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Hydraulic Resources Generated in the Zarafshan River Basin and their Efficient Utilisation

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Abstract: This article describes the formation of water resources of the Zarafshan River basin in the mountainous and middle reaches of the Republic of Uzbekistan and its effective use. Proposals and recommendations for effective and rational use of the total amount of water formed in the basin are presented. For this purpose, the data of the average annual water consumption of the rivers of the upper and middle part of the studied river were used. Also, the rivers and streams of the Zarafshan basin were evaluated for the purpose of organizing efficient use of water resources in the oasis.

Key words: water consumption, quantity of flow, volume, water resources, hydrofoil, medium flow, irrigated land, canals, water distribution facility, anthropogenic factor.

The rivers of Central Asia, namely the Aral Sea basin and its water resources, represent a unified natural system based on their geographical position and hydrological features. Consequently, studying them on an administrative level, namely on the scale of the borders of certain states, becomes far more intricate. Currently, the prioritisation of these resources for the benefit of a distinct state situated in the same region, with a specific objective, also presents several social, economic, and political challenges. Furthermore, these ideas are equally applicable to the entire Zarafshan Basin [2].

Challenges in making accurate quantitative evaluations and efficiently utilising water resources in the rivers of the Zarafshan basin Schulz, V.L., Sheglova, O.P., Mashrapov, R.A., Ivanov, Yu.N., Siddikov, H.S., Sokolov, D.P., Nasirov, M.A., Rubinova, F.E., Chub, V.Y., Dukhovny, F.X.Encompassed in the research conducted by Khikmatov and other scholars. In contrast to the aforementioned research, the following paper addresses both theoretical and practical aspects of water resource conservation and their efficient utilisation. The initial focus is on the idea of "Water Resources" [4].

To ensure the preservation of river water resources and optimise their utilisation, it is necessary to understand the methods of water consumption in rivers. It is well recognised that all forms of water resourcs, particularly those found in rivers, are utilised in binary manners. The first phenomenon arises from natural determinants, observable in their natural state, while the second phenomenon arises from human economic activity, namely anthropogenic variables.

The natural depletion of water resources in rivers is illustrated by several phenomena: the infiltration of rivers into the sediment, evaporation from their water surfaces, transpiration from the vegetation in the riverbed and its banks, the retention of a specific quantity of water in the river during periods of high water levels and flooding, and so on.

The utilisation of river water resources, influenced by human economic activities, or anthropogenic forces, is attributed to their usage for irrigation, industries, drinking water provision, domestic and recreational reasons. The study of water resource usage influenced by anthropogenic phenomena is currently lacking in comprehensive research [6].

Under the prevailing circumstances of our nation, almost 90% of the water resources from rivers are allocated for irrigation. This expenditure will include the evaporated water from the surface of cultivable land, reservoirs, irrigation canals, collectors, and the accumulation of water in recently acquired lands, newly constructed reservoirs, collectors, and the collecting of backwater in natural

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wetlands.

Within its higher sections, the Zarafshan river has its source in the Zarafshan glacier, which is known as Mastchohdarya. The river becomes known as Zarafshan after it is interconnected by a left-flowing Fandarya near Ayniy settlement. The Zarafshan River converges with circa 200 tributaries in the hilly region. Most significant among these tributaries are the Mastchohdarya, the left-leaning Fandarya, Kishtutdarya, and Magiyondaryo. There is no ongoing tributary of the Zarafshan river beyond its passage through the town of Panjikent (Table 1) [7].

Table 1: Major hydrographic indicators of the major tributaries of the Zarafshan River in the mountainous massif

