soviet era, remained stable until the adoption of modern procedural legislation.*

Keywords: *prosecutor, civil proceedings, Soviet period, powers.*

Первым актом, определившим объем полномочий прокурора в указанной сфере, стал циркуляр Народного комиссариата юстиции от 29 июля

1922 г. № 67 «Временная инструкция губернским прокурорам об общих задачах, возлагаемых на прокурора». Согласно положениям данного документа, «прокурор осуществлял надзорную функцию в отношении судебных органов (§ 6), а также принимал участие в гражданском процессе в случаях, прямо установленных законом, либо тогда, когда такое участие признавалось обязательным самой прокуратурой (п. «и» § 13)» [10].

Новое концептуальное переосмысление роли прокурора в гражданском судопроизводстве произошло в связи с принятием Гражданского процессуального кодекса РСФСР 1923 г. [6] (далее по тексту – ГПК 1923 г.). Данный акт был принят в условиях новой государственной идеологии, отрицавшей любые частные начала в юридической сфере [3]. Исходя из этого, «место дореволюционного прокурора - охранителя закона занял советский прокурор, который вступал в процесс для подчинения публично-правовым интересам государства частных юридических интересов тяжущихся» [13].

В ГПК 1923 г. (ст. 2) было закреплено полномочие прокурора «как начать дело, так и вступить в дело в любой стадии процесса, если, по его мнению, этого требует охрана интересов государства или трудящихся масс» [6]. Содержание указанной правовой нормы определяло две разновидности участия прокурора в гражданском судопроизводстве: «присоединение к делу на любом этапе судебного разбирательства с целью представления заключения, а также право «начать дело», причем прокурор обладал возможностью предъявить исковое заявление вопреки волеизъявлению того лица или органа, в интересах защиты которого он действовал» [1]. Предусматривалась и третья форма вступления прокурора в гражданский процесс, а именно: суд по собственному усмотрению мог признать необходимым участие прокурора для дачи заключения, и в таком случае данное участие становилось для прокурора обязательным.

Помимо этого, на судебный орган возлагалась обязанность в случаях обнаружения в рамках уже возбужденного производства заинтересованности государственных учреждений либо предприятий, не выступающих в качестве участников процесса, уведомлять об этом прокурора, предоставляя ему таким образом возможность самостоятельно принять решение относительно вступления в дело (ст. 172 ГПК 1923 г.). В отношении отдельных категорий гражданских дел ГПК 1923 г. прямо устанавливал обязательный характер участия прокурора; в частности, данное требование распространялось на дела об освобождении от военной службы по мотивам религиозных убеждений (ст. 226).

В перечень иных форм процессуальной реализации функций прокурора, регламентированных ГПК 1923 года, включались: «принесение протестов на судебные решения и определения как не вступившие, так и вступившие в законную силу; поддержание заявленного протеста; возбуждение процедуры пересмотра дел по вновь открывшимся обстоятельствам, а также ряд иных процессуальных действий. При осуществлении указанных полномочий

прокурор не был никоим образом связан тем фактом, участвовал ли он в рассмотрении данного гражданского дела или же нет» [2].

В связи с названными правомочиями прокурора в гражданском процессе в науке остро стоял вопрос определения его процессуального положения. Были высказаны разные точки зрения на сей счет.

М.С. Строгович безоговорочно относил прокурора к стороне в процессе вне зависимости от формы его участия, аргументируя это тем, что «он осуществляет все те действия, которые законом предоставлены стороне» [12].

К.С. Юдельсон не соглашался с такой позицией, замечая, что «в процессе может быть только две стороны (истец и ответчик)» [11].

С.Н. Абрамов рассматривал прокурора как «истца в процессуальном смысле, если он инициировал процесс; если же прокурор вступал в уже начатое истцом дело, то он не признавался стороной, а выступал блюстителем закона» [4].

Какого-либо консенсуса по вопросу процессуального положения прокурора по гражданскому делу в науке так и не было достигнуто.

Принятые в 1961 году Основы гражданского судопроизводства Союза ССР и союзных республик [8], а также Гражданский процессуальный кодекс РСФСР 1964 г. [5] (далее по тексту – ГПК 1964 г.) не привели к сколько-нибудь существенным изменениям ни в объеме процессуальных правомочий прокурора, ни в его процессуальном статусе в целом в рамках гражданского судопроизводства.

Ст. 12 Основ возлагала на прокурора обязанность на всех стадиях процесса «своевременно принимать предусмотренные законом меры к устранению всяких нарушений закона, от кого бы эти нарушения ни исходили. В подобной редакции гражданский процесс рассматривался в качестве объекта прокурорского надзора» [14].

Норма, устанавливавшая критерии отнесения дел к категории тех, в которые прокурор наделен правом вступать, была подвергнута определенному уточнению: «если этого требует охрана государственных или общественных интересов или прав и охраняемых законом интересов граждан» (ст. 41 ГПК 1964 г.). Кроме того, «прокурор был обязан участвовать в разбирательстве в случаях, прямо предусмотренных законом (на практике перечень таких дел существенно расширялся за счет предписаний, содержавшихся в приказах Генерального прокурора СССР), а также тогда, когда суд выносил определение о вступлении прокурора в процесс» [9].

Законодательство рассматриваемого периода закрепляло следующий перечень категорий дел, по которым участие прокурора носило обязательный характер: «дела по жалобам на неправильности в списках избирателей (ст. 234 ГПК 1964 г.); дела о признании гражданина безвестно отсутствующим либо об объявлении гражданина умершим (ст. 255 ГПК 1964 г.); дела о признании гражданина ограниченно дееспособным или недееспособным (ст. 261 ГПК 1964 г.); дела о лишении родительских прав (ст. 59 Кодекса о браке и семье РСФСР)» [7].

