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ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
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Satbayev University

ХАБАРЛАРЫ

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ
НАУК РЕСПУБЛИКИ
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PROBLEMS OF THE USE OF WATER RESOURCES AND THE WAYS OF THEIR SOLUTION IN KAZAKHSTAN

Abstract. The development of the Republic of Kazakhstan is determined to a decisive extent by the quantity and quality of available water resources. The countries are currently high water stress experiencing. The solution to this problem depends on the efficiency of the use of water resources, the state of infrastructure, the state of the environment, etc. The available water resources use for the needs of the economy, and the distribution of river flow among water management basins are assessed. Unsatisfactory consideration of the current state of water resources by state plans and programs for the development was noted of water management. Measures for the collection and saving of water, implemented within the framework are presented of state programs. The main indicators of the development have been determined of the country's water resources management. However, the experience of implementing previously developed state plans and programs in the water industry has shown that their practical implementation is at a low level and the planned results have not been achieved in many key indicators. The current state of the water industry continues to deteriorate despite numerous declarative attempts to get out of this situation. Solving the problems of the country's water industry is possible only if they are actually transferred to the forefront of actions by both state bodies and the general public.

Key words: Water resources, water industry, river flow, usage problems, plan and program.

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ҚАЗАҚСТАНДАҒЫ СУ РЕСУРСТАРЫН ПАЙДАЛАНУ МӘСЕЛЕЛЕРІ ЖӘНЕ ОЛАРДЫ ШЕШУ ЖОЛДАРЫ

Аннотация. Қазақстан Республикасының дамуы су ресурстарының саны мен сапасы арқылы анықталады. Қазіргі таңда су тапшылығы өзекті мәселердің бірі болып тұр. Су ресурстарын пайдалану тиімділігіне, инфрақұрылымның жай-күйіне, қоршаған ортаның жай-күйіне және т.б. байланысты бұл мәселелерді шешуге болады. Бұл мақалада Қазақстанның қолда бар су ресурстары, суды экономиканың қажеттіліктері үшін пайдалану және бөлу су шаруашылығы бассейндері арасындағы өзен ағыны бағаланды. Қазақстанның су шаруашылығының негізгі мәселелері және суды жинау және үнемдеу шаралары анықталды. Еліміздегі су ресурстарын басқаруды дамытудың негізгі көрсеткіштері келтірілді. Су шаруашылығын дамытудың мемлекеттік жоспарлары мен бағдарламалары бойынша су ресурстарының ағымдағы жай-күйінің есебі қанағаттанарлықсыз жүргізіліп жатқаны анықталды. Мемлекеттік бағдарламалар аясында жүзеге асырылып жатқан суды жинау және үнемдеу шаралары келтірілді. Еліміздің су ресурстарын басқаруды дамытудың негізгі көрсеткіштері анықталды. Бірақ, су шаруашылығы саласында бұрын әзірленген мемлекеттік жоспарлар мен бағдарламаларды іске асыру тәжірибесі олардың іс жүзінде орындалуы төмен деңгейде екенін және көптеген негізгі көрсеткіштер бойынша жоспарланған нәтижелерге қол жеткізілмегенін көрсетті. Қазақстанның су шаруашылығы ең терең дағдарыста деген қорытынды жасалды. Су шаруашылығының қазіргі жағдайы осы жағдайдан шығудың көптеген декларациялық әрекеттеріне қарамастан нашарлауы тоқтамай жатқаны байқалды. Қазіргі жағдайдың шешуші факторларының бірі Қазақстанның су шаруашылығындағы әзірленген бағдарламалар мен басқару шешімдерінің ғылыми қамтамасыз етілуі әлсіз болып табылады. Еліміздің су шаруашылығының мәселелерін шешу үшін іс жүзінде мемлекеттік органдармен қатар, жалпы жұртшылықты да алдыңғы қатарға шығарған жағдайда ғана мүмкін болады.

Түйін сөздер: су ресурстары, су саласы, ағын, пайдалану мәселесі, жоспар және бағдарлама.

