THE ENVIRONMENTAL RISKS OF PESTICIDES IN AGRICULTURAL CROPS

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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.

References.

1. Environmental Research Letters. Human impact on ecosystems and environmental sustainability, 2021.
2. Environmental Science: Toward a Sustainable Future – Richard T. Wright, Dorothy F. Boorse. Boston: Pearson Education, 2017.
3. Food and Agriculture Organization. The State of the World's Land and Water Resources for Food and Agriculture. Rome, 2021.
4. Intergovernmental Panel on Climate Change. Climate Change 2022: Impacts, Adaptation and Vulnerability.

5. Nature Climate Change. Global environmental challenges and sustainable development strategies, 2022.
6. Nurillayev I. X. YIELD ELEMENTS OF SOME VEGETABLE CORN HYBRIDS // Экономика и социум. 2025. №9-2 (136). URL: https://cyberleninka.ru/article/n/yield-elements-of-some-vegetable-corn-hybrids (дата обращения: 03.03.2026).
7. Nurillayev I.X.. "GROWTH AND DEVELOPMENT OF SWEET MAIZE IN THE SOIL CLIMATE CONDITIONS OF THE SOUTHERN REGION" Экономика и социум, no. 3-2 (118), 2024, pp. 269-271.
8. Nurillayev I.X.. "GROWTH AND PRODUCTIVITY INDICATORS OF VEGETABLE (SWEET) MAIZE MEGATON F1 AND GOLD F1 HYBRIDS IN SOUTHERN REGIONS" Экономика и социум, no. 5-1 (120), 2024, pp. 583-587.
9. Principles of Environmental Science – William P. Cunningham, Mary Ann Cunningham. New York: McGraw-Hill Education, 2015.
10. Silent Spring – Rachel Carson. Boston: Houghton Mifflin, 1962.
11. The Sixth Extinction: An Unnatural History – Elizabeth Kolbert. New York: Henry Holt and Company, 2014.
12. United Nations Environment Programme. Global Environment Outlook Report. Nairobi, 2022.
13. World Health Organization. Environmental Pollution and Human Health Report. Geneva, 2021.