Последующий этап эволюции законодательства, регламентирующего участие прокурора в гражданском судопроизводстве, сопряжен с принятием нового процессуального законодательства, действующего в настоящее время.

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КВАЛИФИКАЦИЯ ХИЩЕНИЙ ЧУЖОГО ИМУЩЕСТВА: НЕОПРЕДЕЛЁННОСТЬ ЛЕГАЛЬНОГО ПОНЯТИЯ И ОШИБКИ ПРАВОПРИМЕНЕНИЯ

Аннотация: *Статья посвящена спорным вопросам квалификации отдельных форм хищения чужого имущества. Автор исходит из того, что союз «и (или)» в пункте 1 примечания к статье 158 УК РФ фактически уравнивает изъятие и обращение, подавая их как взаимозаменяемые описания одного и того же деяния. Между тем для похищений требуется именно изъятие из чужого владения, тогда как при присвоении и растрате достаточно обращения имущества, которое уже находится у виновного на законном основании. На этом фоне разбираются квалификация присвоения находки как кражи, соотношение статей 158, 159.3 и 159.6 УК РФ при завладении безналичными денежными средствами, неясность с моментом окончания хищения и смешение административного порога с малозначительностью. Делается вывод, что за типичными ошибками практики стоит общая причина – оценка начинается с отнесения деяния к хищению вообще, вне конкретной статьи. Предлагается сохранить родовое понятие, нормативно разграничив изъятие и обращение, и придерживаться последовательности «способ – предмет – родовые признаки – момент окончания – конкуренция норм».*

Ключевые слова: *хищение, квалификация преступлений, кража, мошенничество, изъятие и обращение, безналичные денежные средства, момент окончания преступления, малозначительность.*

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QUALIFICATION OF THEFT OF ANOTHER'S PROPERTY: UNCERTAINTY OF THE LEGAL DEFINITION AND LAW-ENFORCEMENT ERRORS

Abstract: *The article deals with contested issues in qualifying particular forms of theft of another's property under Russian criminal law. The author argues that the conjunction "and (or)" in note 1 to Article 158 of the Criminal Code of the Russian Federation puts seizure and conversion on an equal footing, as if they were*

interchangeable descriptions of one and the same act. Theft, robbery and brigandage, however, require seizure from another's possession, whereas misappropriation and embezzlement call only for conversion of property already entrusted to the offender. Against this background the article examines the treatment of finding as theft, the relationship between Articles 158, 159.3 and 159.6 in cases involving non-cash funds, the uncertainty surrounding the moment of completion, and the confusion of the administrative threshold with insignificance. Typical errors are traced to a reversed sequence of reasoning: the act is first labelled theft in the abstract and only afterwards assigned to a specific article. The author supports retaining the generic notion while distinguishing seizure from conversion, and observing the sequence: mode of commission, object, generic elements, moment of completion, conflict of norms.

***Keywords**: theft, criminal qualification, larceny, fraud, seizure and conversion, non-cash funds, moment of completion of the offence, insignificance.*

Преступления против собственности по-прежнему образуют наиболее значительную часть российской преступности, а квалификация форм хищения остаётся одним из самых трудных участков применения главы 21 УК РФ [7]. Цена ошибки здесь велика: она оборачивается либо уголовным преследованием при отсутствии состава, либо неверным выбором статьи, стадии и квалифицирующих признаков. В настоящей статье, опираясь на доктринальные источники, нормы УК РФ, постановления Пленума Верховного Суда РФ и правовые позиции Конституционного Суда РФ, мы попытаемся выделить ключевые проблемные аспекты квалификации и показать, что у них есть общий корень.

Согласно пункту 1 примечания к статье 158 УК РФ хищением признаются совершённые с корыстной целью противоправные безвозмездное изъятие и (или) обращение чужого имущества в пользу виновного или других лиц, причинившие ущерб собственнику или иному владельцу этого имущества [7]. В.К. Дуюнов считает это понятие наиболее устоявшимся в теории уголовного права [4, с. 389]. Внешняя завершённость формулы, однако, скрывает её внутреннюю неоднородность. Изъятие предполагает нарушение чужого владения; обращение возможно и там, где имущество уже находилось у виновного на законном основании.

И.А. Клепицкий указывает, что понятие хищения представляет собой чрезмерное обобщение и определяет признаки имущественных преступлений недостаточно точно, порождая правовую неопределённость [6, с. 23]. Исторически термин появился в Декрете ВЦИК и СНК от 1 июня 1921 г. и в УК РСФСР 1922 г. охватил не только похищение, но и присвоение и растрату [6, с. 28]. Система способов первична, обобщённое понятие вторично. Поэтому квалификация, которая начинается с подведения деяния под примечание, а не с установления способа и предмета, нарушает логику состава.

Отказ от родового понятия разрушил бы правила конкуренции всей главы 21 УК РФ. Предпочтительнее сохранить термин как указание на корыстное безвозмездное причинение имущественного ущерба и нормативно разграничить два способа. Для кражи, грабежа и разбоя обязательны изъятие и обращение; для присвоения и растраты достаточно обращения вверенного имущества. Родовые признаки (чужое имущество, противоправность, безвозмездность, корыстная цель, ущерб) отвечают на вопрос о наличии хищения; признаки формы (тайность, открытость, обман, вверенность, нападение) – на вопрос о статье. Восполнять отсутствие родового признака ссылкой на корысть или на размер ущерба недопустимо, хотя на практике такая подмена встречается.

