ВОДНОЕ ДЕЛО

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MAIN DIRECTIONS FOR RATIONAL USE OF WATER RESOURCES IN THE REPUBLIC OF KAZAKHSTAN

Abstract: The article identifies the main directions of the rational use of water resources in the Republic of Kazakhstan, specifically, the South Kazakhstan region. Rational water use is the process of efficient use of water resources, which guarantees the preservation and protection of water bodies from negative and excessive anthropogenic impact and at the same time provides the population and sectors of the national economy with water resources of adequate quality and in the amount that can guarantee not only satisfaction of needs, but also development of industry, energy, water transport and agriculture at the rates that are necessary for sustainable socio-economic development of the Republic of Kazakhstan as a whole. The analysis of the foundations of rational water use was carried out; the main economic instruments affecting the process of water use in Kazakhstan are considered, an overview of the structure of water resources management in the South Kazakhstan region is made. Currently, it is necessary to ensure the rational use of natural resources, their protection from pollution and degradation, as well as skillfully restore, multiply and control them for the benefit of human society. Water resources as an object of management are a complex phenomenon and require a special approach for the formation of governing bodies with a clear division of their sphere of influence and responsibility.
Key words: water resources, water industry of the Republic of Kazakhstan, water capacity, hydraulic structures, state water resources management, water losses, rational water use, water saving, economic mechanism of rational water use.

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Түйіндеме: Мақалада Қазақстан Республикасында, атап айтқанда Оңтүстік Қазақстан облысында су ресурстарын тиімді пайдаланудың негізгі бағыттары анықталған. Су ресурстарын тиімді пайдалану дегеніміз - бұл су объектілерін сақтау мен қорғауға кепілдік беретін, теріс және шамадан тыс антропогендік әсерден және сонымен бірге халық пен халық шаруашылығы салаларын тиісті деңгейдегі су ресурстарымен және қажеттіліктерді қанағаттандыруға ғана емес, тұтастай алғанда Қазақстан Республикасының тұрақты әлеуметтік-

экономикалық дамуы үшін қажетті қарқынмен өнеркәсіп, энергетика, су көлігі және ауыл шаруашылығы салаларының да тұрақты дамуына да кепілдік бере алатын мөлшерде қамтамасыз ететін су ресурстарын ұтымды пайдалану процесі. Мақалада суды тиімді пайдалану негіздеріне талдау жүргізілді, Қазақстандағы суды пайдалану процесіне әсер ететін негізгі экономикалық құралдар қарастырылып, Оңтүстік Қазақстан облысының су ресурстарын басқару құрылымына шолу жасалды. Қазіргі уақытта табиғи ресурстарды тиімді пайдалануды, оларды ластану мен деградациядан қорғауды қамтамасыз ету, сондай-ақ оларды уақытылы қалпына келтіру, көбейту және адамзат қоғамының игілігі үшін бақылау қажет.
Түйінді сөздер: су ресурстары, Қазақстан Республикасының су шаруашылығы кешені, су сыйымдылығы, мемлекеттік су ресурстарын басқару, , суды тиімді пайдалану, су үнемдеу, су ресурстарын тиімді пайдаланудың экономикалық механизмі.

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Аннотация. В статье выявлены основные направления рационального использования водных ресурсов в Республики Казахстан, в частности Южно-Казахстанской области. Рациональное водопользование – процесс эффективного использования водных ресурсов, гарантирующий сохранение и охрану водных объектов от негативного и избыточного антропогенного воздействия и при этом обеспечивающий население и отрасли народного хозяйства водными ресурсами надлежащего качества и в том количестве, которое способно гарантировать не только удовлетворение потребностей, но и развитие промышленности, энергетики, водного транспорта и сельского хозяйства теми темпами, которые необходимы для устойчивого социально-экономического развития Республики Казахстан в целом. Наличие достаточно большого количества проблем, присущих водопользованию Казахстана, свидетельствует о том, что процесс водопользования в стране не является рациональным. Проведен анализ основ рационального водопользования; рассмотрены основные экономические инструменты, влияющие на процесс водопользования в Казахстане, сделан обзор структуры управления водными ресурсами в Южно-Казахстанской области. В настоящее время необходимо обеспечить рациональное использование природных ресурсов, их защиту от загрязнения и деградации, а также умело их восстанавливать, умножать и контролировать для блага человеческого общества. Актуальность проблемы управления водопользованием определяется плачевным состоянием отрасли, причем неоднократные попытки решения отдельных проблем никак не изменили ситуацию в целом.
Ключевые слова: водные ресурсы, водохозяйственный комплекс Республики Казахстан, водоемкость, гидротехнические сооружения, государственное управление водными ресурсами, рациональное водопользование, экономический механизм рационального водопользования.

