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MONITORING OF GROUNDWATER QUALITY CHANGES IN IRRIGATED LANDS OF KASHKADARYA REGION

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Abstract:
In this article, a comprehensive study of changes in the quality of groundwater in the irrigated lands of Kashkadarya region is conducted, with the main focus on the impact of cotton cultivation. During the research, changes in the groundwater level and salinity were monitored in Karshi, Qamashi and Kitab districts. Modern monitoring equipment, including an online monitoring system (Diver), has been launched for continuous data collection. The analysis reveals important insights into the condition of reclamation wells and the overall quality of groundwater in the region. It should be recognized that the water resources of Kashkadarya region are very unevenly distributed. The lack of water resources is certainly observed a lot at the district level, and their quality indicators are very important. In the article, the quality indicators of underground water in the irrigated lands of Kashkadarya region on the scale of districts, the quality indicators of underground water are determined based on the data obtained from observation wells. Groundwater was studied in a cross-sectional area and monitored in the example of Qamashi, Karshi, Kitab districts. Monitoring analysis of the surface water level indicators was carried out on the general areas, and in 45.47% of the areas, the surface water level corresponds to the range from 3 to 5 meters.

Keywords: Groundwater, water quality, salinity, monitoring, saturation, water mineralization, collector drains, groundwater level, water distribution, monitoring wells, water scarcity.

Introduction:

In the expansive region encompassing parts of the Amu Darya River Basin in Central Asia, as well as Afghanistan and the former Soviet republics of Tajikistan, Uzbekistan, and Turkmenistan, groundwater reservoirs are increasingly being explored as a viable alternative water source for sustaining irrigated agriculture and livestock [1,7]. This shift is particularly crucial during periods of recurring droughts and heightened contamination of surface water, primarily attributed to elevated levels of salts and pesticides stemming from extensive irrigation practices [2-4,8]. Given the unique climatic conditions, economic priorities, and geopolitical dynamics, Uzbekistan is witnessing intensifying competition for its water resources [5,9-10]. The country's drive to expand irrigated agricultural lands, notably in the often arid uplands, underscores its aspirations for economic development and integration into the global community. Cash crops like rice and wheat are cultivated to bolster internal food security while facilitating substantial exports, particularly of commodities such as cotton. In essence, Uzbekistan's strategic focus on agricultural expansion and diversification reflects its ambition to address domestic needs while capitalizing on opportunities for international trade, amid growing pressures on water resources and environmental sustainability [1,11-13].

Kashkadarya region, famous for its cotton production, has problems maintaining groundwater quality due to extensive agricultural practices [6,14-18]. This study aims to analyze changes in groundwater quality, focusing on changes in groundwater levels and salinity during cotton planting. Monitoring was conducted across Karshi, Qamashi and Kitab districts, using modern equipment to ensure accurate data collection. The findings shed light on the impact of agricultural activities on groundwater resources and provide insight into sustainable water management practices [19-20].

The situation with water shortage in our region is getting more complicated year by year. In the last 10 years, for example, the volume of water in Uzbekistan has decreased by 12%, compared to last year, this year by 15%. Conditions have been created for the introduction of water-saving technologies and the use of water-saving technologies for various plants in our republic [21-23].

Methods

The paper uses field research methods, analysis of system data, and common methods of soil survey and chemical analysis of groundwater and surface water.

Objects and subject of research:

Analysis of groundwater quality in the irrigated lands of Karshi, Qamashi and Kitab districts of Kashkadarya region.

Results and discussions

The study focused on changes in the quality of underground water in the irrigated lands of Kashkadarya region, in particular, in the areas where cotton is planted. Modern monitoring equipment, including an online monitoring system (Diver), was installed in selected monitoring wells during the research. Fluctuations in groundwater levels and salinities were continuously measured and recorded throughout the study period. Surface water level indicators were also analyzed to estimate total water availability in the region. Data analysis involves statistical methods and graphical representation to identify trends and patterns.