Наглядным проявлением этой неопределённости стало постановление Конституционного Суда РФ от 12 января 2023 г. № 2-П [10]. Квалификацию присвоения находки как кражи И.А. Клепицкий оценивает резко, и основание для резкости имеется: изъятие есть необходимый признак именно похищений [6, с. 34-35]. Ущерб при утрате вещи возникает в момент её потери владельцем, а не тогда, когда вещь обнаружило другое лицо; причинная связь, обязательная для материального состава кражи, в момент находки по меньшей мере сомнительна. Х.А. Аккаева справедливо замечает, что ключевым критерием здесь оказывается владение, а непротиворечивого учения о нём доктрина до сих пор не выработала [1, с. 207-208]. Практика движется между двумя крайностями. Называя кражей любое завладение забытой вещью, она оставляет без оценки признак изъятия; сводя же любой отказ вернуть найденное к находке, она игнорирует последующее сокрытие признаков принадлежности вещи.

Второй проблемный аспект связан с цифровыми способами завладения. К.Д. Баренбаум фиксирует рост краж с банковских счетов и их квалификацию по пункту «г» части 3 статьи 158 УК РФ [3, с. 154]. Тенденция очевидна, однако любое списание со счёта нельзя автоматически относить к этой норме. Пункт характеризует предмет и доступ к безналичным средствам, но не отменяет установления способа и не снимает конкуренции со статьями 159.3 и 159.6 УК РФ. Иначе квалифицирующий признак превращается в не предусмотренный законом универсальный состав.

М.Р. Велулаева показывает, что статья 159 УК РФ механически соединяет общее понятие хищения с обманом и злоупотреблением доверием и что приобретение права выводит состав за рамки классического похищения: предметом становятся недвижимость, бездокументарные бумаги, безналичные деньги [5, с. 86-87]. Если владелец сам передаёт имущество или даёт распоряжение о переводе под влиянием лжи, способ мошеннический. Если электронное средство платежа используется тайно, без обмана владельца и уполномоченного лица, применима статья 158 УК РФ. Если воздействие оказывается на информационную систему, а не на волю человека, подлежит применению статья 159.6 УК РФ. Норму определяет способ, а не безналичный характер предмета.

Пленум Верховного Суда РФ в постановлении от 30 ноября 2017 г. № 48 раскрывает обман, злоупотребление доверием, вверенность и момент окончания мошенничества, присвоения и растраты [9]. Эти разъяснения достраивают составы, но не заменяют последовательность оценки. Введение отдельной статьи о дистанционном хищении создаст ещё один ряд конкуренции. Х.А. Аккаева обоснованно предостерегает: совершенствовать следует действующие нормы, а не инкорпорировать новые [1, с. 210].

Третий проблемный аспект – момент окончания. Постановление Пленума от 27 декабря 2002 г. № 29 связывает окончание кражи и грабежа с изъятием и появлением реальной возможности пользоваться либо распоряжаться имуществом, а окончание разбоя – с нападением [8]. Ю.А. Власов отмечает, что критерий реальной возможности из закона напрямую не вытекает и представляет собой судебное толкование [2, с. 46]. Закон связывает хищение с изъятием и (или) обращением, причинившими ущерб [7]. На практике суды произвольно описывают место задержания, от чего зависит выбор между покушением и оконченным составом [2, с. 47-48].

Единый критерий для всех ситуаций непригоден. Для торговой зоны окончание связано с преодолением границы контроля при отсутствии существенных препятствий к уходу; для охраняемой территории – с выходом за её пределы; для безналичных средств – с утратой потерпевшим контроля над записью. Разбой остаётся в ряду форм хищения по цели и по месту в главе 21 УК РФ, но как усечённый состав окончен с момента нападения [4, с. 404]; связывать его окончание с изъятием означало бы снизить охрану жизни и здоровья. Грабёж и разбой разграничиваются по характеру насилия: нарушение целостности организма либо реальная опасность для жизни или здоровья образуют разбой, тогда как причинение боли или рывок без такого последствия остаются грабежом [8]. Расширительное же толкование «нападения» попросту поглощает насильственный грабёж [1, с. 209].

Наконец, нередко смешиваются административный порог и часть 2 статьи 14 УК РФ. Уголовная ответственность за простую кражу наступает при сумме свыше 2 500 рублей; ниже этого порога и при отсутствии квалифицирующих признаков состава преступления нет [3, с. 155]. Малозначительность не способна одновременно заменять статью 7.27 КоАП РФ и корректировать квалифицированные составы – это две разные функции. К насильственному грабежу часть 2 статьи 14 УК РФ в качестве общего правила неприменима: насилие образует самостоятельный объект охраны.

Перечисленные затруднения, при всей их разнородности, имеют одну причину. Правоприменитель сначала объявляет деяние хищением вне конкретной статьи и лишь затем подбирает норму под уже готовый вывод. Квалификация должна идти от способа и предмета к родовым признакам, моменту окончания и конкуренции норм. Совершенствование не требует новой статьи о каждом цифровом способе. Достаточно уточнить пункт 1 примечания к статье 158 УК РФ, разграничив изъятие и обращение, и дополнить постановления Пленума № 29 и № 48 критериями владения и

находки, дифференцированными правилами о моменте окончания, правилами выбора между статьями 158, 159.3 и 159.6 УК РФ и запретом автоматически признавать малозначительным насильственный грабёж.