Introduction

General formulation of the problem and its connection with important scientific and practical problems. Rational water use is a set of measures to reduce water consumption and improve the efficiency of wastewater treatment in order to save resources, protect nature and to increase economic efficiency in industry, housing and communal services and agriculture.

At one time I.A. Shiklomanov noted the fact that Central Asia has the greatest anthropogenic load on water resources in general. There is no similar natural and ecological region in the whole world as in Central Asia, where more than 75% of all water resources of the world are used. In this regard, there is a very deep lack of water resources in this region, which in turn reveals the need to change traditional methods of water use [1].

According to the Water Code of the Republic of Kazakhstan: "Water resources are the most important component of the natural environment, a limited, renewable and vulnerable natural resource, are protected and used on the territory of Kazakhstan as the basis for the life of peoples and ensure the ecological, social and economic well-being of the population, as well as the existence of flora and fauna. The classification of water resources is shown in Figure 1.

The main goals achieved by measures to rationalize water use:

1. Renewability. To ensure the availability of water resources for future generations, fresh water intake should not exceed the natural water replacement rate.

2. Conservation of energy. Water pumping, delivery and wastewater treatment activities consume significant amounts of energy. In some regions of the world, 15% of total energy consumption is spent on water management activities.

3. Preservation of natural habitat. Reducing human consumption of water helps to preserve the natural aquatic environment, which is important for local flora and fauna, and also increases the total water flow. It also reduces the need to build new dams and other facilities for water intake.

Water management measures include:

1. Any significant reduction in water loss, use or pollution, as well as preservation of the quality of water resources.

2. Reducing water use by introducing water conservation measures or increasing water use efficiency.

Implementation of water resource management systems that reduce or favor the reduction of excess water consumption.

Research objects. Kazakhstan is not rich in water resources, and they are not evenly distributed on its territory. There are over 85 thousand rivers and temporary reservoirs in the republic. (Periodically drying up rivers due to climatic conditions of the year). The main source of their filling is glaciers and snow. In total, there are 2,724 glaciers with a total glaciation area of about 2 thousand square km.

There are 48 thousand lakes in the republic, of which 45 are small, the area of which is less than 1 sq. km. The lakes are located unevenly on the territory: either they are hundreds of kilometers apart from each other, or they are located so densely that they form lake areas.

The renewable water resources of the basins usually consist of the runoff recorded in the outlet sections of the rivers, the inflow of water below these sections, as well as the runoff of unexplored rivers. Since in the lower reaches of rivers in lowland Kazakhstan, the runoff is usually scattered, sometimes even to the point of complete disappearance, when calculating the total water resources, data were used for the sections with the maximum runoff [2].

The most recent data on river flow in the Republic of Kazakhstan include the work carried out within the framework of the project “Rational use of water resources with an increase in the areas of regular and inundation irrigation in all water basins of the Republic of Kazakhstan until 2021”. Where, on the scale of 8 water basins, both average water resources and resources in water-specific years were estimated (50, 75, 95% of availability). Studies have shown that the total resources of surface waters formed in Kazakhstan and coming from the territories of neighboring states are on average 122.0 km^3. Water resources formed within Kazakhstan amount to 58.0 km^3. The inflow from neighboring states is determined at 67.2 km^3, including about 26 km^3 from China, 10.6 km^3 from Russia, 26.5 km^3 from Uzbekistan, and 4.1 km^3 from Kyrgyzstan. As a result, if in the 50s of the last millennium, the surface runoff resources of Kazakhstani rivers were estimated at 150 km^3 / year, in the 70s and 80s - at 115 ... 125 km^3 / year, then, as follows from the above data, they have decreased even more [3].

There are 150 wastewater receivers on the territory of the Republic of Kazakhstan. Including wastewater discharges to the terrain - 7, to filtration fields - 38, to storage ponds - 20, to ponds with evaporators - 18, and

to biological ponds - 7 and others. The category of discharged wastewater is mainly domestic, industrial, quarry, mine and mixed. Purification type: mechanical, natural and artificial biological [4].

