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ISSUES OF EFFECTIVE USE OF WATER RESOURCES IN THE CONDITIONS OF CLIMATE CHANGE (ON THE EXAMPLE OF BUKHARA REGION)

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Abstract: As a result of climate change and anthropogenic factors, the areas subject to degradation are increasing. This article discusses the issues of irrigation of areas irrigated with collector-drainage waters in the Bukhara region and their use for salt leaching. The structure, main function, meliorative significance of the central collector-drainage systems in the region, as well as existing problems, are analyzed. In addition, considerations were made on the efficient use of water resources and ensuring ecological sustainability. The dynamics of changes in irrigated areas across districts were also highlighted.

Keywords: collector-drainage system, secondary use, brine washing, sewage, salinization, land reclamation, water resources, ecological safety.

Introduction. Currently, climate change processes are leading to an increase in ecological problems around the world. As a result of increasing air temperatures, decreasing precipitation, and frequent droughts, water resources are becoming increasingly scarce. Water is one of the most important natural resources for human life, agriculture, industry, and the environment, and its scarcity negatively affects economic and social stability. In many developed countries of the world, a lot of scientific research has been carried out to determine the quality of irrigation waters, the degree of mineralization, quantity, consumption and quality of collector-demand waters formed in irrigated areas. In our country, V.A. Dukhovny, S.I. Kharchenko, S.A. Muradov, V.I. It was reflected in the scientific research works of Sokolov and E.I. Chembarisov. Agriculture, the largest sector of the national economy of the republic, plays an important role in the development of the country's economy. After our republic gained independence, in order to develop this sector, special attention is paid to such urgent issues as ensuring the equal recognition of new forms of ownership.

The laws being adopted in our country, including the “Uzbekistan-2030” Strategy for the Development of the Republic of Uzbekistan, “Increasing the efficiency of irrigation systems and irrigation networks to 0.73 within the framework of a seven-year program to replace soil-covered canals with concrete lining and convert internal irrigation networks to closed pipe irrigation systems,” provide for the use of secondary water resources, i.e., collector-demand water. The issues of efficient use of water are taken into account.

By 2030, the population is expected to reach 40 million people, and under such conditions, the level of water scarcity could increase from 13-14% to 44-46%. Reuse of collector-drainage water, which stores tens of millions of liters of water, can help us as an additional source of irrigation.

Uzbekistan, especially the Bukhara oasis, is one of the regions most affected by climate change. Natural water resources in this region are limited, and the main water supply is dependent on transboundary rivers, groundwater, and artificial irrigation systems. For this reason, the issues

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of rational and efficient use of water resources, their conservation, and reuse are extremely relevant today. The annual decrease in irrigation water makes the reuse of collector-drainage water in agriculture (mixed with river water or in a ratio of 1/1 and 1/2) of great importance.

Bukhara region is one of the regions with developed irrigated agriculture. The natural climate in the region is dry, and the demand for irrigation water is very high. Excess water generated during irrigation and the rise of groundwater lead to soil salinization. Therefore, collector-discharge systems have been established in the region, among which inter-district (Northern, Central Bukhara, Oyakogitma) collector-discharge networks occupy a special place [5].

The object of the study is to determine the characteristics of the formation of water in the inter-district collector-sewers (Central Bukhara, Northern, Oyakogitma and others), the Amu-Bukhara Machine Canal and inter-farm collector-sewers in the region, the hydrological indicators of the collector-sewers in the cross-district, and their use as an additional water source.

Research results and their discussion. A collector-drainage network is an open channel or drainage pipe that receives water from the water-collecting part of the network and discharges it from the irrigated area. Collectors are divided into inter-district, inter-farm and intra-farm types. Usually collectors are laid in lowlands and along the borders of areas where agricultural crops are grown.

The hydrogeological and melioration conditions of irrigated areas in the region have their own characteristics and are as complex as in the southern regions of the republic. The hydrogeological and melioration conditions in the Bukhara region are complex, mainly due to the hydrological and hydrochemical regime of groundwater, and the fact that irrigated areas are located in the lower reaches of the Zarafshon River. 60 percent of the annual precipitation occurs from January to the end of April. A large part of the irrigated areas is formed by zavors and reservoirs. Currently, part of the zavor waters flows into the Amu Darya basin through the Parsankul zavor, the rest is discharged into the lowlands around the Bukhara oasis. As a result, more than 10 abandoned lakes have formed in the region.