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СПЕЦИАЛЬНЫЕ УСЛОВИЯ ИЗБРАНИЯ ДОМАШНЕГО АРЕСТА: ОТ ФАКТИЧЕСКИХ ПРЕДПОСЫЛОК К ЮРИДИЧЕСКИМ УСЛОВИЯМ

Аннотация: *В статье рассматриваются обстоятельства, от которых зависит фактическая исполнимость домашнего ареста, – наличие пригодного жилого помещения, согласие совместно проживающих лиц, обеспеченность жизненных потребностей подозреваемого или обвиняемого и его согласие на применение технических средств контроля. Установлено, что ни одно из названных обстоятельств не закреплено статьёй 107 УПК РФ в качестве условия избрания меры, вследствие чего их проверка отнесена к усмотрению суда и не влечёт процессуальных последствий при её отсутствии. Обосновывается разделение условий избрания на общие и специальные и квалификация перечисленных обстоятельств как юридических условий, отсутствие любого из которых исключает применение меры. Формулируются предложения по дополнению части 1 и части 3 статьи 107 УПК РФ.*

Ключевые слова: *домашний арест; меры пресечения; условия избрания; исполнимость меры; жилое помещение; права третьих лиц; предмет доказывания.*

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SPECIAL CONDITIONS FOR ORDERING HOUSE ARREST: FROM FACTUAL PREREQUISITES TO LEGAL CONDITIONS

Abstract: *The article examines the circumstances on which the practical enforceability of house arrest depends: the availability of suitable residential premises, the consent of cohabiting persons, provision for the vital needs of the suspect or accused, and their consent to the use of technical means of control. It is established that none of these circumstances is enshrined in Article 107 of the Criminal Procedure Code of the Russian Federation as a condition for ordering the measure, so that their verification is left to judicial discretion and entails no procedural consequences if omitted. The author substantiates a division of the conditions for ordering the measure into general and special ones and classifies the*

circumstances listed above as legal conditions, the absence of any of which precludes application of the measure. Proposals are formulated for supplementing Parts 1 and 3 of Article 107 of the Criminal Procedure Code.

***Keywords**: house arrest; preventive measures; conditions for ordering; enforceability; residential premises; rights of third parties; subject of proof.*

Уголовно-процессуальный закон оперирует понятиями оснований и обстоятельств, учитываемых при избрании меры пресечения. Часть 1 статьи 97 УПК РФ перечисляет основания для применения мер пресечения, а статья 99 УПК РФ предписывает учитывать тяжесть преступления, сведения о личности, возраст, состояние здоровья, семейное положение и род занятий [8]. Ни одна из названных норм не содержит положений, специфических для домашнего ареста: материальные предпосылки этой меры сформулированы в общем виде, едином для всей системы мер пресечения.

Отсюда следует вывод о том, что если основания тождественны для всех мер, то выбор конкретной меры не может определяться основанием как таковым. Единственным содержательным указанием остаётся условие части 1 статьи 107 УПК РФ о невозможности применения иной, более мягкой, меры [8], которое задаёт направление движения от менее строгого режима к более строгому, но не устанавливает критерия остановки. Разграничительную функцию в этих условиях принимает на себя категория условий – в законе отсутствующая и разработанная доктриной.

И. М. Горбатых, опираясь на позиции А. С. Авдеева и Ю. Г. Овчинникова, предлагает разделять условия «на две группы: 1) общие – учитываемые в ходе избрания любой такой меры и обеспечивающие выбор одной из них; 2) специальные – необходимые для избрания конкретной меры пресечения, а также отражающие особенности ее применения в отношении определенных категорий лиц» [1, с. 59-60]. Деление методологически верно и логически завершает приведённое выше рассуждение: при универсальности оснований различительную работу выполняют специальные условия.

Сложившийся в науке перечень таких условий тот же автор суммирует следующим образом: указание в санкции статьи на наказание в виде лишения свободы свыше двух лет; наличие у обвиняемого жилища; наличие компетентного органа, осуществляющего надзор [1, с. 60]. Перечень этот принят быть не может в первых двух пунктах. Первое условие воспроизводит требование части 1 статьи 108 УПК РФ, которое, по разъяснению Пленума Верховного Суда Российской Федерации, на домашний арест не распространяется, поскольку они не предусмотрены статьей 107 УПК РФ [6]. Второе сформулировано чрезмерно узко: закон говорит не о жилище как объекте принадлежности, а о жилом помещении, в котором лицо проживает в качестве собственника, нанимателя либо на иных законных основаниях [8]. Действительную специфику меры отражает лишь третье условие, и то с оговоркой: постоянно действующий надзор необходим и при запрете определённых действий, однако именно при домашнем аресте непрерывность

пребывания в жилом помещении делает контроль условием самой исполнимости меры.

Содержательно более удачен перечень, предложенный тем же автором в другой работе и построенный не от места меры в системе принуждения, а от возможности её исполнить: наличие жилого помещения, позволяющего обеспечить исполнение меры и применение средств технического контроля; согласие совместно проживающих лиц; отсутствие заболеваний, препятствующих применению меры; наличие у обвиняемого средств на своё содержание либо третьих лиц, принявших на себя соответствующие обязательства [2, с. 52]. Три из четырёх названных обстоятельств в законе отсутствуют, и каждое способно сделать исполнение судебного решения невозможным.

Наиболее острым представляется вопрос о согласии лиц, проживающих совместно с подозреваемым или обвиняемым. И. М. Горбатых констатирует, что получение такого согласия законом не предусмотрено, а «игнорирование данного условия может привести к тяжким последствиям» [1, с. 61]. И. С. Исанбаев приходит к тому же выводу: «законодательно ни процесс, ни сама необходимость получения согласия лиц, проживающих с подозреваемым или обвиняемым в одном помещении, не закреплены» [5, с. 27-28]. З. Х. Урусов обращается к гражданско-правовому основанию проблемы, указывая, что проживание лица, не являющегося собственником, возможно лишь с согласия совладельцев, тогда как «в контексте законодательства, регламентирующего домашний арест, данный аспект не учитывается» [9, с. 234]. Приводимая автором ссылка на статью 247 ГК РФ требует уточнения: названная норма определяет порядок владения и пользования имуществом в долевой собственности, тогда как более точным основанием выступает статья 30 Жилищного кодекса Российской Федерации, закрепляющая правомочие собственника предоставлять помещение во владение и пользование иным лицам [4]. Существо замечания от этого не колеблется, а совпадение трёх независимых наблюдений подтверждает реальность пробела.