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ПРОБЛЕМЫ ИСПОЛЬЗОВАНИЯ ВОДНЫХ РЕСУРСОВ КАЗАХСТАНА И ПУТИ ИХ РЕШЕНИЯ

Аннотация. Развитие Республики Казахстан в решающей мере обусловливается количеством и качеством располагаемых водных ресурсов. В настоящее время страна испытывает высокий водный стресс. Решение данной проблемы зависит от эффективности использования водных ресурсов, состояния инфраструктуры, состояния окружающей среды и др. Оценены располагаемые водные ресурсы Казахстана, использование воды на нужды экономики, распределение речного стока по водохозяйственным бассейнам. Определены основные проблемы водной отрасли Казахстана и мероприятия по сбору и экономии воды. Приведены основные показатели развития управления водными ресурсами страны. Отмечен неудовлетворительный учет современного состояния водных ресурсов государственными планами и программами развития водного хозяйства. Представлены мероприятия по сбору и экономии воды, реализуемые в рамках государственных программ. Определены основные показатели развития управления водными ресурсами страны. Однако опыт реализации ранее разработанных государственных планов и программ в водной отрасли показал, что их практическая реализация на невысоком уровне и по многим ключевым показателям планируемые результаты не достигнуты. Сделан вывод, что водная отрасль Казахстана находится в глубочайшем кризисе. Текущее состояние водной отрасли продолжает ухудшаться, несмотря на многочисленные декларативные попытки выхода из сложившейся ситуации. Одной из решающих факторов сложившейся ситуации является слабое научной сопровождение разрабатываемых программ и управленческих решений в водной отрасли Казахстана. Решение проблем водной отрасли страны возможно только при реальном

переводе их на первый план действий как государственных органов, так и широкой общественности.

Ключевые слова: водные ресурсы, водная отрасль, сток, проблема использования, план и программа.

Introduction. The development potential of every country in the world is unequivocally measured by the availability of water resourcesvwhich are the most important natural resources. The prosperity of Kazakhstan is determined by the quantity and quality of available water resources to a decisive extent. At the present time, Kazakhstan in terms of water scarcity (water stress) is on the 8th place across Asia after Bangladesh, India, China and other countries. According to the World Resources Institute, the countries of the Central Asian region are at the high level of stress, while Kazakhstan is at the medium-high level (Coalition for the "green economy" and the development of G-Global, 2021).

According to the World Bank forecasts, by 2030 the volume of water resources in Kazakhstan will decrease from 90 to 76 km³ per year. This means that in 8 years the water deficit in the country will be about 12-15 km³ per year, i.e. about 15% (Kurishbaev, 2022).

The solution to this problem is possible only by addressing the following challenges:

1) an increase of the effectiveness of water resources usage with the improvement of their management system at the level of river basins;

2) modernization of existing and construction of new infrastructure to reduce water losses;

3) improvement of the population's well-being and the environment's state by increasing environmental releases to the lower reaches of river basins;

4) improvement of the country's water security on the basis of timely water supply to all consumers and users in any region of the country, regardless of meteorological, hydrological and other conditions.

Research Materials and methods. The data of water management and research organizations and state administration, gathered from the open literature, were used. The collected materials and applied research methods were aimed at studying, systematizing, analyzing, generalizing and evaluating the current state of the usage of water resources in Kazakhstan, as well as the effectiveness of managing the country's water industry.

A comparison method based on the examination of similarities and differences in a number of indicators of the usage and management of water resources was used. Moreover, an analysis was also undertaken and conclusions have been drawn. The analysis allowed to divide the problems of usage of water resources in Kazakhstan into the following parts: available water resources, a decrease

of surface water runoff, a supply of water management basins, main problems of the water industry, measures of water collection and conservation and main indicators of the development of water resources management. Based on the synthesis of the identified parts of the problem of usage of water resources, a conclusion was made about the prospects for solving the above problems.

The logical method of research was also applied at the theoretical level, based on the facts, terms and conclusions collected during the work. The results and conclusions were summed up. The current state of the usage of water resources in Kazakhstan was investigated, then the dynamics of changes in the runoff of surface waters of the country was reconstructed, namely, the genesis (the emergence of the main and last stages of the state of water resources) was considered and the future and trends in the further development of the water industry were predicted.

Overall, a study was conducted on the discipline "Water Management", and depending on the available data on the usage and management of water resources in Kazakhstan, a conclusion about the unsatisfactory impact of state plans and programs for the rational usage of water resources on the development of the country's water industry was made.

