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EFFICIENT USE OF WATER IN CONDITIONS OF WATER RESOURCE SCARCITY

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Abstract

The shortage of water from Uzbekistan is becoming increasingly urgent due to global climate change. The demand for water of the population of the Central Asian countries is mainly satisfied at the expense of transboundary rivers. According to research, by 2025, due to climate change and global temperature increase, the reserve of glaciers supplying water to the Amu Darya and Sir Darya rivers is expected to decrease by 15-20%. It has been found that the volume of mountain glaciers is decreasing by 0.2-1 percent per year, and the snow reserves in mountain river basins are decreasing. In order to solve the problems presented in this article, it is necessary to improve the use of water-saving technologies in the irrigation of agricultural crops and fully automate the methods of water consumption calculation, remote control of the channel, recording of water losses in the channel and its prevention. elaborate proposals have been developed.

Keywords: *Groundwater, water quality, salinity, monitoring, saturation, water mineralization, water distribution, water scarcity.*

Introduction. Today, in most regions of the world, there is a problem of water resource shortage. The main reasons for this are global warming, the destruction of the ecosystem on our planet, the increase in the demand for additional water resources as a result of the growth of the economy and population of countries. It is worth mentioning that in recent years, the problem of shortage of water resources has been clearly manifested in the Central Asian region. Climate change and temperature rise have been happening continuously in Central Asia for several years. Experts say that in the last 50-60 years, the area of glaciers in the region has decreased by about 30 percent. According to estimates, glaciers may lose 50 percent of their volume if the average annual temperature rises by 2 degrees, and up to 78 percent if the temperature rises by 4 degrees. As a result, the volume of available water resources will decrease sharply. As a result of climate warming in the region, ice is melting more than accumulating, and glaciers are losing their mass every year. This may cause economic, social and political instability in the future. According to experts' analysis, in the last 40 years, the volume of water supply in Central Asia has decreased from 8.4 thousand to 2.5 thousand cubic meters per person per year, by 2050, the population of Central Asia will increase to 90 million people, and the water shortage will increase by 25-30 percent., and the volume of water supply reaches a critical level - less than 1.7 thousand cubic meters per year [1,2].

With the increase in the population, the process of desertification is intensifying in hot climate regions. At the same time, desertification has negatively affected the way of life of 100-200 million people worldwide, forcing more than 50 million people to leave their places of residence in the next ten years. The economic damage from it is estimated at 42 billion US dollars. Global climate change can change this process. In more than 50 countries in about 20 river basins, there are intense discussions on the use of water and its correct distribution, and measures aimed at efficient and rational use of water are being implemented.

It is known that in the 70s and 80s of the last centuries, our country received 74.1 km3 of water annually from Amu Darya and Sir Darya, so 28.4 km3 went to Amu Darya, 10.9 km3 to Sir Darya, 19.2 km3 to internal small rivers, 12.6 km3 underground and corresponded to the collector waters. Today, Uzbekistan's water intake is only 79% of the amount in the 1980s. In the years of drought, the volume of water intake from Amu Darya and Sir Darya decreases by 8-10 km3, and due to the fact that we use up to 49.0 km3 of water for irrigation, the yield of agricultural products decreases by 1.3-1.5 times. Therefore, using the available opportunities, increasing the efficiency of water resources use are among the urgent problems [4].

It is known that, according to the researches of the World Resources Institute and the British "Economist Intelligence Unit", the Central Asian countries, especially Uzbekistan, are among the 33 countries that are expected to face water shortages by 2040. The existence of the republic is a sign that it is the worst situation. This, in turn, regardless of the degree to which the assumptions will be resolved by this period, it is necessary to prioritize the transition to economical use of available resources for Uzbekistan, which is located far from the ocean and large seas. In this regard, in order to prevent the problem of water shortage, adapt to climate changes and use water-saving technologies in providing guaranteed water to agriculture and increase the economic efficiency of their use, July 10, 2020 PF-6024 of the President of the Republic of Uzbekistan Decree No. "On approval of the concept of water management development of the Republic of Uzbekistan for 2020-2030" dated March 1, 2022 "Measures to further improve the introduction of water-saving technologies in agriculture" The strategic directions defined in the Resolution No. PQ-144 serve as the main source for solving the above-mentioned problems[3,4].

2.Materials and 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. To conduct this analysis, we collected historical climate data, including temperature and precipitation records, from reliable sources. Additionally, flow data from various hydrostations across the Kashkadarya region were obtained. Utilizing statistical and modeling techniques, we examined trends in these variables over recent decades. Furthermore, we employed climate change projections to simulate future scenarios and predict potential changes in temperature, precipitation, and flow patterns [5,6].