During the period of cotton cultivation in the experimental plot in Karshi, Qamashi and Kitab districts of Kashkadarya region, changes in the level and salinity of underground water were monitored. The condition of reclamation wells in these areas was studied. During the study, the total number of observation wells in Kashkadarya region in 2021 was 3,537 and in 2022 was 3,589, of which 3,309 are observation wells and 228 are double pressure gauges in 2021. In 2022, the number of monitoring wells is 3,361, and the number of double pressure gauges is 228. During 2021-2022, modern monitoring equipment was installed in the regions, which allows to receive data directly and continuously, and an online monitoring system (Diver) was installed from them. The number of wells with an online monitoring system (Dyver) was 81 in 2021, and increased to 146 in 2022, and their number reached a total of 227. Of these observation wells, 20 in 2021 and 31 in 2022 were made in Karshi district. It was 50 in Kamasi district. In the Kasbi district, 4 in 2021, and 21 in 2022. It can be seen that compared to the previous year, our possibilities of online data processing from our on-site reclamation monitoring wells are increasing.

Picture-2. Smart meter in monitoring well

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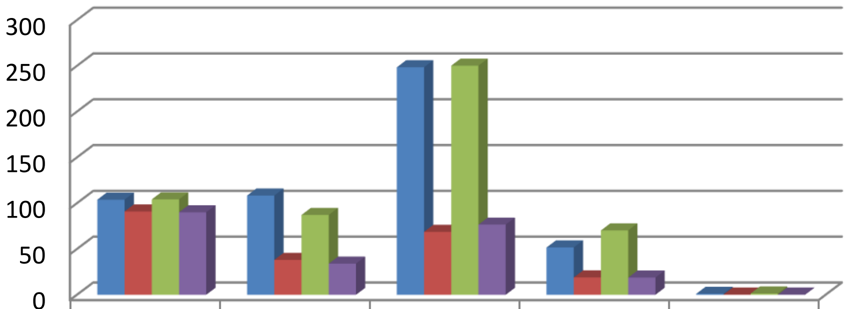
Division of groundwater into areas according to salinity level.

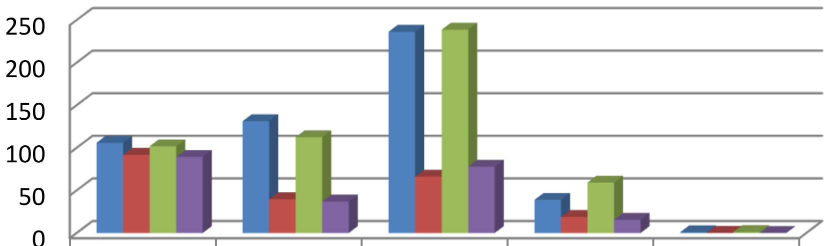


	0-1 up to g/l	1-3 up to g/l	3-5 up to g/l	5-10 up to g/l	>10 g/l
2021 irrigated fields	103.84	108.4	248.43	51.67	1.11
2021 of which the fields without ditches.	91.01	38.06	68.68	18.93	0.22
2022 irrigated fields	104.14	87.22	250.18	70.34	1.45
2022 of which the fields without ditches.	90.07	34.02	76.64	18.79	0.2

1-Graph Division of groundwater into areas according to salinity level. Kashkadarya region in 1-October, 2021-2022

Monitoring analysis of the surface water level indicators was carried out on the general areas, and in 45.47% of the areas, the surface water level corresponds to the range from 3 to 5 meters.

Division of groundwater into areas according to salinity level.



	0-1 up to g/l	1-3 up to g/l	3-5 up to g/l	5-10 up to g/l	>10 g/l
2021 irrigated fields	105.93	131.32	236.32	38.9	0.98
2021 of which the fields without ditches.	91.88	39.69	66.21	18.96	0.16
2022 irrigated fields	101.8	112.47	238.7	59.2	1.16
2022 of which the fields without ditches.	89.29	37	77.86	15.49	0.08

2-Graph Division of groundwater into areas according to salinity level. Kashkadarya region in 1- july, 2021-2022