T/r	River-place of observation	Semolina procedure	L, km	F, km^2	$H_{o'rt}$, m	Q, m^3/s	M, $l/s \cdot km^2$
1	Zarafshan-Dupuli k.	1	877	10200	3100	152	14,9
2	Mastchohdarya-Dexauz q.	1.1a	200	780	3820	33,4	42,8
3	Mastchohdarya-Fandarya q.	1.1b	200	4650	3350	79,5	17,1
4	Surkhat-casting	1.1.1	20	104	3120	0,85	8,2
5	Zasuntaka-Zasun q.	1.1.2	14	34,7	2770	0,26	7,5
6	Fandario-casting	1.2.	24,5	3230	3270	62,7	19,4
7	Jagannobdarya-Takfon q.	1.2.1	120	1490	3350	31,9	21,4
8	Dijikrud-casting	1.2.1.1	17	112	3180	1,94	17,3
9	Pshanza-casting	1.2.1.2	9,2	79,2	3220	0,70	8,8
10	Iskandardarya-boshl.	1.2.2	20	760	3520	19,0	25,0
11	Hozarmech-Letovka q.	1.2.2.1	16	170	3660	4,07	23,,9
12	Saritog-casting	1.2.2.2	35	537	3480	13,8	25,7
13	Serima-casting	1.2.2.3	7,1	23,9	3400	0,33	13,8
14	Pasruddario-Pinion q.	1.2.3	30	340	3250	4,85	14,3
15	Kishtutdarya-Zerifshor q.	1.3	53	792	3010	7,32	9,25
16	Daryourech-Koyloli q.	1.3.1	24	162	2880	1,27	7,83
17	Sarikotonsoy-Yori q.	1.4	18	51,8	2090	0,50	9,65
18	Magiyondarya-Sujina q.	1.5	67	1100	2660	8,35	7,60

Under the name Mastchohdarya, the Zarafshan river begins in its higher sections from the Zarafshan glacier. The river becomes known as Zarafshan after it is interconnected by a left-flowing Fandarya near Ayniy settlement. The Zarafshan River converges with circa 200 tributaries in the hilly region. Most significant among these tributaries are the Mastchohdarya, the left-leaning Fandarya, Kishtutdarya, and Magiyondaryo. There is no ongoing tributary of the Zarafshan river beyond its passage through the town of Panjikent (Table 1) [7].

Table 1. Major tributaries of the Zarafshan River in the mountainous region and their primary hydrological parameters

Hydrometric analysis of rivers and streams in the Middle Zarafshan Basin reveals that the barrier river has a flow volume of 54.8 / 106 m3, the White River has a flow volume of 33.7 / 1 / 106 m3, the skyscraper has a flow volume of 30.3 / 106 m3, the Omonkotonsoy has a flow volume of 30.0 / 106 m3, and the Beglarsoy has a flow volume of 22.5 / 106 m3. The relative values of the flow indicators fall within the range of Omonqoatonsoy (M = 16.5 l/s km2), Urgutsoy (16.0 l/s km2), Oqdaryo (15.1 L/s km2), Sazagonsoy (14.2 L/s km2), and so on. These values correspond to the flow module and the highest influx of the flow layer. Within this particular region of the basin, The Blackout stands out as one of the most diminutive rivers in terms of both absolute and relative flow volumes. The river has an

annual flow volume of 7.25,000,000 cubic meters and a flow modulus of 1.92 litres per second per square kilometre (Table 2).

Table 2 Hydrometric study in the Middle Zarafshan Basin average perennial flow rates of rivers are

River post	F, km^2	H, km	Q, m^3/s	W, 10^6 m^3	M, $l/s \cdot km^2$	h, mm
Hydrometric studied						
Urgut-Urgut sh.	25,1	1,710	0,402	12,7	16,0	504
Omonkoton-Omonkoton q.	57,8	1,601	0,951	30,0	16,5	518
Oqdaryo-Oğalıq q.	70,9	1,384	1,07	33,7	15,1	475
Sazagansay-Sazagan q.	26,8	1,456	0,381	12,0	14,2	448
Qorasuv-Kosa q.	120	1,040	0,230	7,25	1,92	60
Tegermonsoy-Saghishmon q.	39,3	1,143	0,278	8,77	7,08	223
Cutter-casting	1100	0,940	1,74	54,8	1,58	50
Oqtepasoy-Ocha q.	43,8	1,570	0,304	9,58	6,94	219
Karagachsoy-Mavlon q.	34,7	1,257	0,227	7,13	6,53	206
Maordsoy-Almaty q.	62,5	1,138	0,488	15,4	7,80	246
Koksaroysoy-mountaineering	247	0,938	0,961	30,3	3,89	123
Beglarsoy - new Swan q.	180	-	0,714	22,5	3,97	125
Total:	2008		7,75	244,13	3,86	122
Hydrometric unexplored						
Oqsoy	30,1	1,200	0,142	4,460	4,70	148
Borgsøy	23,9	1,187	0,099	3,121	4,30	131
Langarsøy	41,2	0,950	0,035	1,102	0,85	27
Kattasoy	56,0	0,890	0,025	0,795	0,45	14
Sarmić	133	0,730	0,013	0,410	0,10	3
Total:	284	-	0,214	9,885	0,75	34
All:	2292	-	7.96	254	3,48	110