In writing the article, the Law of the Republic of Uzbekistan "On Water and Water Use", Decrees and Decisions of the President of the Republic of Uzbekistan, decisions of the Cabinet of Ministers of the Republic of Uzbekistan, as well as the opinions of our country and foreign economists and the agricultural sector of the Republic of Uzbekistan the information of the Ministry of Economy, Kashkadarya Region Department of Agriculture was widely used. Logical thinking, comparative and comparative analysis methods were used to cover the topic.

3. Results and Discussion

Improving water supply in our republic, rational and economical use of existing water resources, introduction of new science-based technologies is an urgent issue of today. According to experts, 25 to 40 percent of water is lost from water sources to irrigation fields through canals and ditches. For this, first of all, it is necessary to modernize the current irrigation systems, implement ways to drastically reduce water loss situations through digitalization of water infrastructure management.

It is known that the average annual amount of water used in Uzbekistan in the last five years was 51-53 billion m3. In 2020, 49 billion m3 of water was used in all sectors of the economy of Uzbekistan, and this indicator is not even 75-80 percent of the water needed in the republic calculated or consumed in the 1980s. However, by 2022, the population has almost doubled, industry has developed, people's lifestyles have changed, and their wellbeing and needs have increased. Taking into account that a similar situation was observed in neighboring countries, it is not difficult to imagine how important the rational use of common water resources of Central Asia is in ensuring security and stability in the region. In Figure 1 below, inefficient use of water in agriculture causes drought, resulting in crops not meeting their water needs and yields that are not as expected



Figure 1. Consequences of inefficient water use in agriculture.

Uzbekistan is taking the initiative among Central Asian countries in introducing watersaving technologies to reduce water shortages and expanding the possibilities of using modern technologies in water management.

In accordance with the Decision of the President of the Republic of Uzbekistan dated December 21, 2020 "On measures to accelerate the introduction of water-saving technologies in agriculture" in 2021, the introduction of water-saving irrigation technologies on a total of 230 thousand hectares, laser leveling of 200,000 hectares was decided. In January-June 2022, 750 water management facilities will be equipped with "Smart Water" devices, 95 pumping stations will be equipped with an online monitoring device for water and electricity consumption, 423 reclamation monitoring wells will be equipped with soil salinity, mineralization an online level control device was installed and 7 water management facilities were automated. As a result of this, it was possible to control and account for water in real time in water management facilities, to monitor the water resources supplied at the border of the region and district online, and to accurately account for water. Reduction of the human factor in water management processes, prevention of technical losses of water, transparent and fair use of water based on the set limit was established.

Since the beginning of 2022, on 172 thousand 555 hectares of land, including 142 thousand 500 hectares of raw cotton cultivation area - drip irrigation, on 8 thousand 782 hectares of grain and other crops - sprinkler irrigation, 4 thousand 100 hectares of cotton and other cultivated areas - discrete irrigation technologies were launched, on 50 thousand 200 hectares - with the help of portable flexible pipes, on 4 thousand 710 hectares - irrigation was started by laying a film on the edge. It is known that the equipment and components of water-saving irrigation technologies were mainly imported from foreign countries. Therefore, special attention was paid to increasing the number of local manufacturing enterprises in order to reduce imports and meet domestic demand, and as a result, as of July 1, 2021, the number of local enterprises producing equipment and components of water-saving irrigation technologies reached 38. It is planned to launch more than ten new enterprises by the end of the year. As a result, at the end of 2021, 50 percent of the 230,000 hectares of land where water-saving technologies will be introduced will be provided with products by local producers, and the level of localization will reach 70 percent. Therefore, due to saving the cost of transportation of products from another country, the cost can be reduced by 15-20% or 5 million per hectare. it was possible to reduce the price to soum.

Currently, efficient use of water has become an urgent issue not only in our country, but throughout the world. Because water consumption is increasing year by year, and water reserves are not unlimited. All this requires special attention to attract the latest and most efficient technologies to the management of water resources in most countries of the world.

It's no secret that a huge amount of water is lost in agricultural irrigation today through absorption, evaporation, and excess water consumption. This figure is 65-70 percent in some cases. Based on this, raising the coefficient of water use in irrigation to 90-95% is one of the most pressing issues today. In addition, it is necessary to expand the use of drip irrigation technology in the agricultural sector. This, in turn, saves water several times compared to traditional irrigation. When this technology is used, leaching and re-salination of the soil is drastically reduced. Also, measures should be taken to clean the large amount of salt water accumulated in natural depths (Aydar-Arnasoy lake system, Dengizkol, etc.) and use it in agriculture. This makes it possible to develop a very large area of land and, most importantly, it is important to ensure food security.