Result and discussion. The available water resources of Kazakhstan are: surface - 90-100 km3/year, underground - 15.5 km3/year. Meanwhile, in 2021 about 44.3 km3 / year (48.5%) of surface water resources have come from bordering countries (China - 18.4 km3 / year, Uzbekistan - 14.2 km3 / year, Russia - 8.6 km3/year and Kyrgyzstan - 3.1 km3/year) and 47.0 km3/year (51.5%) is formed on the territory of the Republic of Kazakhstan. The flow of water to the Russian Federation in the Yertis River basin is 39.2 km3/year. Explored reserves of groundwater are about 15.5 km3/year. 25 km3/year are used for the needs of the economy, including 15 km3/year (60%) - agriculture, 6 km3/year (24%) – production industry, 1 km3/year (4%) - household needs of the population and 3 km3/year (12%) – losses (The results of the activities of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan in the water sector, 2022).

A decrease in the surface water runoff in Kazakhstan, under the influence of climate change and a reduction in inflow from the territory of bordering countries, is predicted to 72.4 km3 / year by 2030, including transboundary - up to 22.2 km3 / year and local - 50.2 km3 /year (Fig. 1) (Questions of water economy. Report of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan, 2021).

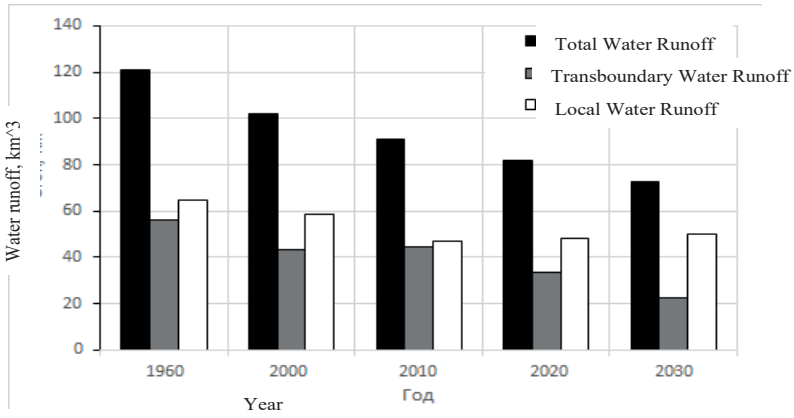

Figure 1. Changes in surface water runoff

According to research conducted in 2021-2022 under the scientific and technical program "Irrigation technologies and technical means for the introduction of new irrigation lands, reconstruction and modernization of existing irrigation systems", annual water consumption in all sectors of the country's economy is 85% covered by surface water and during the growing season, mainly, water resources coming from neighboring countries are used. In Turkestan, Almaty, Zhambyl and Kyzylorda regions 97% of the water volume is used for irrigation (11.8 km3 out of 12.1 km3). At the same time, the total irrigated area is 1.5 million hectares or 77% of all irrigated lands in the country (Questions of water economy. Report of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan, 2021).

The territory of the Republic of Kazakhstan is divided into eight river basins: Yertissky, Balkash-Alakolsky, Esilsky, Aral-Syrdarya, Shu-Talassky, Zhaiyk-Caspian, Nura-Sarysusky and Tobyl-Torgaisky. The allocation of water resources across the water management basins of Kazakhstan is extremely uneven (Table 1).

Table 1 – The allocation of river flow among water management basins (The results of the activities of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan in the water sector, 2022)

Water management basins	River flow, km^3/year		
	Total	From neighboring countries	Percentage of incoming water in the total flow, %
Yertissky	31,0	6,5	21
Balkash-Alakolsky	25,6	11,9	45
Aral-Syrdarya	15,9	14,2	89
Zhaiyk-Caspian	10,5	8,3	78
Shu-Talassky	4,1	3,1	74

Esilsky	1,7	-	-
Tobyl-Torgaisky	1,4	0,3	22
Nura-Sarysusky	1,1	-	-
Overall	91,3	44,3	48,5

The Yertis and Balkash-Alakol water management basins are the most provided with surface water resources (eastern - 34.5% and southeastern - 24.1% of the country). The Nura-Sarysusky, Tobyl-Torgaisky and Esilsky water management basins are among the least provided (central - 2.6% and northern - 4.2% of the country). The Aral-Syrdarya, Balkash-Alakolsky and Zhaiyk-Caspian water management basins, being transboundary, are the most dependent on the inflow of water from adjacent territories (southern - 21.2% and western - 13.4% of the country) (Water security of Kazakhstan: state, problems and recommendations, 2019).