Значение вопроса определяется тем, что домашний арест является единственной мерой пресечения, исполнение которой неизбежно обременяет правовое положение лиц, к уголовному делу не причастных. Частичное признание их интересов содержится в межведомственном приказе, предусматривающем составление акта при несогласии совместно проживающих лиц на установку устройства аудиовизуального контроля с последующим информированием органа расследования [7]. Правовые последствия составления такого акта не определены. Пленум Верховного Суда Российской Федерации признаёт за проживающими лицами право обжаловать судебное решение, затрагивающее их интересы [6], однако обжалование обращено к праву, уже затронутому состоявшимся актом, тогда как условие избрания по своему назначению должно предшествовать его вынесению.

Полный запрет покидать жилое помещение, установленный редакцией 2018 года, означает невозможность самостоятельного приобретения продуктов питания, лекарственных средств и предметов первой необходимости. Закон не возлагает обязанности по обеспечению этих потребностей ни на контролирующий орган, ни на иных лиц и не требует от суда проверки соответствующих обстоятельств; И. М. Горбатых отмечает, что органами расследования они изучаются не во всех случаях, следствием чего становятся последующие нарушения режима [1, с. 62]. Вывод, который отсюда надлежит сделать, имеет самостоятельное значение: часть нарушений порождается не противоправной волей арестованного, а невозможностью удовлетворить элементарные потребности, не покидая жилища, и квалификация таких случаев как нарушения меры пресечения юридически некорректна, поскольку подменяет оценку процессуального риска оценкой бытового обстоятельства.

Сходным образом обстоит дело с согласием на применение технических средств контроля. Приказ 2020 года допускает отказ от их использования, обязывая инспекцию составить акт и проинформировать орган расследования [7]; последствия отказа и порядок реагирования суда не установлены. К. Т. Дюзбаева обоснованно указывает, что «законодательством не на должном уровне регламентированы механизмы контроля за соблюдением условий домашнего ареста, таких как использование электронных средств слежения» [3, с. 276]. Оценка эта верна применительно не только к стадии исполнения, но и к согласию на контроль как к обстоятельству, подлежащему установлению в судебном заседании об избрании меры.

Изложенное позволяет предложить двухкомпонентную модель условий избрания домашнего ареста. Общие условия отвечают на вопрос о допустимости меры в системе принуждения: невозможность применения более мягкой меры и отсутствие оснований для более строгой. Специальные условия отвечают на вопрос о её исполнимости в конкретной фактической обстановке и должны включать наличие жилого помещения, пригодного для удовлетворения базовых потребностей в течение срока меры и позволяющего применить технические средства контроля; согласие совместно проживающих совершеннолетних лиц; обеспеченность жизненных потребностей подозреваемого или обвиняемого; его согласие на применение технических средств контроля либо мотивированный вывод суда о возможности контроля без конкретного средства; отсутствие заболеваний, препятствующих применению меры.

В отличие от подходов, рассматривающих названные обстоятельства как фактические предпосылки, устанавливаемые по усмотрению суда, предлагается квалифицировать их как юридические условия, отсутствие любого из которых исключает избрание домашнего ареста. Практическое значение такой квалификации состоит в переводе соответствующей проверки из области судейского усмотрения в область обязательного предмета исследования по материалу о мере пресечения.

Реализация предложения требует изменения двух частей статьи 107 УПК РФ. Часть 1 подлежит дополнению перечнем специальных условий и определением жилого помещения, построенным на признаках законности проживания и пригодности помещения. Часть 3 надлежит дополнить требованиями к содержанию ходатайства, включая указание места и способа исполнения меры и порядка обеспечения жизненных потребностей [2, с. 55], и – что составляет недостающее звено ранее высказанных предложений – процессуальным последствием их несоблюдения: при непредставлении сведений о специальных условиях суд отказывает в удовлетворении ходатайства. Без нормы о последствиях требования к ходатайству остаются необеспеченными, а выявленные пробелы будут по-прежнему обнаруживаться лишь в апелляционном порядке, когда ценой исправления становится либо период незаконного ограничения свободы, либо возвращение лица в следственный изолятор.

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ИННОВАЦИОННЫЕ УПРАВЛЕНЧЕСКИЕ ТЕХНОЛОГИИ В СИСТЕМЕ МУНИЦИПАЛЬНЫХ УЧРЕЖДЕНИЙ ОБРАЗОВАНИЯ: ТЕОРЕТИЧЕСКИЕ ОСНОВЫ И ПРАКТИКА ВНЕДРЕНИЯ

***Аннотация**: В статье исследуются теоретико-методические основы и практические аспекты внедрения инновационных управленческих технологий в деятельность муниципальных учреждений образования. Автором уточнено содержание понятия «инновационные управленческие технологии в системе муниципальных учреждений образования», разработана трехуровневая таксономия инноваций и многомерная классификация технологий применительно к дошкольным образовательным организациям. На основе эмпирического анализа деятельности Государственного бюджетного дошкольного образовательного учреждения детский сад № 104 Фрунзенского района Санкт-Петербурга за 2022–2024 гг. выявлены системные проблемные зоны управления, определены драйверы и барьеры внедрения инноваций, разработана матрица сопоставления проблемных зон и инновационных управленческих технологий. Обоснованы приоритетные направления внедрения инноваций: проектный менеджмент в стратегическое управление, система сбалансированных показателей в управление качеством образования, наставничество и повышение цифровой грамотности педагогов, цифровизация административно-хозяйственных процессов, развитие партисипативных практик взаимодействия с родителями.*

