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EROSION ACTIVITY INDICATORS OF MIDDLE ZARAFSHAN BASIN RIVERS

Annotation: *The article identifies indicators of erosion activity of rivers and streams in the middle part of the Zarafshan River. For this purpose, the turbidity of river and stream water was calculated as the flow of sediments (in units of weight and volume), washing modulus and washing layer, erosion meter, etc. As a result, erosion processes were accelerated in Tusunsay, Omonqutansay and Urgutsay basins.*

Key words: *river basin, river, flow rate, water flow, turbidity, flow modulus, erosion meter.*

It is important to investigate water erosion from river basins and their products - the formation of suspended riverbeds. Research in this area has a key role in determining the laws of water erosion and the formation of riverbeds, in the design of water management systems and hydraulic structures, their effective operation. In this regard, it is important to study in depth the regime of suspended tributaries of the middle reaches of the Zarafshan River, to draw appropriate conclusions and develop the necessary recommendations in this regard. The first scientific and theoretical views on the study of water erosion processes in river basins were studied by B.V. Polyakov, K.S. Kabanova, N.I.

Makkaveev, V.L. Shuls, A.V. Karaushev, G.N. Khmaladze. Later researches in this direction were continued by O.P. Sheglova, Yu.N. Ivanov, H.M. Mahsudov, A.R. Rasulov, Z.S. Sirliboeva, F.H. Hikmatov and others. It should be noted that almost all of the above-named scientists have focused on assessing the suspension of large mountain rivers and the intensity of water erosion in their basins. More precisely, in these studies, the rivers that form directly in Uzbekistan and adjacent areas are relatively little studied. This situation requires the study of the problem associated with the formation of suspended sediments and the intensity of soil washing on the example of rivers and streams of the Republic, based on new hydrological data.

The main purpose of this work is to create conditions for maintaining the intensity of soil accumulation, i.e. erosion, under the waters of the Central Zarafshan basin of Uzbekistan.

Based on the purpose of the work, 7 hydrological posts were selected for observations on rivers in the Middle Zarafshan basin. Based on the data on water (Q) and suspended runoff (R) consumption observed at the selected hydrological posts, indicators such as turbidity, runoff volume, washout modulus, washout layer, erosion meter were determined for each river and river basin. The extreme, i.e., average, maximum, and minimum values of each indicator were calculated based on the data observed in 1961-2020.

Data on the selected hydrological monitoring sites for the study of the intensity of soil leaching from river basins are given in Table 1. It can be seen from this table that the largest of the average heights of the observed hydrological posts relative to sea level in the water and suspension runoff flows belong to Biglyarsoy (1340 m). Measurements of water consumption in this stream began in 1964 and continue to this day. At the Yangi-Akchob hydrological post of Biglyarsay, the discharge of suspended sediments was observed in 1974-2001.

In contrast, the most studied streams in the basin are the Utgutsoy and Biglyarsoy. Although the catchment area of these streams is not large, the

duration of the years in which water consumption was measured is more than 50 years, i.e., the measurement of water consumption in these streams began in 1950 and 1964 (Table 1).

The longest observed value of the consumption of suspended streams in the rivers and streams of the middle part of the Zarafshan River also belongs to the Karaogach (Mavlon) river, which collects water from an area of 34,7 km^2. Measurements of the consumption of suspended solids in the river were recorded during 1979-2016.

Table 1. Water and water floating consumption in rivers and streams in the middle part of the Zarafshan basin

№	River observation point	Years of observation			
		Q, water consumption	R, floating consumption	Number	
				Q	R
1	Urgutsoy – Urgut town	1950-89, 2006-2020	1966-1989	55	24
2	Omanqutansoy – Oman-Qutan village	1970-2020	1971-75, 1977-92	51	21
3	Oqdaryo–Ogaliq village	1985-2020	1985-2020	36	36
4	Tusunsoy – Qoraqiya village	1963-1990	1966-1975, 1977-1991	28	25
5	Qoraog'ash – Mavlon village	1978-2020	1979-2020	44	42
6	Maydon – Olmaota village	1982-2005	1983-2005	24	23
7	Viglyarsoy-Yangi-Oqshob village	1964-2020	1974-2001	57	28

The turbidity of river water (ρ, g/l) was calculated using the following expression based on the values of water consumption and suspended runoff measured in them:

$$\rho = \frac{R}{Q}$$

Turbidity flow values were determined in two different units of measurement:

a) in units of weight: $W_{RG} = 86,4 \cdot T \cdot R$, tons,

b) in the unit of volume:

$$W_{RV} = \frac{W_{RG}}{\gamma_R}$$

One of the main indicators of river erosion activity is the washing modulus (M_R, t/km^2), taking into account the basin area (F) $M_R = \frac{W_{RG}}{F}$ determined using the expression.

