 https://doi.org/10.1051/e3sconf/202339004042

The usage of ditch water for irrigation

Ismayil J. Khudaev*, and *Rustam* Temirov

Bukhara Institute of Natural Resources Management "Tashkent Institute of Irrigation and Agricultural Mechanization Engineers" National Research University, Gazli ave. 32, Bukhara City, 200100, Uzbekistan

Abstract. The paper gives recommendations on the use of mineralized collector water as an additional water resource reserve. The introduction of elements of irrigation techniques are developed taking into account the mechanical composition of the soil, the regime of seepage water and the slope of the field. The results of the research made it possible to save up to 15% of irrigation water. In the period of water shortage, the technology of using mineralized collector water with ditch water was used on cotton fields. As a result of using collector water as an additional source of water in farm fields it was possible to save river water by 50%.

1 Introduction

In the world, the problem of global climate change is urgent on the agenda of mankind, and it is not only the average annual temperature increase on our planet, but also the change of the entire geosystem, the rise of the world ocean, the melting of ice and permanent glaciers, the increase of uneven precipitation, the change of the river flow regime, the water shortage. and other changes associated with climate change. Jakhan agriculture uses 2.8 thousand km^3 of fresh water per year. This is 70% of the world's freshwater consumption, or 7 times more than the water used by global industry [1-5]. Almost all of this water is used to irrigate crops [6-9]. In this regard, it is important to study the processes of climate change and increasing water scarcity.

In the context of the increasing shortage of water resources in the world, in developed countries such as the USA, Australia, Israel, Russia, China and India, it is necessary to drastically increase the efficiency of water use in agriculture, to develop irrigation methods for agricultural crops, to develop water-saving irrigation technologies, to use natural irrigation methods and technologies special attention is being paid to carrying out large-scale scientific and research works on zoning according to economic conditions, determining the elements of optimal irrigation techniques, etc [10-18].

One of the important tasks is to carry out research and development activities aimed at modernizing irrigation with resource-efficient techniques and technologies for effective use of land and water resources in our republic during the period of water resource shortage. In the Strategy of Actions for further development of the Republic of Uzbekistan in 2017-2021, including "...to reduce the consumption of energy and resources to increase the competitiveness of the national economy, develop networks of land reclamation and

* Corresponding author: fazliyev1990@mail.ru

irrigation facilities, wide implementation of resource-saving technologies in production" and the implementation of water-saving technologies in the cultivation of agricultural crops based on the decision of the President of the Republic of Uzbekistan dated December 11, 2020 "On measures to accelerate the introduction of water-saving technologies in agriculture" №. PQ-4919 tasks are defined. It is important to develop water - saving irrigation technologies on contoured, discrete, mechanical soils in order to carry out these tasks, including the effective use of irrigation water in mountain areas of Kashkadarya region, eliminate the process of irrigation erosion, uniform distribution of moisture along the length of the furrow, and reduce the consumption of throwing water.

It is known that as a result of the evaporation of seepage water from the surface of the earth through soil capillaries, salt accumulates in the soil. This, in turn, causes a violation of the chemical composition and structure of the soil, which endangers the development of plants. Collectors reduce the harmful effects of salts by removing them from the soil [20-27].

2 Materials and methods

Systematic analysis, calculation of water-salt balances, methods of mathematical modeling of experiments, laboratory and field studies and phenological observations were used in the research process. From "Methods of conducting field experiments" (UzPITI, 2007) of the Scientific-Research Institute of Agricultural Technologies of Cotton Selection and Seed Cultivation, elements of irrigation techniques. the methods accepted in ISMITI (SANIIRI) were used in the determination, as well as the method of B.A. Dospekhov in the mathematical-statistical analysis of the obtained data.

3 Results and discussion

In the years of drought, the shortage of irrigation water makes it necessary for farmers and peasants to use mineralized collector water. This situation is complicated by the outdated and in need of reconstruction collector-ditch system. It is also possible to observe such an unfavorable water-salt balance in the desert lands and to face a significant loss of the crop.