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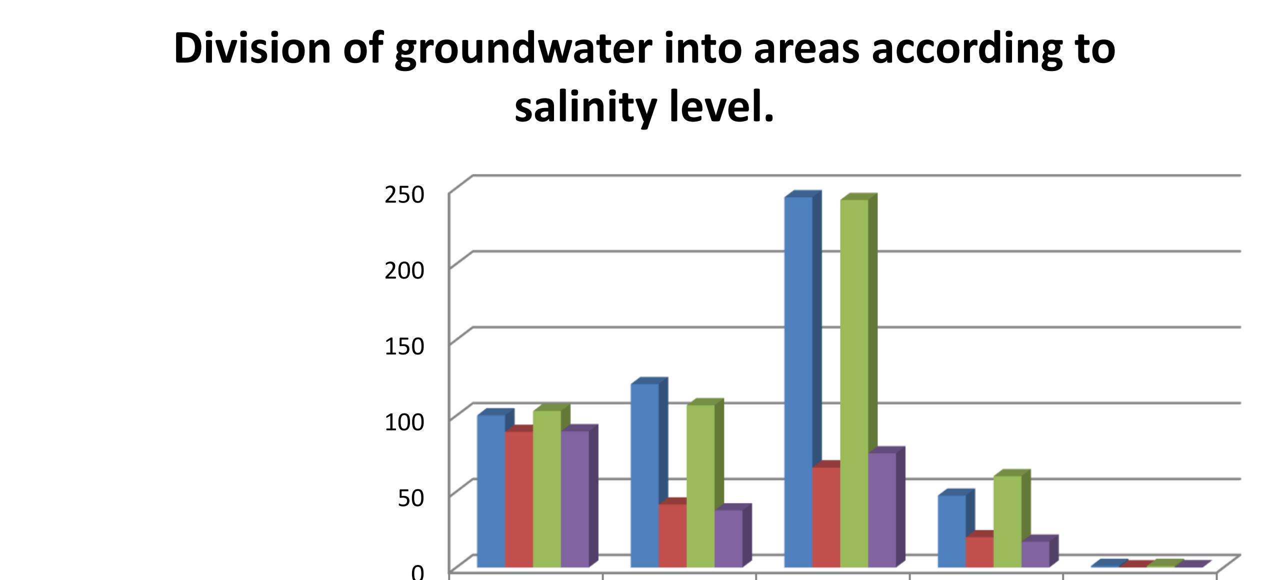

	0-1 up to g/l	1-3 up to g/l	3-5 up to g/l	5-10 up to g/l	>10 g/l
2021 irrigated fields	100.3	120.8	243.91	47.37	1.07
2021 of which the fields without ditches.	89.38	41.49	65.96	19.96	0.11
2022 irrigated fields	103.09	106.89	242.14	60.18	1.03
2022 of which the fields without ditches.	89.73	37.63	75.22	16.98	0.16

3-Graph Division of groundwater into areas according to salinity level. Kashkadarya region in 1- april, 2021-2022

Based on these 3 months of observations, it is possible to see the change in the salinity level of underground water. Based on these observations, it is possible to study the quality of groundwater before and after irrigation in irrigated lands.As a result of the analysis of the average vegetation state, changes in the level of runoff and mineralization of irrigated land areas in Kashkadarya region were determined. Table 1 provides insights into the average growing season and associated groundwater quality indicators for 2021-2022.

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Table 1: The average vegetation period on the level of seepage water and the level of mineralization of irrigated land areas in Kashkadarya region in 2021-2022