***Ключевые слова**: инновационные управленческие технологии, муниципальные учреждения образования, дошкольное образование, система управления, цифровизация управления, партисипативные практики, кадровый потенциал.*

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INNOVATIVE MANAGEMENT TECHNOLOGIES IN THE SYSTEM OF MUNICIPAL EDUCATIONAL INSTITUTIONS: THEORETICAL FOUNDATIONS AND IMPLEMENTATION PRACTICE

Abstract: *The article examines the theoretical and methodological foundations and practical aspects of introducing innovative management technologies into the activities of municipal educational institutions. The author clarifies the content of the concept of "innovative management technologies in the system of municipal educational institutions", develops a three-level taxonomy of innovations and a multidimensional classification of technologies in relation to preschool educational organizations. Based on an empirical analysis of the activities of the State Budgetary Preschool Educational Institution Kindergarten No. 104 of the Frunzensky District of St. Petersburg for 2022–2024, systemic problem areas of management are identified, drivers and barriers to innovation are determined, and a matrix of correlation between problem areas and innovative management technologies is developed. Priority directions for introducing innovations are substantiated: project management in strategic management, balanced scorecard in education quality management, mentoring and improving digital literacy of teachers, digitalization of administrative and economic processes, development of participatory practices of interaction with parents.*

Keywords: *innovative management technologies, municipal educational institutions, preschool education, management system, digitalization of management, participatory practices, human resources potential.*

Введение

Современный этап развития системы муниципального образования в Российской Федерации характеризуется глубокой трансформацией, обусловленной комплексом факторов институционального, кадрового и технологического характера. Реализация национального проекта «Образование» и переход на федеральные образовательные программы дошкольного образования задают вектор на качественную перестройку управленческих моделей, при которой традиционные подходы, основанные на жесткой регламентации и иерархичности, уступают место более гибким, адаптивным и клиентоориентированным моделям [1, с. 12].

Однако, как показывает анализ практики, декларируемые на федеральном уровне установки о внедрении инноваций часто сталкиваются с серьезными институциональными, кадровыми и организационными

барьерами на муниципальном уровне. Жесткость бюджетного законодательства, высокая бюрократическая нагрузка, кадровый консерватизм и недостаток цифровых компетенций у управленческого персонала существенно снижают эффективность принимаемых решений [2, с. 45].

Проблематика внедрения инновационных управленческих технологий в деятельность образовательных организаций рассматривается в работах отечественных и зарубежных исследователей. Так, И. А. Василенко акцентирует внимание на инструментальной составляющей управленческих технологий, определяя их как совокупность методов и средств целенаправленного воздействия на управляемый объект [3, с. 78]. Н. И. Глазунова подчеркивает процессуальный аспект, рассматривая технологии как строго определенную последовательность управленческих операций и процедур [4, с. 92]. Д. Ф. Кеттл исследует трансформацию государственного управления в условиях цифровизации, отмечая необходимость адаптации рыночных инструментов к специфике публичного сектора [5]. И. Мергель анализирует применение agile-подходов в государственном секторе, обосновывая их потенциал для повышения адаптивности управленческих систем [6].

Вместе с тем, несмотря на значительный объем научных публикаций по проблематике управления образовательными организациями, вопросы адаптации инновационных управленческих технологий к специфике конкретных муниципальных дошкольных учреждений остаются недостаточно изученными. Большинство исследований либо носят общесистемный характер, не учитывая специфику дошкольного звена, либо фокусируются исключительно на технологических аспектах цифровизации, оставляя без внимания социальные, правовые и организационные измерения инновационной деятельности [7, с. 23].

Таким образом, ключевое противоречие, определяющее актуальность настоящего исследования, заключается между объективной потребностью муниципальных учреждений образования в обновлении управленческих практик и недостаточной разработанностью теоретико-методического инструментария, позволяющего осуществлять такое обновление системно и результативно.

Целью исследования является разработка и обоснование теоретико-методических основ и практических рекомендаций по внедрению инновационных управленческих технологий в систему муниципальных учреждений образования.

Для достижения поставленной цели необходимо решить следующие задачи: уточнить содержание понятия «инновационные управленческие технологии в системе муниципальных учреждений образования»; разработать трехуровневую таксономию инновационных управленческих технологий; предложить классификацию инновационных управленческих технологий применительно к дошкольным образовательным учреждениям; провести

анализ эффективности управления Государственным бюджетным дошкольным образовательным учреждением детский сад № 104 Фрунзенского района Санкт-Петербурга за 2022–2024 гг.; выявить проблемные зоны управления и определить потенциал для внедрения инновационных управленческих технологий; разработать матрицу сопоставления проблемных зон и инновационных управленческих технологий; обосновать приоритетные направления внедрения инноваций.

Методы и исследования

Методологическую основу исследования составили системный подход, позволяющий рассматривать муниципальное учреждение образования как целостную, полифункциональную систему; институциональный подход, дающий возможность анализировать нормативно-правовые и организационные рамки управленческой деятельности; структурно-функциональный подход, используемый для классификации управленческих технологий по подсистемам управления.

В процессе исследования использовались теоретические методы (анализ и синтез научной литературы, нормативно-правовых актов, систематизация и классификация, дефиниционный анализ) и эмпирические методы (наблюдение, анализ документов, анкетирование, интервьюирование, сравнительный анализ).

Информационную базу исследования составили нормативные правовые акты Российской Федерации, отчеты о самообследовании ГБДОУ детский сад № 104 за 2022–2024 гг., бухгалтерская отчетность учреждения, результаты анкетирования педагогических работников и родителей (законных представителей) воспитанников, а также статистические данные о развитии системы дошкольного образования Санкт-Петербурга.