The modulus of leaching of soils from river basins (h_R, mm) was determined as follows:

$$h_R = \frac{W_{RV}}{F}$$

The determined values of the wash layer allowed to calculate the erosion meter (h_e, year) specific to each river basin using the following expression:

$$h_e = \frac{1,0\ m}{h_R}$$

The results of the calculations are summarized in the table 2.

Table 2. Indicators of erosion activity of the Middle Zarafshan rivers

№	River observation point	Values	Erosion activity indicators							
			Water consumption Q, m^3/s	Floating consumption, R, kg/s	Water turbidity, ρ, gr/l	Nutrients flow		Washing module $M_{R,\ t/km^2\ year}$	Washing layer $h_{R,\ mm}$	Erosion meter, $h_{e,\ year}$
						W_{RG}, 10^3 t	W_{RV}, 10^3 m^3			
1	Urgutsoy – Urgut town	max	1,34	0,510	0,384	16,08	10,72	641	0,427	2342
		min	0,031	0,002	0,065	0,063	0,042	2,51	0,0017	588235
		normal	0,386	0,106	0,275	3,343	2,229	133	0,089	11236
2	Omanqutansoy – Oman-Qutan village	max	1,99	1,20	0,603	37,84	25,23	655	0,436	2294
		min	0,190	0,007	0,037	0,221	0,147	3,82	0,0003	4000000
		normal	0,976	0,184	0,189	5,80	3,87	100	0,067	14925

3	Oqdaryo – Ogaliq village	Max min normal	3,04 0,373 1,03	0,310 0,003 0,081	0,102 0,008 0,079	9,77 0,095 2,55	6,51 0,063 1,70	138 1,34 35,97	0,092 0,001 0,024	10870 1000000 41667
4	Tusunsoy – Qoraqiya village	max min normal	7,9 0,70 1,56	42,0 0,004 2,11	5,32 0,006 1,53	1325 0,126 66,5	883 0,084 44,3	1484 0,141 74,5	0,989 0,0001 0,050	1011 10000000 20000
5	Qoraog'ash – Mavlon village	max min normal	0,945 0,062 0,301	0,113 0,001 0,027	0,120 0,016 0,090	3,56 0,032 0,851	2,37 0,021 0,567	103 0,922 24,5	0,068 0,001 0,016	14706 1000000 62500
6	Maydon – Olmaota village	max min normal	1,36 0,138 0,669	1,0 0,001 0,106	0,725 0,007 0,158	31,54 0,032 3,34	21,03 0,021 2,23	505 0,513 53,5	0,336 0,0003 0,036	2976 3333333 27778
7	Viglyarsoy – Yangi-Oqshob village	max min normal	2,25 0,110 0,601	0,370 0,001 0,040	0,164 0,009 0,067	11,7 0,032 1,260	7,80 0,021 0,840	65,0 0,178 7,00	0,043 0,0001 0,005	23256 10000000 200000

Note: Q - water consumption, R - Floating consumption, r - turbidity, M_R - washing module, h_R - washing layer, h_e - erosion meter.

As can be seen from the table, erosion processes are accelerated in the rivers Tusunsoy (Karakiya), Omanqutansoy (Omanqutan) and Urgutsay (Urgut). For example, the leaching modulus (M_R) determined for maximum values in Tusunsay is 1484 t/km^2, while in Omanqutansoy it is 655 t/km^2. According to these values of the wash modulus, the annual wash layer (h_R) from the river basins is 0,989 mm and 0,436 mm, respectively.

It is known that the average perennial water consumption in the Urgutsoy River in 1966-1989 was Q = 0,386 m^3/s, and the average perennial value of suspended sediment consumption was R = 0,106 kg/s. The washing modulus determined on the basis of these average perennial values of water and suspended runoff consumption observed in the river was M_R = 133 t/km^2·year. The mean perennial wash layer was h_R = 0,089 mm. The identified washout layer made it possible to calculate the average perennial erosion meter, and the average perennial erosion meter detected for this river basin was h_e = 11236

years. This means that the surface area of the Urgutsoy basin decreases by one meter on average during 11236 years.

The amount of erosion meter calculated on the basis of the maximum values of the tributaries of the Urgutsoy River is 2342 years, while the minimum value increases sharply to 588236 years.

Among all the studied rivers, the process of water erosion on the surface of the basin of the river Koksaroysay (Koksaroy) is relatively slow. It would take 249968 years for the surface of this river basin to fall by an average of one meter. The reason for this can be explained by the natural conditions of the river basin, more precisely by the geological structure, relief, soils and vegetation condition of the basin.

In summary, the modulus of soil leaching (M_R) from the catchment areas of the rivers of the Middle Zarafshan Basin varies from 7,0 to 133 t/km^2. According to these values, the washing layer (h_R) from the river basins has values in the range of 0,005 – 0,089 mm. It should be noted that these figures are preliminary results and require clarification in future studies, based on calculations performed on the basis of homogeneous hydrological series.

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