If we look at the countries of the world, irrigated fields in Israel have been transferred to 100% water-saving technologies. In the USA, this figure is 38.2%, in Egypt 36%, in Kazakhstan 14%, in Turkey 12%, in the People's Republic of China 11%. The research shows that the sprinkler irrigation method is used more in Russia, the USA, China and India, while the drip irrigation method is mainly used in the countries of Israel and Spain .

Water-saving technologies have been introduced in 7% of irrigated lands in Uzbekistan, i.e. 284,000 hectares. Of this, drip irrigation - 114 thousand hectares, sprinkler irrigation - 3 thousand hectares, discrete irrigation (pulsar) - 4 thousand hectares, and irrigation using flexible pipes is 163 thousand hectares. The need to invest in water-saving technologies has made Israel a world leader in this field. For example, the Israeli company IDE Technologies, which participated in the construction of all desalination plants in Israel, exported its experience to 35 countries (built about 400 desalination plants, including the USA and China). Netafim, the world's largest low-volume irrigation company, is represented in more than 110 countries. Scarcity of water resources has made Israel a leader in water-saving technologies, and now the country is eager to share its experience with the world.

The General Plan for the development of water management for the period 2010-2050 has been adopted in Israel. According to it, by 2050, the water shortage will be covered by the complete treatment of wastewater and the

construction of additional facilities for desalination of sea water (Table 1).

Table 1.

Current and prospective water balance and water consumption system in Israel.

Years	Agriculture			Total
	Drinking water	Brackish waters	Treated wastewater	
2010	500	144	400	1044
2020	490	120	528	1138
2030	470	110	645	1225
2050	450	100	900	1450

Wastewater reuse is an important source of water for Israeli agriculture. 476 million m3 (93%) of the 530 million m3 of wastewater processed annually is treated and 410 million m3 (86%) is reused for irrigation. It should be noted that Israeli agriculture is developing in close cooperation between scientists, consultants and farmers. It should be said that in recent years, great work has been done in this regard in Uzbekistan. Projects are being implemented in cooperation with the advanced countries of the world to introduce new and cost-effective technologies in the field for efficient use of water resources. As an example, in Kashkadarya region, when drip irrigation technologies were introduced in cotton fields, water consumption saved in 2022 amounted to 11.7 million m3 (Table 2).

Table 2.

Water consumption saved when drip irrigation technologies are introduced in the irrigation of cotton fields in Kashkadarya region.

No.	District name	In 2022, he did drip irrigation		Water consumption in the normal way, million m³	Water consumption in drip irrigation, million m³
		number of farms	area (ha)		
1	Guzor	39	1 331	2.0	1.0
2	Qarshi	26	1 810	2.7	1.4
3	Koson	74	2 167	3.3	1.6
4	Qamashi	32	1 201	1.8	0.9
5	Kitob			0.0	0.0
6	Mirishkor	51	2 316	3.5	1.7
7	Muborak	50	1 545	2.3	1.2
8	Nishon	60	1 334	2.0	1.0
9	Kasbi	45	1 040	1.6	0.8
10	Chiroqchi	33	882	1.3	0.7
11	Shahrisabz	39	1 272	1.9	1.0
12	Yakkabog	49	750	1.1	0.6
	Total:	498	15 647	23.5	11.7

Another effective mechanism for reducing water consumption is water pricing. It is progressive in nature, that is, the price for final consumers does not change only for a certain volume of water consumed, beyond which the price per cubic meter of water is extra, the higher the price. will be the price of water is set in a block system. Quotas are set for each consumer, both for urban water consumers, and for industry and agriculture (Table 3).

Table 3.

Indicators of use of water and land resources of the State of Israel (2014).

No.	Indicators	unit of measure	quantity
1.	Total used land resources	thousand hectares	440
2.	Irrigated lands from it	thousand hectares	182
3.	Total water resources	million m³/year	2000
4.	That sentence. water resources used in agriculture(60-70%)	million m³/year	1300
5.	Amount of water used per hectare per year	m3	7143
6.	Efficiency of 1 m³ of water, USD.	$/ m³	3.93
7.	Efficiency of 1 ha of land, USD.	$/ga	18182
8.	Average price of 1 m³ of water for irrigation	$	0.57
9.	Water resources per capita	m3	285
10	Land resources per capita	ha	0.06
11.	Cotton yield	c/ ha	60-70
12.	Wheat productivity	c/ha	60

As water savings are achieved by this mechanism, i.e. setting a price for water, we recommended using the following formula to determine the economic efficiency of efficient use of water in the irrigated lands of the Kashkadarya region that we are analyzing. That is, the price of 1m3 of water is as follows:

$$N = X + \frac{M}{C}$$

Here: N- the price of one cubic meter of water, soum; X- including the costs of supplying water to the consumer border general costs of water management, sums; M- mandatory payments of water management organizations to general expenses, sums; C- the total volume of irrigation water delivered to consumers within the norms, cubic meters.