It was found out by our scientists that irrigation with water with a mineral content of 3-3.5 g/l causes soil degradation and a sharp decrease in cotton productivity due to the accumulation of salt. At the same time, in experiments conducted by ISMITI, PSUEAITI, ToshSAU and other researchers, it was shown that it is possible to mix the collector water with river water in the amount of 3.2 g/l for irrigation.

Accordingly, it is natural that farmers and peasants will be interested in the question of the concentration of mixing of collector water with fresh water of the river. They should know that when using these waters of different quality for irrigation of cotton, the composition will not harm the plant and will not reduce the fertility of the soil.

In the Kashkadarya region, there is also a way to return the collector water from the beginning to the end of the river. Table 4.1 provides information on the formation, distribution, and mineralized flow of collector-ditch waters (KZS) in the region in recent years.

The performed analyzes show that the total volume of returned water in Kashkadarya region increased from 1722 to 2340 million m3 per year, and the flow of salt increased from 11.64 to 16.61 million tons. The flow of the KZS and the volume of salts are distributed as follows: the volume returned to the Amudarya increased from 654 to 800 million m3, and salts increased from 4.3 to 5.68 million tons per year, which is 34-39% of the total volume.

The collector-ditch water flows into the lowlands from 1068 to 1540 million m3 and 7.2-10.9 million tons of salts are released with them, which is 61-64% of the total flow. In the following years, the volume of KZS was 1,293 million m3, of which 430 million m3 of water and 1,760,000 tons of salt are transported to the river. In the years when water is scarce, KZS is used in a volume of 1-5% within the contour.

The large amount of highly mineralized KZS returned to the river was the main reason for the deterioration of the water quality of the Amudarya River, but this route provided an opportunity to obtain a certain amount of water resources in the river bed.

At the same time, a significant part of KZS (61-64%) is transported to the lowlands of the desert, where they are used for evaporation and filtration. At the same time, it is worth noting that in the conditions of extreme shortage of water resources in the middle reaches of the Amudarya basin, in the summer months of water shortage years in the irrigated lands of Kashkadarya region, the water supply does not exceed 57-60% of the set limit, the use of a part of the flow of KZS in their formation is necessary for the irrigation of agricultural crops. provides an opportunity to alleviate the lack of supply.

The use of KZS in irrigated agriculture is practically not widely used in large areas of Kashkadarya region. The volumes of the ditch water flow are set in the following sequence:

- suitability of ditch water quality is determined from the point of view of their use for irrigation of agricultural crops and washing of saline land;
- assessment of the types and areas of distribution of light soils according to the mechanical composition best suited for harmless use of ditch water for agricultural production is carried out;
- on the example of the design and application section, on-site research on the use of collector-ditch water is carried out.

In world practice, a lot of experience has been accumulated in evaluating the suitability of collector water for irrigating agricultural crops, releasing water to pastures, building fish farm ponds, etc. Such countries include the United States, Israel, Mexico, Egypt, Pakistan, India, China, and others.

Considerable experience in assessing the suitability of mineralized ditch water for reuse has been collected and summarized in numerous published works of our country and foreign researchers.

According to scientists, the permissible levels of mineralization of water for irrigation vary from 1 to 8 g/l, and from 12 to 16 g/l for washing saline lands.

Despite such a big difference in the opinions of experts about the possible limits of the mineralization of collector water, in general, they show that it is possible to reuse collector water, taking into account the specific natural and economic conditions of the objects.

The surface water resources of the Kashkadarya basin consist of the sum of water flows from rivers and tributaries such as Kashkadarya, Jinnidarya, Karasuv, Shurobsoy, Tankhazdarya, Yakkabog, Turnabulok, Chuldaryo, Jara.