№	Districts	Years	indicators	total	This is the area under surveillance	Division of the water surface into areas according to the depth						Division of underground water into areas according to the degree of mineralization				
						0-1 up to a meter	1-1,5 up to a meter	1,5-2 up to a meter	2-3 up to a meter	3-5 up to a meter	>5 метр	0-1 up to a meter	1-1,5 up to a meter	1,5-2 up to a meter	2-3 up to a meter	3-5 up to a meter
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
2	Karshi	2021	irrigated fields	50,36	50,36		0,01	0,27	14,61	33,73	1,74	0,45	26,47	19,31	3,94	0,19
			of which the fields without ditches.	16,19				0,15	3,49	11,87	0,68	0,07	9,03	6,49	0,56	0,04
		2022	irrigated fields	50,32	50,32		0,01	0,26	6,82	40,86	2,37	0,13	24,63	20,01	5,35	0,20
			of which the fields without ditches.	16,08	16,08			0,15	2,87	12,07	0,99	0,07	8,40	7,39	0,22	
4	Kitob	2021	irrigated fields	20,28	11,17		0,05	0,20	4,15	6,18	9,70	20,28				
			of which the fields without ditches.	18,80				0,01	3,41	5,88	9,50	18,80				
		2022	irrigated fields	20,28	20,28		0,02	0,02	4,08	6,51	9,65	20,28				
			of which the fields without ditches.	17,22	17,22				3,54	5,66	8,02	17,22				
5	Kamashi	2021	irrigated fields	34,84	32,95			0,07	10,30	14,63	9,84	10,68	9,69	5,70	8,68	0,09
			of which the fields without ditches.	14,69					0,73	7,55	6,41	7,32	6,57	0,75	0,05	
		2022	irrigated fields	34,84	34,84			0,01	4,83	18,17	11,83	10,16	8,60	16,08		
			of which the fields without ditches.	14,45	14,45				0,58	7,14	6,73	8,08	5,73	0,64		

The results of the analysis of the distribution of irrigated cropland in the Kashkadarya river basin according to the level of mineralization of underground seepage water in 49% of the irrigated areas (24,630 ha) in Karshi district, the level of mineralization of underground seepage water is in the range of 1-3 g/l, in 40% of 3-5 g /l showed 5 - 10 g/l in 11%.

In 30% of the irrigated areas of Qamashi district, the level of mineralization of groundwater is 0-1 g/l, in 27% it is 1-3 g/l, in 16% it is 3-5 g/l, in 25% it is 5-10 g/l and in the remaining 2% it was more than 10 g/l.

In almost all (100%) of the irrigated areas of Kitab District, the level of mineralization of groundwater did not exceed 0-1 g/l.

Analysis of the data on changes in groundwater levels in irrigated agricultural fields in the Kashkadarya river basin during the year. 5 meters, in cultivated fields of Kitab district, it showed a change at a depth of 2.7 - 3.6 meters from the surface of the earth (Table 2).

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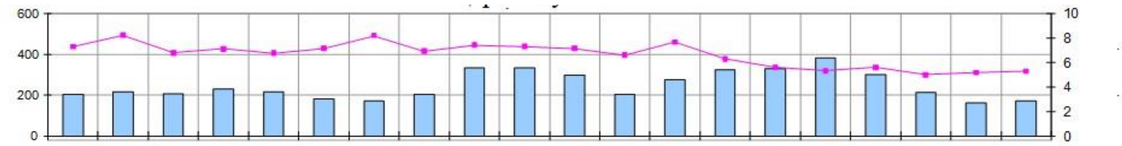
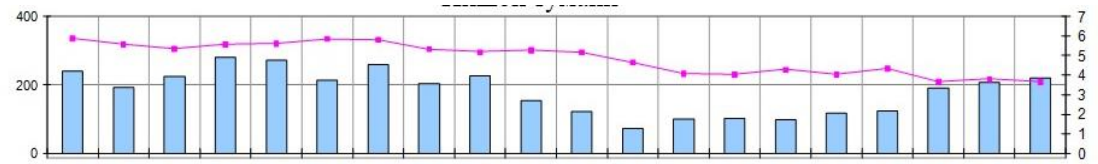
Table 2. Year-round changes in groundwater levels in irrigated croplands in the Kashkadarya River basin.