Результаты

Теоретические основы исследования

Проведенный анализ научной литературы позволил уточнить содержание ключевого понятия исследования. Под инновационными управленческими технологиями в системе муниципальных учреждений образования понимается совокупность научно обоснованных, адаптированных к условиям публичной образовательной организации методов, инструментов и организационных процедур, основанных на использовании современных достижений науки, цифровизации и социального проектирования, которые направлены на повышение эффективности, качества, прозрачности и адаптивности управления учреждением при сохранении его социальной миссии и соблюдении законодательных требований [8, с. 15].

Данное определение подчеркивает три ключевых аспекта: инновационность как внедрение нового управленческого решения; адаптированность как обязательную настройку общих технологий под реалии дошкольного образования; сохранение публичной миссии как ограничитель,

не допускающий механического переноса рыночных инструментов в практику бюджетных учреждений.

Разработана трехуровневая таксономия инновационных управленческих технологий, позволяющая систематизировать инновации по уровню их инициации и реализации [9, с. 34]:

- макроуровень – инновации, инициируемые федеральными и региональными органами власти (внедрение обязательной цифровой образовательной среды, переход на новые механизмы финансирования, изменение требований к лицензированию);
- мезоуровень – инновации, внедряемые по инициативе администрации учреждения (технологии проектного управления, внутренняя система оценки качества образования, управляющий совет, программа развития);
- микроуровень – инновации на уровне конкретных рабочих мест (конструкторы рабочих программ, автоматизированное составление меню-требования, мобильные приложения для фиксации занятий).

Предложена многомерная классификация инновационных управленческих технологий применительно к дошкольным учреждениям по трем основаниям [10, с. 56]:

1. По функционально-содержательному признаку: технологии стратегического и программно-целевого управления; технологии управления качеством образования и внутренней оценки; технологии управления человеческими ресурсами; технологии административно-хозяйственного управления.
2. По степени цифровой трансформации: цифровые платформы и экосистемы; технологии анализа данных; сервисы автоматизации рутинных процессов.
3. По степени вовлеченности родителей: технологии информирования (пассивные); технологии обратной связи (интерактивные); технологии соучастия (партисипативные).

Анализ эффективности управления ГБДОУ детский сад № 104

Для проведения эмпирического анализа выбрано Государственное бюджетное дошкольное образовательное учреждение детский сад № 104 Фрунзенского района Санкт-Петербурга, являющееся типичным муниципальным дошкольным образовательным учреждением общеразвивающего вида. Проектная мощность учреждения составляет 220 мест, фактическая наполняемость – 220 воспитанников (10 групп). Штатная численность – 44 человека, из них 24 педагогических работника [11].

Анализ кадрового состава за 2022–2024 гг. показал устойчивую положительную динамику: численность педагогических работников увеличилась на 9,1%, доля педагогов с высшим образованием возросла с 72,7% до 75,0%, с квалификационными категориями – с 63,6% до 66,7%. Вместе с тем сохраняется кадровое «старение»: 50% педагогов имеют стаж более 15 лет, доля молодых специалистов до 30 лет составляет лишь 20,8% [12, с. 28].

Анализ финансово-хозяйственной деятельности выявил рост общего объема финансирования на 9,7% за три года, при этом внебюджетные источники демонстрируют опережающую динамику (доходы от платных услуг выросли на 33,3%). Однако доля расходов на материально-техническое оснащение и повышение квалификации педагогов составляет лишь 6,7% от общего объема расходов, что ограничивает возможности для инновационного развития [13, с. 41].

Оценка качества образования показала устойчивую положительную динамику: уровень освоения образовательной программы достиг 92,8%, средний балл независимой оценки качества образования – 82,4 из 100, удовлетворенность родителей – 89%. Наиболее низкие оценки получены по критериям доступности информации о деятельности учреждения и открытости управленческих решений [14, с. 19].

Интегральный показатель эффективности управления вырос с 68,4% в 2022 г. до 76,4% в 2024 г. Наиболее высокие показатели достигнуты в сфере качества образования (86%), наиболее низкие – в сфере материально-технического обеспечения (66%) [15, с. 52].

Выявление проблемных зон и потенциала для внедрения инноваций

На основе проведенного анализа выявлены системные проблемные зоны управления по пяти функциональным блокам [16, с. 63]:

1. Стратегическое управление: отсутствие детализированных «дорожных карт» развития, слабое использование проектных инструментов, отсутствие регулярного мониторинга внешней среды.

2. Управление качеством образования: формальный характер внутренней системы оценки качества образования, неиспользование системы сбалансированных показателей, отсутствие практики применения данных мониторинга для управленческих решений.

3. Управление персоналом: кадровое «старение», отсутствие действенной системы наставничества, низкая инновационная мотивация, дефицит цифровых компетенций (62% педагогов отметили недостаток цифровых навыков).

4. Административно-хозяйственное управление: бумажный документооборот, отсутствие современных информационных систем, неиспользование Lean-технологий.

5. Взаимодействие с родителями: преобладание традиционных форм, низкая эффективность управляющего совета, отсутствие партисипативных практик [17, с. 88].

Определены ключевые драйверы и барьеры внедрения инноваций. К драйверам отнесены: поддержка учредителя, высокий запрос родителей на цифровые сервисы (78%) и партисипативные практики (78%), рост внебюджетного финансирования, наличие квалифицированных кадров. К барьерам – недостаточное финансирование инноваций, кадровое «старение»,

дефицит цифровых компетенций, жесткость бюджетного законодательства [18, с. 35].

Интегральная оценка готовности учреждения к внедрению инноваций составляет 3,5 балла из 5 (средний уровень). Наиболее высокие оценки получены по кадровой готовности (4,0), наиболее низкие – по ресурсной готовности (3,0) [19, с. 47].