The length of the Kashkadarya is 310 km, the catchment area is 8780 km2, the largest water consumption occurs in April, and the least in late summer and early autumn.

Average water resources for many years are 1.11 km^3 per year and water consumption is 35.2 m3/c.

Development and irrigation of the lands of the Karshi desert began in the 60s of the last century, and in a short period of time, the Karshi main canal (KMC) consisting of 7 pumping stations with a length of 178 km and a total installed capacity of 450 thousand kW was completed. Talimarjon reservoir with a capacity of 1.55 km^2 was built at the junction of the main and working parts of KMC

The main part of KMC is 78 km long and takes 175 m^3/c of water from Amudarya with 7 pumping stations and raises it to a height of 132.2 m. The 72 km long working part of KMC starts from the Talimarjan reservoir and continues to the Kashkadarya river according to the 1st order project. It will continue for another 28 km in the development of land in the 2nd phase project of KMC. Estimated water consumption at the beginning of the working part is 350 m3/c and at the junction with the Kashkadarya river - 205 m3/c.

Nowadays the available water resources of Kashkadarya region are collected from underground and collector-source waters of Amudarya, Zarafshan and local rivers (Table 1).

Table 1. Estimated available water resources of Kashkadarya region, mln. m^3/year.

Taking water from rivers			**Use of underground water**	**Using the collector current**	**Available water resources**
Main	**small river from**	**Total**			
4566	1739	6305	157	313	6775

Water intake from large rivers is 4566 million m3 per year, from small rivers - 1739 million m3, a total of 6305 million m^3, underground water reserves - 157 million m^3, intake from collector water - 313 million m^3, the total amount of water resources is 6775 mln.m^3 per year, and Table 1 shows the resources of underground water.

The natural resources of underground water in Kashkadarya hydrogeological region are 0.66 km3 or 1797 thousand m3/daily.

Territorial operational reserves of nourished groundwater are determined in the amount of 0.63 km3 (1722 thousand m3/daily), of which the fresh groundwater with mineralization up to 1.0 g/l is 0.49 km3 (1349 thousand m3/daily) is enough.

Currently, 126,000 hectares of land are irrigated from regional rivers, 322,000 hectares from Amudarya, 46,000 hectares from Zarafshan river, 0.4 thousand hectares from springs in Kitab district.

In 1971-1977, the rate of development of new land in the Karshi Desert was 40-50 thousand hec per year, and in 1980, the irrigated area increased from 176.5 thousand hec (1970) to 348.9 thousand ha. Since 1985, the introduction of new land has slightly decreased to 2-10 thousand hectares per year. In 2008, irrigated land in the region was 507.8 thousand ha. During this period, water intake increased from 1118 to 6298.5 million m3 per year and only in the following years it decreased to 4823-5355 million m3.

The methodology developed at ISMITI is used as a basis for soil typification and classification. They take into account the mechanical composition of the soil and the exchange of layers with different water permeability. This classification is presented in Table 2.

Table 2. Typification of soil erosion by categories of water permeability, taking into account the stratification of soils.

Description of the mechanical composition of soils in the 30-100 cm layer	**Description of soil erosion by categories of soil composition in 100-200 cm layers**					
	sand	**sand**	**light sand**	**average sand**	**Medium sand with weak water permeable layers**	**Heavy sand, clay**
1	2	3	4	5	6	7
Sand (fine and medium-grained, sandy)	v. 1	1-p	1-p	2-p	3rd p	4-p
Sand and light sand	v. 1	2nd v	2-p	2-p	3rd p	4-p
Average sand	2-a	2-a	3-a	v. 3	3rd p	4-p
Heavy sand, clay	3-a	3-a	3-a	4-a	4-a	v. 4

Note:

1- intensive water permeable;

2- water permeable;

3- weak water permeable;

4- poor water permeability;

a)- soil shears that become heavier from bottom to top according to their mechanical composition;

b)- lightening from bottom to top according to the mechanical structure;

c)-relatively homogeneous in terms of mechanical composition.