The average long-term surface runoff in Kazakhstan is 95.2 km3 (Fig. 2) and it represents the main source of water supply. For the period 2009-2021, there is a decrease in river flow in all its components, such as the inflow of transboundary rivers and the rivers' flow which is formed on the country's territory (The results of the activities of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan in the water sector, 2022).

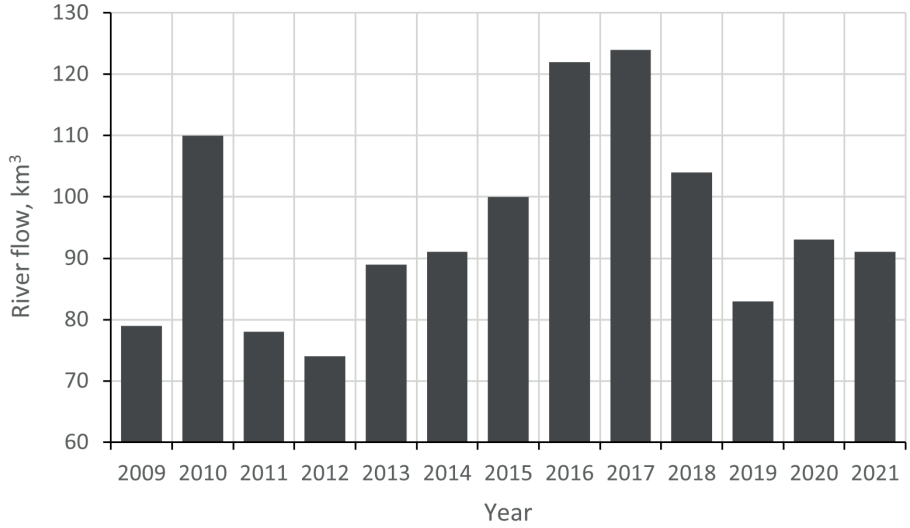

Figure 2. River flow changes

The main problems of the water industry in Kazakhstan:

1. Low efficiency of water usage and insignificant tariffs for water supply services. Per production unit, 3 times more water is spent than in Russia or the USA, and 6 times more than in Australia. The level of water tariffs in agriculture

is 2-10 times less than in countries such as Australia, Great Britain, China and Greece and 20 times less than in Israel. Irrigation water productivity in Kazakhstan is 0.4-0.8 kg/m3 and abroad - 2.5-6.0 kg/m3 (Mukhamedzhanov et all, 2020).

The cost of irrigation water per unit of crop in Kazakhstan is 1.25-2.50 m3/kg and abroad - 0.15-0.40 m3/kg (Mueller et all, 2014).

2. Great deterioration of the water infrastructure, irrational exploitation and technical maintenance of water facilities and low automation and digitalization levels of the processes of allocation and accounting of water (water losses during transportation reach 40% (Li et all, 2018; Ibrayev et all, 2014);

3. Wide dependence of the southern regions on transboundary flows (Kyzylorda and Turkestan regions - 89%, Zhambyl - 74% and Almaty - 45% (The results of the activities of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan in the water sector, 2022));

4. Inefficient structure and deficient completeness of the authorized body of water resources management (insufficient governmental control over the rational usage and protection of the water fund, which is in exclusive state ownership);

5. Ignorance of the ecologically optimal level of water usage (the ecology of river basins is provided with water on a residual basis);

6. Unsatisfactory scientific support in the management of water resources and deficit of highly qualified personnel;

7. Insufficient legal and regulatory framework (a number of necessary laws regulating relations in the country's water industry are missing).

The Water Resources Committee of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan has developed the following measures of collection and conservation of water (The results of the activities of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan in the water sector, 2022):

-application of water-saving irrigation technologies in the amount of 2.2 billion km3/year (Kalashnikov et all, 2017; Zharkov et all, 2020);

-reconstruction of irrigation systems and the introduction of a digitalization system in the amount of 2.0 billion km3 / year to reduce water losses;

-construction of 39 new reservoirs in the amount of 3.6 billion km3/year for water storage;

- an increase in the usage of recycling water supply technologies in the amount of 0.6 billion km3/year to decrease an industrial water intake;

- diversification of less hydrophilic crops in the amount of 1.0 billion km3/year.

The implementation of the above measures will save about 19.8 km3/year and increase the area of irrigated land to 3.0 million hectares.