When using mineralized collector-drainage waters for irrigation, the salts in the water have a certain negative effect on the plant, especially in its initial stages. In order to ensure moderate seedling density in irrigated areas, the planting rate is slightly higher than in the conditions of irrigation with river water. The irrigated areas of the Bukhara region are considered to have soils prone to salinization.

Table 1

Salinity of irrigated land in the districts of Bukhara region in 2024 (thousand ha)

t/r	Name of districts	Total irrigated area in thousand ha	Including this				
			Strongly salty gan thousand s.ga	Average salt content per thousand	Less salty gan thousand .ga	Total salted gan thousands	In the interest calculation
By region		274,61	6,11	57,70	170,47	234,28	85,3
1	Bukhara district	30,11	0,32	6,09	19,84	26,24	87,2
2	Wobkent	21,52	0,34	3,99	14,12	18,44	85,7

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3	Jandor	32,92	1,61	8,10	20,32	30,02	91,2
4	Kogon	18,77	0,31	3,53	11,90	15,74	83,8
5	Olot	21,52	0,94	3,96	3,96	17,60	81,8
6	Peshku	22,78	0,28	4,63	13,98	18,90	83,0
7	Ramitan	27,22	0,29	6,60	16,36	23,25	85,4
8	SHofirkon	28,35	0,69	7,31	25,8	24,86	87,7
9	Karakol	25,08	0,34	4,12	17,17	21,63	86,2
10	Qaravulbozor	19,29	0,08	3,45	17,9	14,97	77,6
11	G‘ijduvan	27,01	0,93	6,00	15,70	22,64	83,8

As a result of the studies, it was found that the total irrigated area in the region is 274.61 thousand hectares, of which 6.11 thousand hectares are highly saline, 57.70 thousand hectares are moderately saline, and 170.47 thousand hectares are slightly saline, for a total of 234.28 thousand hectares of land with varying degrees of salinity. In terms of districts, the irrigated areas of Jondor, Shofirkon, Kogon, and Karakul districts are saline to varying degrees.

To use collector-drainage waters, they must be transferred to the irrigation network using pumping stations. In this case, it is necessary to build a dam on the collector-drainage network and prevent the water from flowing into the fields, otherwise the activity of the drains will deteriorate and the level of septic water in the fields will rise [2].

The potential for using collector-demand waters is very large: the water flow in the North and South Bukhara collectors reaches 10-15 m3/sec. Thus, the widespread use of collector-demand waters for irrigation of crops creates favorable conditions for increasing water reserves and simultaneously developing new lands and improving their water supply.

In Bukhara region, the total length of collector-distributor networks in 2024 was 8851.60 km, and domestic household collectors were 4557.31 km. Nowadays, when there is a shortage of irrigation water and a noticeable need to increase the productivity of agricultural crops, it is very important for the Bukhara region to find scientifically based water reserves from irrigation water, reduce the mineralization of collector and aquifer waters, and use them in irrigated agriculture.