Developed typification, classification allows to distinguish different levels of drainage, to select the smallest dangerous areas of secondary salinity on the map of the area describing the mechanical composition of the soil. The initial materials for typification and classification can be the data of soil-ameliorative imaging and maps carried out by project organizations, land cadastre, etc.

Based on the soil image materials of "Uzgiprozem", we performed the typification of soil types of Kashkadarya region and determined the areas suitable for use of KZS.

The expanded evaluation analysis showed that the potentially suitable areas for the use of well water (category I and II) in Kashkadarya region is 119 thousand hec (Table 3).

Table 3. Distribution of areas with favorable conditions for using KZS in Kashkadarya region, thousand hec.

I-extremely comfortable (intensively waterproof)	II-comfortable (water permeable)	III-not comfortable enough (poorly water permeable)	IV-poor (poorly water permeable)
3.21	115.84	144.44	234.91

In order to classify the quality of ditch waters, information on their chemical composition was collected and processed for the main collectors of Kashkadarya region. Long-term data on water consumption, flow and KZS mineralization of reservoir waters by districts are presented above.

Chemical composition of KZS of Kashkadarya region S.A. Polinov, A.U. Usmanov, E.I. Chembarisov and B.A. Bakhritdinov, M.A. The Yakubovs have studied the content of extracted underground water in depth, and M.K. studied and evaluated by Djuraev et al. We used the analysis of water from large reservoirs to supplement the data presented.

The results of chemical analysis of KZS are given in Table 5. Summarizing the collected data showed that the mineralization and chemical composition of KZS is very diverse and depends on the salinity level of soils and the proportions of water balance constituents. The least water mineralization is characteristic of the ditch flow of Shahrisabz and Kitab districts, where the mineralization of water in some collectors does not even reach 1.0 g/l. The highest water mineralization is found in the collectors of Guzor, Koson and other districts, and its value is 8-15 g/l.

KZS contains a lot of sulfate ion anions (50-78% of the total number of anions), chlorine ion is in small amounts, but with the increase of water mineralization, they increase to 10-30% of the total number of anions. Hydrocarbonate ions are more stable (8-10%). In case of low mineralization of 2.0 g/l water, calcium ion occupies a significant place in its cation part (30-38% of total cations), followed by sodium or magnesium ions. When water mineralization increases to 5-10 g/l, there is an increase in Na" and Mg" ions compared to calcium.

In the annual regime of water mineralization, a slight decrease in salt concentration is observed during the growing season due to the discharge of surface water, and it increases during the spring-winter period.

4 Conclusions

During irrigation of cotton with mineralized water, the loss of raw cotton yield can be reduced by using the washing mode of irrigation, i.e. by watering at the acquired standards (on average 25% more than the actual deficiency of moisture in the soil before irrigation)

The salt balance of the soil in the 0-300 cm layer depends on the mineralization of the irrigation water and the irrigation regime. Salts accumulate even when irrigating cotton with river water at irrigation rates calculated according to the moisture deficit. The rate of secondary salinity of the soil increases significantly during irrigation with mineralized water, and especially with mineralization of 3.8 g/l of well water. Therefore, irrigation with well water with a mineral content of 3.8 g/l must be used for a short period of time and only in water shortage years.