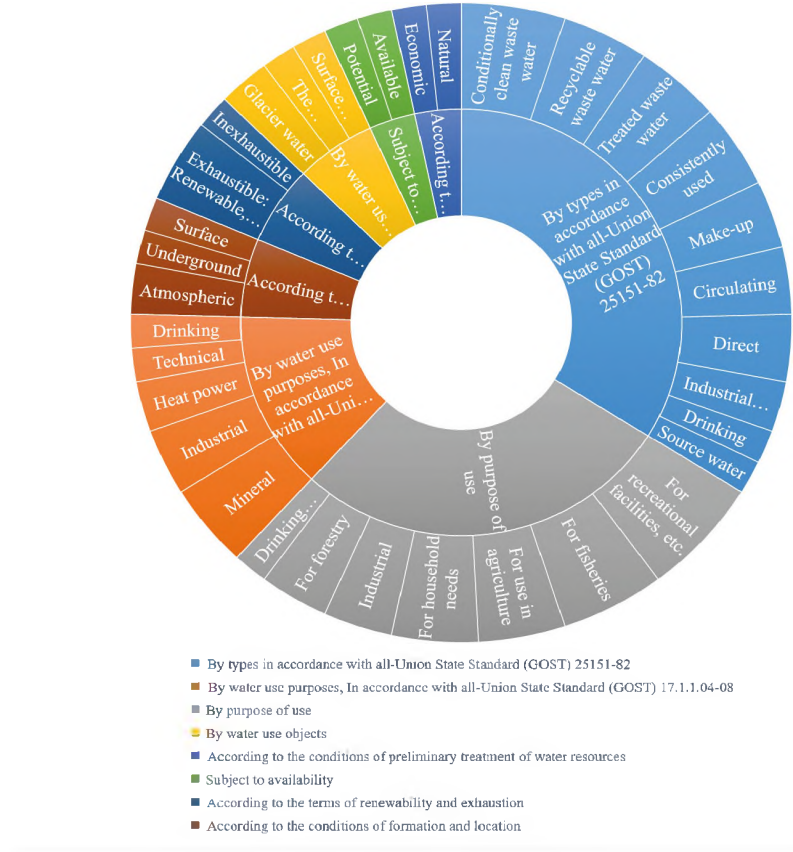

Figure 1 - Classification of water resources

More than 0.81 km^3 of wastewater is discharged into water bodies annually. Industrial enterprises are considered the main pollutants, they account for 63.1% of all wastewater, housing and utilities - 24.9% and agriculture - 11%.

The water management complex of the Republic of Kazakhstan has 44 thousand water facilities, which are distributed as follows (Fig. 2).

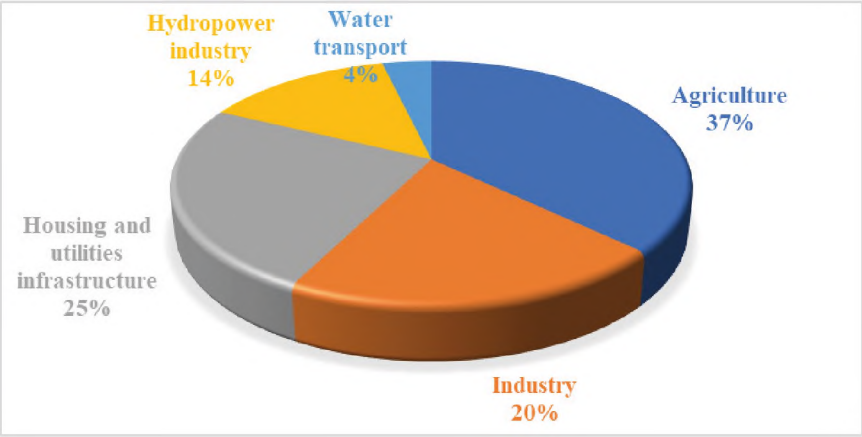

Figure 2 - Percentage ratio of the main water users of the Republic of Kazakhstan

The largest are complex hydroelectric complexes, which include 35 hydroelectric power plants with a total capacity of 2.7 thousand MW, theoretically, the capacity of all the country's hydro resources is 170 billion kWh per year, which is about 23% of the total capacity in the Republic of Kazakhstan as a whole.

Research methods. Such volumes of water resources and hydraulic structures complicate the process of their management, require a large amount of labor and financial resources, and give rise to problems that become an obstacle to ensuring rational water use.

The purpose of this work is to analyze the foundations of rational water use and the main economic instruments affecting the process of water use in Kazakhstan, as well as the structure of water resources management in the South Kazakhstan region.