In fact, taking into account the effectiveness of water-saving irrigation technologies in the production of agricultural products and the importance of preserving water resources, which are invaluable for all living beings on the earth, the implementation of these technologies in the agriculture of our country is considered one of the important tasks. There are a number of benefits and preferences for entities that have introduced water saving technologies in our region, which are as follows:

• Up to 12 million sums for cotton fields with drip irrigation technology, up to 9 million sums for areas with sprinkler irrigation technology, and up to 2 million sums for areas with discrete irrigation technology for introducing water-saving technologies to agricultural producer's subsidy funds are allocated.

• Up to 50% of the purchase costs, but not more than 100 million sums, and up to 30% of the purchase costs of portable generator equipment, if renewable energy source equipment is used for agricultural producers of not less than 10 hectares, where water saving irrigation technologies have been introduced. A system of allocating subsidies in the amount of (not more than 30 million sums) was introduced.

• Producers of agricultural products who have introduced water-saving technologies will be exempted from land tax for a period of 5 years.

• It was determined that the areas where water-saving technologies have been introduced will not be approved for at least 5 years, and the land plot or part of it will be taken away for state and public needs only after the funds spent have been fully reimbursed based on the consent of the land user.

• Commercial loans taken for the purpose of introducing technology up to an amount not exceeding 45% of the Central Bank base rate, and an amount not exceeding 3 percentage points of the interest rate of commercial loans allocated in foreign currency will be covered by the entrepreneur support fund.



Figure 2. Application of water-saving technologies in Kashkadarya region.

Table 3:

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	Division of the water surface into areas according to the depth					
					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
1.	2.	3.	4.	5.	7.	8.	9.	10.	11.	12.
1	Karshi	2021	irrigated fields	50,36		0,01	0,27	14,61	33,73	1,74
			of which the fields without ditches	16,19			0,15	3,49	11,87	0,68
		2022	irrigated fields	50,32		0,01	0,26	6,82	40,86	2,37
			of which the fields without ditches.	16,08			0,15	2,87	12,07	0,99

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%.

Table 4.

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**

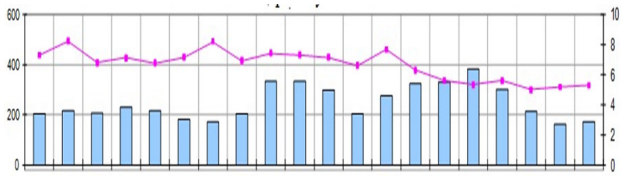


Figure 2. Year-round changes in groundwater levels in irrigated croplands in the Kashkadarya River basin.

4.Conclusion

According to the conducted researches, the areas where water-saving technologies (WST) are used in the republic have increased by 7.7 times in the last five years. If the areas where WST is used will be increased by 10 times, then the need for various hydraulic equipment will increase by 6.6 times. The existence of a few enterprises producing WST equipment in the republic means that the internal competitive environment is not formed and they cannot fully satisfy this need.

Also, from April 1, 2023, state support for the introduction of water-saving technologies in the production of agricultural products is set as the main task: collateral security of commercial bank loans up to 50%, but more than 2.5 billion sums support of business activities in the amount of 1.5 times the base rate on loans of commercial banks allocated in national currency, the interest rate of which does not exceed 1.5 times the base rate of the Central Bank, but the base rate to be compensated from the fund to cover not more than 30 percent and so on.

In the Kasbi district of the Kashkadarya region, until March 1, 2024, the implementation of a pilot project on the digitalization of all water access points management and water delivery to users, as well as the electronic registration of documents between water supply organizations and water consumers at the end of each month The creation of a water accounting information system, which allows filling in the form and confirming it through electronic digital signatures, is evidence that the ground has been created for increasing the efficiency of water use in the region in the future.

To sum up, when studying foreign experiences on the use of water-saving technologies, the countries with developed economies have irrigated agriculture, i.e. 38.2% in the USA, 36% in Egypt, 14% in Kazakhstan, 12% in Turkey, China In the People's Republic, progressive technologies of 11 percent irrigation are being used.

Especially in Israel, programs for the effective use of water at the expense of desalination of sea water for 2050 have been drawn up, and we believe that it is appropriate to develop programs aimed at establishing the effective use of water within the framework of this project in our country.

By studying the experience of foreign countries, the basis for economical and rational use of water and increase in crop productivity will be created by applying water-saving methods of irrigation in the irrigation agriculture of our country, as well as in the Kashkadarya region.

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