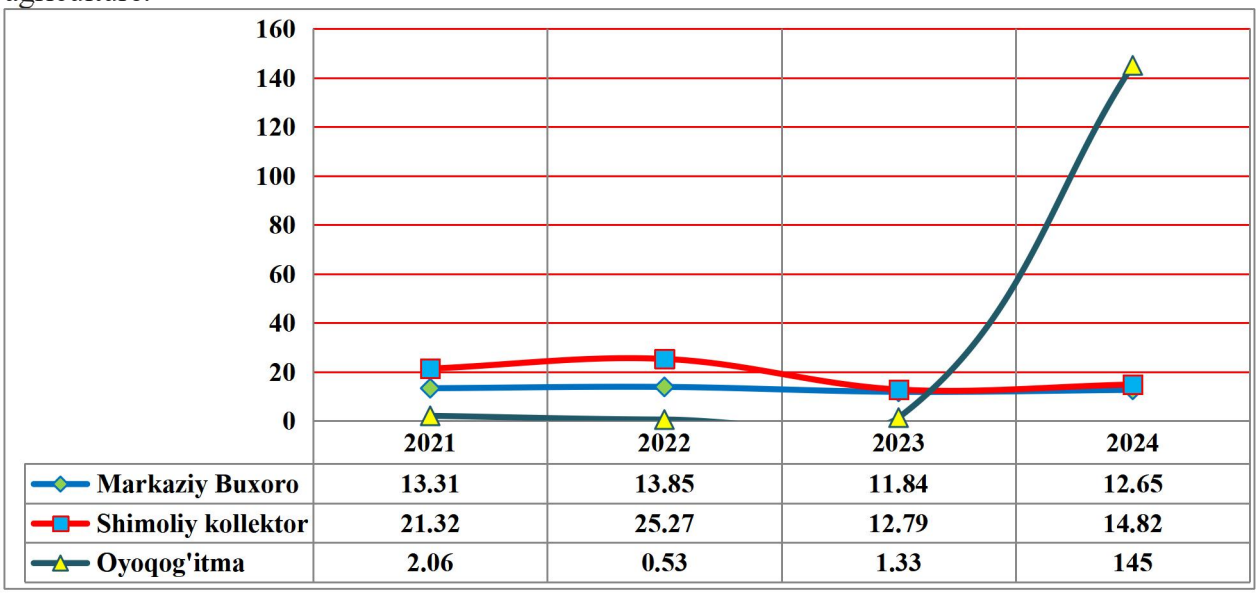

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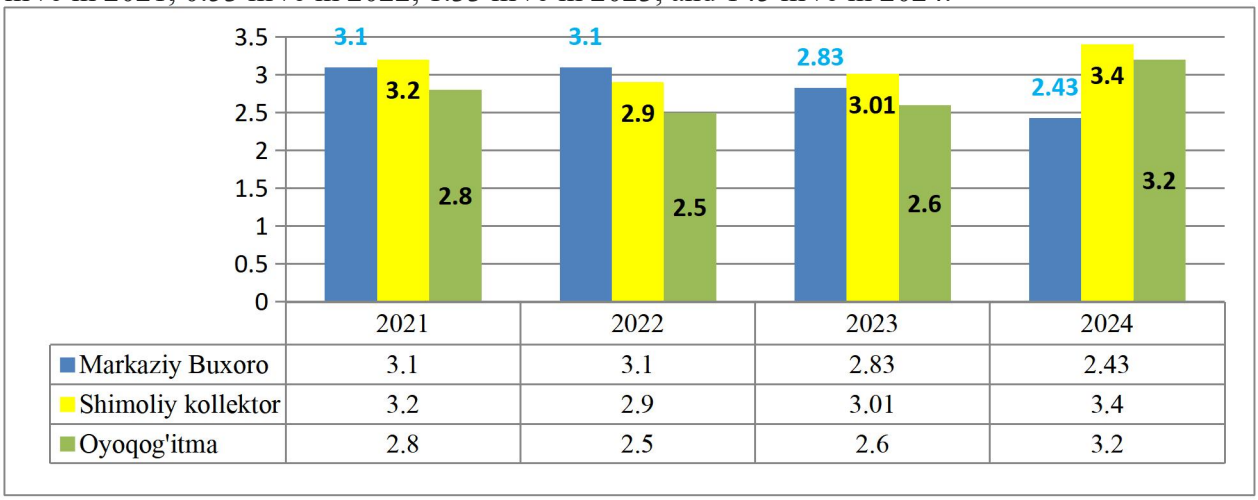
Figure 1. Water consumption levels of inter-district collector-drainage systems over the years

The data presented in this graph shows that the water consumption of the inter-district collectors-sinks in the region over the years is as follows. The Central Bukhara Collector-Sink will provide 13.31 m^3/s in 2021, 13.85 m^3/s in 2022, 11.84 m^3/s in 2023, and 12.65 m^3/s in 2024. The Northern collector produced 21.32 m^3/c, 25.27 m^3/c in 2022, 12.79 m^3/c in 2023, and 14.82 m^3/c in 2024. The water consumption of the Oyakogitma collector-drainage system was 2.06 m^3/c in 2021, 0.53 m^3/c in 2022, 1.33 m^3/c in 2023, and 145 m^3/c in 2024.



	2021	2022	2023	2024
Markaziy Buxoro	3.1	3.1	2.83	2.43
Shimoliy kollektor	3.2	2.9	3.01	3.4
Oyoqog'itma	2.8	2.5	2.6	3.2

Figure 2. Salinity levels of collectors-sediments

As you know, the diagram shows the salinity level of inter-district collector-sewage water, which shows the salinity level (g/l) of the Central Bukhara, Northern Collector, and Oyakogitma Collector-sewage water in 2021-2024. The salinity level in the Central Bukhara collector was 3.1 g/l in 2021-2022, decreased to 2.83 g/l in 2023, and dropped to 2.43 g/l in 2024.