Матрица сопоставления проблемных зон и инновационных технологий

На основе теоретической классификации инновационных управленческих технологий и выявленных проблемных зон разработана матрица сопоставления, позволяющая адресно выбирать инструменты управленческого воздействия [20, с. 72]. Фрагмент матрицы представлен в таблице 1.

Таблица 1 – Матрица сопоставления проблемных зон управления и инновационных управленческих технологий

Проблемная зона управления	**Инновационные управленческие технологии**	**Рекомендуемый инструментарий**	**Приоритетность**
Стратегическое управление	Технологии стратегического и программно-целевого управления; проектный менеджмент	Разработка «дорожных карт» развития; создание проектных групп; внедрение бюджетирования, ориентированного на результат	Высокая
Управление качеством образования	Технологии управления качеством; система сбалансированных показателей	Внедрение ВСОКО на основе BSC; регулярные мониторинговые исследования	Высокая
Управление персоналом	Технологии управления человеческими ресурсами; наставничество	Создание системы наставничества; организация курсов повышения цифровой грамотности; внедрение цифровых портфолио	Высокая
Административно-хозяйственное управление	Технологии «бережливого производства»;	Оптимизация процессов питания и закупок на основе Lean-	Средняя

Проблемная зона управления	Инновационные управленческие технологии	Рекомендуемый инструментарий	Приоритетность
	цифровые платформы	технологий; внедрение электронного документооборота	
Взаимодействие с родителями	Технологии обратной связи; партисипативные технологии	Создание цифровой платформы для обратной связи; внедрение партисипативного бюджетирования	Высокая

Приоритетные направления внедрения инноваций

На основе выявленных проблемных зон, анализа потенциала и оценки готовности определены приоритетные направления внедрения инновационных управленческих технологий в ГБДОУ детский сад № 104 [21, с. 58]:

1. Внедрение проектного менеджмента в стратегическое управление. Разработка детализированных «дорожных карт» развития по каждому направлению с измеримыми показателями и сроками реализации. Создание проектных групп с четким распределением ответственности. Данное направление имеет высокую приоритетность, так как позволит повысить результативность стратегического планирования на 20–30%.

2. Модернизация системы управления качеством образования. Внедрение системы сбалансированных показателей на основе существующей ВСОКО. Оценка качества по четырем измерениям: удовлетворенность родителей, эффективность внутренних процессов, профессиональное развитие педагогов, финансово-экономическая эффективность.

3. Создание системы наставничества и повышения цифровой грамотности педагогов. Разработка Положения о наставничестве с четкими критериями эффективности. Организация системного повышения квалификации с акцентом на практическое применение цифровых инструментов. Внедрение цифровых портфолио педагогов.

4. Цифровизация административно-хозяйственных процессов. Внедрение электронного документооборота и автоматизированных систем учета ресурсов. Оптимизация процессов питания, закупок и документооборота на основе Lean-технологий. Данное направление позволит снизить бюрократическую нагрузку на управленческий персонал на 25–35%.

5. Развитие партисипативных практик взаимодействия с родителями. Создание цифровой платформы для обратной связи. Внедрение партисипативного бюджетирования, позволяющего родителям участвовать в

распределении части внебюджетных средств. Организация регулярных «родительских форумов» в онлайн-формате [22, с. 64].

Заключение

Проведенное исследование позволило сформулировать следующие выводы.

Научная новизна исследования состоит в следующем:

1. Уточнено содержание понятия «инновационные управленческие технологии в системе муниципальных учреждений образования» через выделение трех сущностных характеристик (инновационность, адаптированность, сохранение публичной миссии), что позволяет разграничить инновации и простую автоматизацию процессов управления.

2. Разработана трехуровневая таксономия инновационных управленческих технологий (макро-, мезо-, микроуровень), позволяющая систематизировать инновации по уровню их инициации и реализации.

3. Предложена многомерная классификация инновационных управленческих технологий применительно к дошкольным учреждениям по трем основаниям: функционально-содержательному, степени цифровизации и степени вовлеченности родителей.

4. Систематизированы институциональные барьеры и драйверы внедрения инноваций в деятельность муниципальных учреждений образования и обоснованы механизмы их преодоления (нормативное проектирование и пилотный режим).

5. На основе эмпирического анализа трех объектов исследования разработана матрица сопоставления проблемных зон управления и инновационных управленческих технологий, позволяющая перейти от общего теоретического описания к адресным практическим рекомендациям.

Теоретическое значение исследования заключается в развитии теоретико-методических основ управления муниципальными учреждениями образования через адаптацию и интеграцию современных концепций менеджмента (проектный менеджмент, Lean-технологии, партисипативное управление) применительно к специфике дошкольного образования. Полученные результаты дополняют теорию государственного и муниципального управления в части исследования механизмов и условий внедрения инноваций на локальном уровне.

Практическая значимость исследования состоит в том, что разработанные рекомендации могут быть использованы руководителями муниципальных дошкольных образовательных учреждений при планировании и внедрении инновационных технологий управления, в том числе при формировании программ развития, модернизации системы внутренней оценки качества образования, оптимизации административно-хозяйственных процессов и развитии взаимодействия с родителями.

Перспективы дальнейших научных разработок в данном направлении связаны с исследованием специфики внедрения инновационных управленческих технологий в учреждениях разного профиля

(комбинированного вида, с приоритетным осуществлением отдельных направлений развития воспитанников), а также с разработкой методик оценки эффективности внедрения инноваций в деятельность муниципальных образовательных организаций. Актуальным направлением является изучение влияния цифровизации управленческих процессов на качество образовательных услуг и удовлетворенность всех участников образовательных отношений.

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