Based on the above activities, the following main indicators of the development of the country's water resources management have been determined (National Water Resources Management Project. Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan. Nur-Sultan, 2021):

1. Creation of favorable conditions for the population and water ecosystems:

1.2. Prevention of water objects' clogging and depletion:

- the length of the cleared sections of water objects to improve water availability, in 2021 - 52.9 km until 2025 - 302.3 km;
- liquidation of derelict flowing boreholes to preserve groundwater reserves, in 2022 - 151 to 2025 - 618;
- ensuring the annual water demand: Lake Balkash - at least 12 km3/year, North Aral Sea - at least 3.6 km3/year (Karlykhanov et all, 2018);
- an increase in the proportion of water objects on which water protection zones and strips are established;

1.3. Prevention of the negative impact of water:

- reduction of the number of emergency hydraulic structures, in 2020 - 36 to 2025 – 0 (Ibrayev et all, 2014);
- the percentage of coverage of the rivers Nura, Esil, Yertis and Selety by the flood forecasting and modeling system, in 2020 - 10% to 2025 - 100%;

2. Water for sustainable agriculture:

2.1. Reduction of water losses during irrigation:

- reduction of losses during water supply, in 2020 - 2.6 km3 until 2025 - 1.6 km3;
- an increase of the area of land covered by water-saving technologies in 2020 - 220 ha, by 2025 - 422 ha;
- an increase of the number of channels with digital accounting of water use, in 2020 - 1 until 2025 - 120;

2.2. Providing water to irrigated lands:

- the number of built reservoirs, in 2021 - 1 until 2025 – 25;

3. Improvement of the system of governmental management of water resources:

3.1. Implementation of integrated water resources management approaches:

- development of basin water management plans, in 2021 - 2 to 2025 - 8;
- the percentage of transboundary water basins covered by existing agreements on cooperation in the field of water usage, in 2021 - 30% until 2023 - 100%;

3.2. Modernization of the system of governmental accounting of water resources and forecasting:

- the percentage of development of the Unified Information and Analytical System for Water Resources Management, in 2022 - 20% until 2025 - 100%;
- the number of new hydrological posts, in 2020 - 352 until 2025 - 372;

3.3. Personnel and scientific support:

- development of an updated educational program with the inclusion of innovative disciplines, in 2022 - 1;
- the number of research works in the field of usage and protection of water resources, in 2024 - 2 to 2025 - 7;

4. Socio-economic effect:

- the number of people for whom favorable living conditions near water objects are preserved;
- reduction of water consumption per unit of GDP, in 2021 - 4% until 2025 - 20%;
- increase of the area of water-supplied irrigated lands, in 2021 - 1.6 million hectares until 2025 - 2.2 million hectares.

Governmental plans and programs do not consider the current state of Kazakhstan's water resources in a sufficient manner. Most of the proposed conclusions, goals and indicators for the development of water resources management are generally declarative and are not confirmed by specific organizational and engineering measures.

The problems of the current state of water resources are complex and result from the attitude toward them as secondary at the highest level of public administration in Kazakhstan.

Conclusion. The analysis of the current state of the usage of water resources of Kazakhstan demonstrates that the country's water industry is at the deepest crisis. A 20-30% decrease in the country's surface water runoff is predicted by 2030 and with a deficit of water resources up to 12-15 km³ per year. Per production unit, in Kazakhstan 3-6 times more water is spent in comparison with developed countries. The current state continues to worsen despite numerous declarative attempts to tackle this problem.

A number of measures for the rational usage of water resources were developed by state administration bodies. However, the experience of implementing previously developed governmental plans and programs in the water industry has demonstrated that their practical implementation is at a low level and the planned results have not been achieved according to the multiple key indicators.

One of the decisive factors of the current situation is the weak scientific support of the developed programs and management decisions in the water industry of Kazakhstan. It is necessary to assemble all research organizations which conduct activities aimed to address issues of water management development in Kazakhstan in one departmental authorized body responsible for support and development of the country's water industry. Consolidation of these organizations within the framework of the water cluster of the sectoral authorized body (Committee on Water Resources of the Ministry of Ecology,

Geology and Natural Resources) allows efficient and rapid resolution of existing issues and directions for the development of the water industry. Overall, the solution of the problems of the water industry in Kazakhstan is possible only if they are brought to the forefront of actions by both government bodies and the general public, which is not possible in the near future.

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