This decrease indicates improved water quality and reduced salinity. The salinity level in the northern collector was 3.2 g/l in 2021, decreased slightly to 2.9 g/l in 2022, but increased further in subsequent years, reaching 3.4 g/l in 2024. This may be due to high evaporation in the area or a decrease in the efficiency of the drainage system.

The salinity level in the sewage collector-sewage water was 2.8 g/l in 2021, decreased to 2.5–2.6 g/l in 2022–2023, and increased to 3.2 g/l in 2024. This indicates that the salinity level has increased in these areas in recent years [6]. The water volume and salinity level of the sewage lakes in the region were also as follows.

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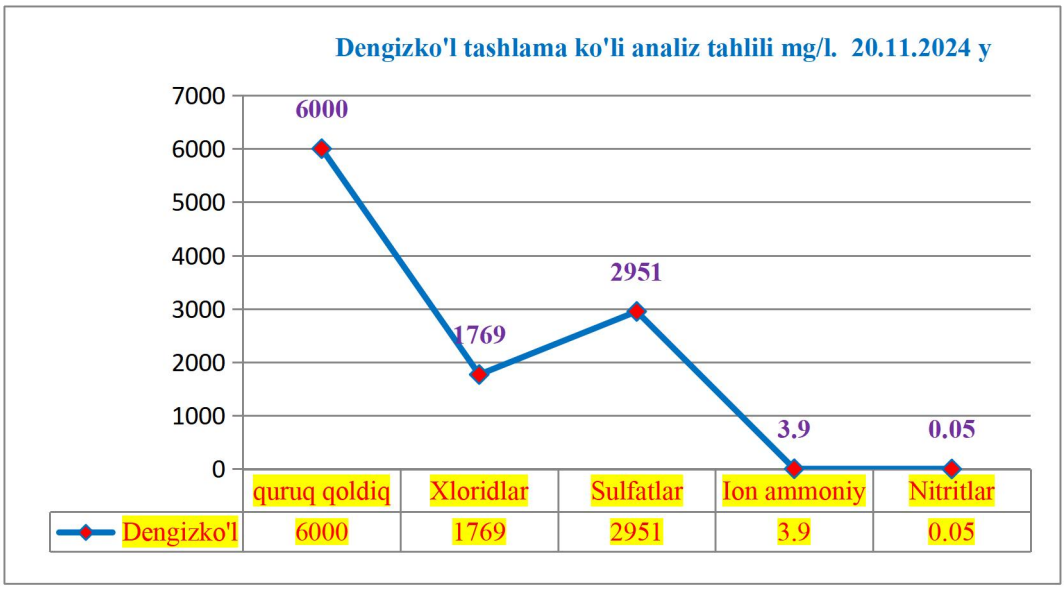

Figure 3. Analysis of the Dengizkul discharge lake in mg/l

The graph shows the concentrations of the main chemical substances in the water taken from the Dengizkul Tashlama Lake in mg/l. The dry residue is 6000 mg/l, which is the highest value. The dry residue is the sum of all mineral and organic substances that remain after the water evaporates. This indicator is considered high and indicates that the water is very salty. Usually, it should not exceed 1000 mg/l in drinking water. The amount of chlorides is also very high, indicating that the lake is highly mineralized. There are also a lot of sulfates, which confirms the high hardness and mineralization of the water in the lake. In conclusion, the mineralization of the Dengizkul Tashlama Lake is very high.

Conclusion.

1. The Northern Collector is a collector-discharge network of great importance in the water management of the Bukhara region. Its stable operation directly affects not only the efficiency of agriculture, but also the ecological balance of the entire region. Improving the technical condition of the collector, introducing a control system, and implementing water resource reuse technologies are among the most important tasks in the future.
2. The salinity level of water in the Central Bukhara collector-drainage has been decreasing year by year, which is a positive situation. On the contrary, the salinity level in the Northern collector and Oyakogitma collectors increased in 2024. This indicates the need to drain saline waters, improve the land reclamation situation, and effectively organize the water exchange system in these areas.

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