The district where the experimental site is located	Change of ground water level during months, sm												average annual, sm
	jan	fev	mar	apr	may	yun	yul	avg	sen	okt	nov	dec	
Karshi	365	377	361	343	341	341	338	343	356	371	375	374	**357**
Kamashi	353	336	340	358	362	349	351	346	365	372	375	446	**363**
Kitob	321	333	289	266	271	293	293	340	349	360	348	360	**319**

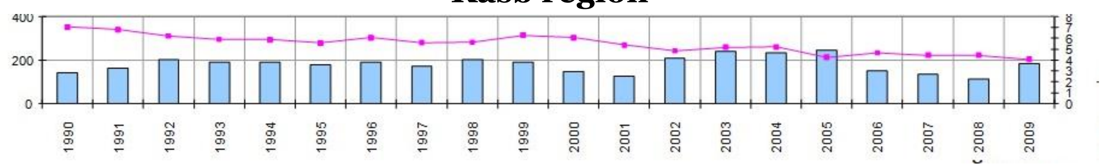
Karshi region



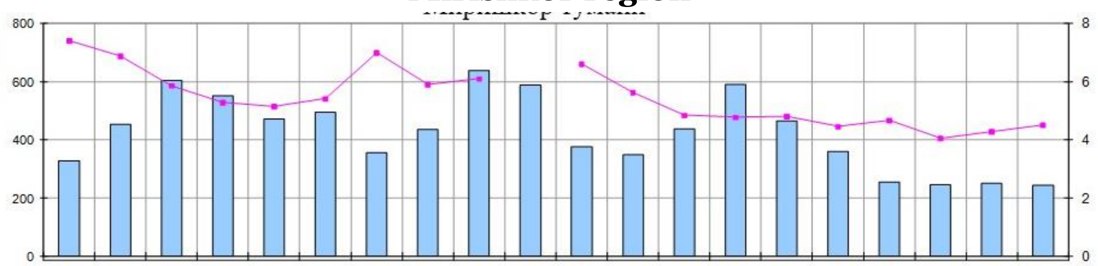
Nishon region



Kasb region



Mirishkor region



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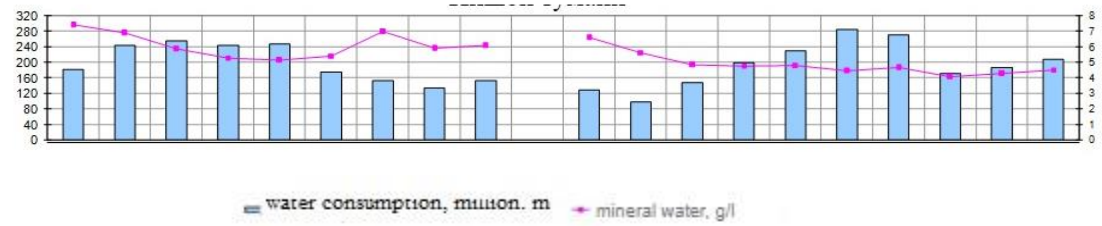
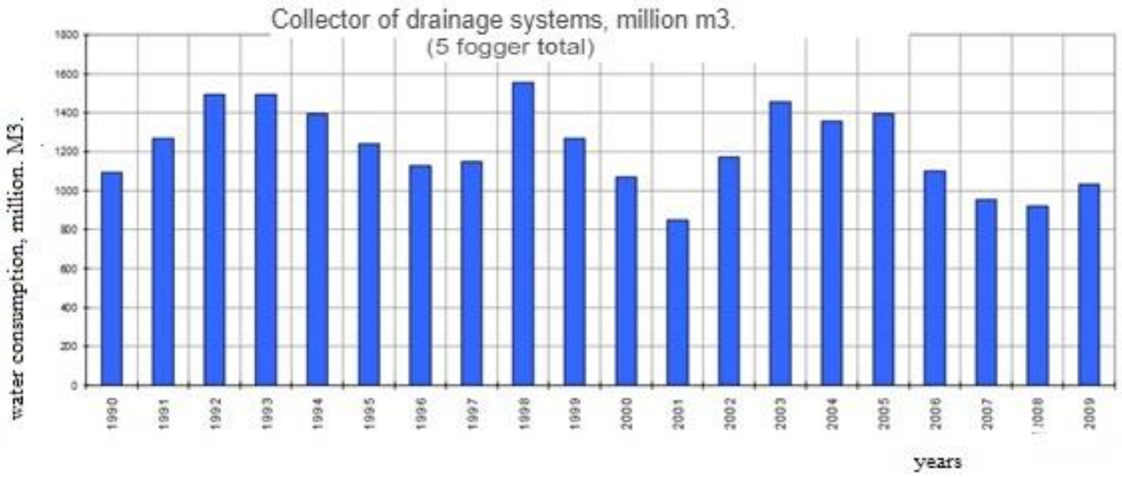
Nishon region