Considering that 95.3% of the primary section of the Zarafshan river stream emerges within the borders of Tajikistan, it is crucial to ensure efficient and focused allocation of its water among the four regions of both countries and our Republic. An objective of the first Gal is to assess the efficiency of irrigated arable land in the regions of the Republic that rely on the water from the Zarafshan River. Furthermore, it is imperative to carefully study the components of the water regime in the tributaries of the Zarafshan River and hydrological stations along its course, to methodically and accurately assess water usage in line with the present needs. For this reason, it is crucial to guarantee comprehensive and uninterrupted data on water use in the Zarafshan River, its major tributaries, hydroposts where consistent flow in the streams entering them is seen.

The adoption of the aforementioned measures will be essential to enhance the technical state of observation devices deployed at hydrological stations in the rivers and streams of the Zarafshan Basin and equip them with state-of-the-art measurement instruments. Based on our own observations, we have seen that the devices at hydrological posts are becoming outdated. In most instances, these devices do not meet the observation standards. Additionally, there have been instances of water level observation rails bending or falling, numbers written to obtain a count being discoloured, and other negative cases. Naturally, these factors contribute to inaccuracies in the process of measuring water, which is conducted in rivers, streams, and canals within the basin.

The consumption occurring in irrigation canals that transport water to the cultivable area in the Zarafshan basin, namely the inefficient use of water, may be categorised into four kind:

1. The costs incurred by major trunk channels;
2. Expenditures from inter-farm service channels;

3. Observed expenditures on farm channels;
4. Expenditures designated for irrigation of agricultural regions.

Extensive water loss caused by evaporation and absorption along the length of big trunk canals receiving water from the river is regularly observed. Initially, our attention will be directed towards the process of water absorption. Specifically, we aim to minimise the infiltration of water into the internal surfaces of the channels. To do this, we will apply different coatings (such as concrete or film) to the bottom of the channels. Furthermore, there exist excellent technical opportunities to enormously decrease the evaporation of running water from the surface in channels located in desert climatic areas characterised by high temperatures, such as the Zarafshan Basin. In light of the aforementioned, it is imperative to conduct these operations across all categories of channels. All these activities offer possibilities for the effective and logical utilisation of river water. A conclusion was reached by offering the following recommendations:

An analysis has been conducted on the allocation of water resources from the Zarafshan River between provinces and the efficient management of their utilisation. Drawing on the known data on the fluctuations in the water regime of the Zarafshan river due to human activities, the subsequent suggestions are put forward:

- The issues of increasing the accuracy of taking into account the amount of water taken into the trunk, Inter-farm and domestic channels under the control of the basin administration of Zarafshan irrigation systems also need to find a solution; - in all types of canals and reservoirs, the implementation of technical measures related to their absorption at the bottom and reducing the inefficient loss of river water to evaporation from their water surfaces also creates favorable conditions for saving the existing water resources of the Zarafshan basin rivers; - effective water distribution, in the sense of water economy, organization, requires that each province accurately take into account the areas of land irrigated from the water of the Zarafshan river every year, to clarify the standards of water laying and irrigation for each type of crop grown in them, as well as the water needs of other water consumers and water users; -Taking into account the further increase in the water deficit in the near future in the Zarafshan River Basin, it is necessary to rapidly expand the arable land, where irrigation drip, rain, water from under the soil and other modern innovative technologies are used.

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