Irrigating cotton with mineralized water for 4 years led to a slight decrease in calcium and an increase in magnesium and sodium. But during this period, salinization of the soil did not occur;

In order to reduce the harmful effects of salts on the development of crops, it is necessary to use the flushing mode of irrigation, that is, to implement irrigation with the norms of increased soil moisture deficit by 25-30% against the background of irrigation

References

1. I. J. Khudayev, K. Sh. Khamraev, *Water-saving irrigation technology in the desert-steppe zone of the south of the Republic of Uzbekistan The Northern Sea Route, water and land transport corridors as the basis for the development of Siberia and the Arctic* in the XXI century Collection of scientific reports of the XX International Scientific-Practical Conference Tyumen, 167-170 (2018)
2. I. J. Khudayev, IJARSET **8**, 9196-9199 (2019)
3. I. Khudaev, J. Fazliev, G. Hamzaev, Journal of critical reviews **7(11)**, 3102-3106 (2020)
4. J. Fazliyev, Modern irrigation methods for gardens Science **22**, 24-26 (2018)
5. M. Khamidov, K. Khamraev, S. Azizov, G. Akhmedjanova, Journal of Critical Reviews **7(1)**, 499-509 (2020)
6. K. Astanakulov, IOP Conference Series: Materials Science and Engineering **883**, 012151 (2020)
7. K. Astanakulov, IOP Conference Series: Materials Science and Engineering **883**, 012137 (2020)
8. K. D. Astanakulov, A. D. Rasulov, K. A. Baimakhanov, Kh. M. Eshankulov, A. J. Kurbanov, IOP Conference Series: Earth and Environmental Science **848(1)**, 012171 (2021)
9. K. D. Astanakulov, V. I. Balabanov, P. Vitliemov, N. A. Ashurov, O. Khakberdiev, IOP Conference Series: Earth and Environmental Science **868(1)**, 012077 (2021)
10. M. Kh. Khamidov, K. T. Isabaev, I. K. Urazbaev, U. P. Islamov, A. N. Inamov, European Journal of Molecular and Clinical Medicine **7(2)**, 1649-1657 (2020)
11. M. K. Khamidov, D. Balla, A. M. Hamidov, U. A. Juraev, IOP Conference Series: Earth and Environmental Science **422(1)**, 012121 (2020)
12. M. Khamidov, K. Khamraev, IOP Conference Series: Materials Science and Engineering **883(1)**, 012077 (2020)
13. M. Khamidov, A. Muratov, IOP Conference Series: Materials Science and Engineering **1030(1)**, 012130 (2021)

14. I. Khudayev, J. Fazliyev, N. Sharopov, Shkola Nauki **4(15)**, 14-15 (2019)
15. M. Khamidov, U. Juraev, A. Juraev, K. Khamraev, S. Khamidova, Annals of the Romanian Society for Cell Biology **25(4)**, 5117-5136 (2021)
16. J. Sh. Fazliev et al, Internauka **21(3),** 78-79 (2019)
17. D. J. Fazliev, Sovremennye metody orosheniya sada Science **22**, 24-26 (2021)
18. Z. S. Fazliev et al, Put nauki **14**, 56 (2014)
19. N. E. Sattarov, A. N. Borotov, R. F. Yunusov, A. E. Yangiboev, IOP Conference Series: Earth and Environmental Science **1076(1)**, 012081 (2022)
20. Z. S. Fazliyev et al, The Way of Science **21**, 56 (2014)
21. I. Khudayev, J. Fazliev, S. Baratov, AGRO ILM **1**, 57 (2019)
22. I. Khudaev, J. Fazliev, Irrigation and melioration **2** 0301-0309 (2022)
23. K. Astanakulov, F. Karshiev, Sh. Gapparov, D. Khudaynazarov, Sh. Azizov, E3S Web of Conferences **264**, 04038 (2021)
24. A. N. Borotov, IOP Conference Series: Earth and Environmental Science **1076**, 012027 (2022)
25. B. Shaymardanov, A. Borotov, Y. Jumatov, IOP Conference Series: Materials Science and Engineering **883**, 1-9 (2020)
26. A. Tukhtakuziyev, Sh. U. Ishmuradov, R. B. Abdumajidov, IOP Conference Series: Materials Science and Engineering **868**, 012058 (2021)
27. Sh. U. Ishmuradov, R. B. Abdumajidov, IOP Conference Series: Earth and Environmental Science **1076**, 012039 (2022)