1. Graph. Water consumption of collector-drainage systems and water salinity in them

In 30% of the irrigated areas of Qamashi district, the level of mineralization of groundwater is 0-1 g/l, in 27% it is 1-3 g/l, in 16% it is 3-5 g/l, in 25% it is 5-10 g/l and in the remaining 2% it was more than 10 g/l.

In almost all (100%) of the irrigated areas of Kitab district, the level of mineralization of groundwater does not exceed 0 - 1 g/l (Table 3).

Table 2 Levels of mineralization of groundwater seepage of irrigated croplands in the Kashkadarya river basin.

The district where the experimental site is located	Total irrigated area, thousand hectares	The share of irrigated areas according to the mineralization of groundwater, thousand hectares				
		0 - 1	1 - 3	3 - 5	5 - 10	> 10
Karshi	50,3	0,13	24,63	20,01	5,35	0,20
Kamashi	34,84	10,68	9,69	5,70	8,68	0,09

The productivity of crops grown in the irrigated fields of the Kashkadarya river basin was carried out based on the assessment of the productivity of the main crop grown in the area - cotton. Results of data analysis on cotton productivity: 52,465 tons of raw cotton are grown on 15,000 hectares of irrigated land in Karshi district, with an average yield of 35 t/ha. It was found that it was 32 ts/ha (Table 3).

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Table 3 Gross yield and productivity indicators of cotton grown in irrigated fields in the Kashkadarya basin

Districts	Cotton area, hectares	Gross yield, tons	Cotton yield	
			centner hectare	tons per hectare
Karshi	15000	52465	34,98	3,5
Kamashi	9000	28454	31,62	3,2

At the same time, it should be noted that Kitab District, where one of the experimental plots is located, has not grown cotton and its productivity has not been determined.
During the cultivation of cotton plants in our research area, all observations were made from seed sowing to harvest. During planting, agrotechnical activities, underground and surface water quality indicators were studied. Continuous phenological observations were made during crop growth. Based on all the experiences, it can be said that when watering the plant, it is necessary to pay great attention to the water quality indicators, to observe the indicators of the underground water level, and to determine the effect on the plant and the soil. We even observed that the temperature of the water supplied to the crops has a significant effect on the productivity.

Conclusion:
The study underscores the importance of monitoring groundwater quality in irrigated lands, particularly in regions with intensive agricultural activities like cotton cultivation. The findings highlight significant variations in groundwater level and salinity, emphasizing the need for sustainable water management practices. The installation of modern monitoring equipment, including online monitoring systems, enhances data collection capabilities and facilitates informed decision-making for resource management. Addressing groundwater quality challenges requires collaborative efforts among stakeholders, including farmers, policymakers, and environmental agencies, to ensure the long-term sustainability of water resources in the Kashkadarya region.
The reclamation condition of more than half (57%) of the irrigated cropland in the Kashkadarya river basin, especially in Karshi and Kamashi districts, and all (100%) of the irrigated land in Kitab district was assessed as good.
The saturation of the underground water is mainly due to the absorption of water from the gravel part of the cone-outlet of Guzordarya and from the Kashkadarya river and large canals such as Fayzabad, Qamashi, Denov, Beshkent. The source of saturation of groundwater in areas close to the surface of the earth is due to atmospheric precipitation and absorption of water used for irrigation in irrigated areas. Groundwater is mainly discharged for underground flow towards the modern valley of Amudarya, where there is a regional flow of groundwater in most of the area. Also, seepage waters are consumed as a result of evaporation and transpiration processes in Charag'il lowlands and places

close to seepage waters. The degree of mineralization of groundwater is very diverse, its density varies from 0.5 to 30 g/l and reaches 50.78 g/l in the area of saline lowlands.

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