In this work, the main methods of statistical analysis and comparison were applied. General summary and quantitative indicators were given for the main characteristics of river flow and water use. Also, analytical research methods have created a structure of units in the main field of study.

The main factors of irrational use of water resources include:

- deterioration and unsatisfactory technical condition of hydraulic structures and water supply and sewerage facilities;

- the use of outdated water-intensive production technologies;
- excessive pollution of water bodies, emergency discharges of polluted waters;
- high level of water losses during transportation;
- insufficient equipment of water intake facilities with metering systems;
- orientation towards extensive development, as well as neglect of water use efficiency issues;
- lack of a unified management system for the water management complex, lack of qualified personnel and, as a result, a large number of inadequate decisions in the field of water use;
- imperfection of the tariff policy, both in terms of water use and wastewater disposal, and in terms of penalties and preventive sanctions;
- the lack of effective economic mechanisms stimulating business to actively introduce progressive water-saving production technologies, systems of recirculating and re-sequential water supply and reducing unproductive water losses.

Results and discussion

The economy of Kazakhstan uses more than 20-24.8 km^3 of water annually. The state of the water management complex of Kazakhstan and the presence of a number of major problems in water use indicate the need to take measures to rationalize it [5]. And although at the present time a complete solution of problems in the field of water use seems impossible, there are a number of directions that allow solving existing problems and smoothing out the contradictions that arise. The classification of the main directions of the rational use of water resources is presented in table 1.

Table 1 - Classification of the main directions of rational use of water resources

Directions of rationalization of water use	
Organizational	1. Ensuring Integrated Water Resources Management
	2. Basin principle application
	3. Norm setting
	4. Carrying out timely preventive and current repairs of hydraulic structures and pipelines

Economic	1. Promotion of rational water use
	2. Application of penalties for irrational use of water resources
	3. Improving the efficiency of tariff policy
	4. Payment for all types of water use
Legal	1. Restoration of water sources: cleaning of river beds and reservoirs; reducing the number of discharges of pollutants; restoration of sanitary zones
	2. Protection of water bodies
	3. Creation of reserve sources of water supply: groundwater; precipitation; treated waste water
	4. Introduction of water-saving technologies
	5. Organization of water monitoring systems
	6. Development of methods for predicting the qualitative and quantitative state of water resources
	7. Improving the quality of hydro forecasts
Technical	1. Implementation of innovative technologies for water resources purification
	2. Development of low water and ahydrous technologies
	3. Development of machinery and equipment with less water loss
	4. Creation of group systems of recycling water supply
	5. Improvement of schemes and technologies for the use of water resources
	6. Implementation of water pipe self-cleaning technologies

The water intensity of the country's gross domestic product significantly exceeds that of the economies of such developed countries as Germany, France, the USA and Canada. A high level of water capacity is characterized not only by the country's economy as a whole, but also by individual industries and agriculture.

Reducing water capacity is a prerequisite for the transition to rational water use.

It is necessary that at the “entrance” to the system, water resources are rationally used, and at the “exit” - the established standards for the negative impact of production factors on water bodies and product quality indicators are observed.

The presence of a large number of factors of irrational use of water resources and a high level of water capacity of the country lead to the need for measures to rationalize the process of water use as a whole [6-8]. The main strategic goal of state water management is to achieve and maintain an economically efficient and environmentally safe level of water use. Achievement of the dialectical unity of “economically efficient and environmentally safe level of water use” is defined by us as “sustainable water use”, which is characterized:

- balanced satisfaction of the needs of economic development and ensuring the reproduction of water resources;

- balancing the implementation of the rights of present and future generations to use economically efficient and environmentally safe water resource potential.

To achieve this goal in conditions of limited economic opportunities, both for water users and the state, when determining the main directions for the effective development of water management, it is necessary to proceed from the principle of ergonomizing decisions made (minimizing costs in water use and choosing environmentally effective solutions that have at the same time a positive economic effect).

One of the most topical and innovative ways to solve the problems of rational water use is virtual water. The concept of the 21st century, which has been widely studied in the scientific community in recent years. According to the research of Christian Opp, [9, 14,16] the relevance of this topic dates back to 1998, when the world community raised the alarm about the irrational use and lack of fresh water. Since then, there has been a lot of research on this topic, and now in the “Age of Water”, it is relevant for every person.

Research into virtual water and the water footprint has attracted the attention of many scientists from different angles. Scientists from China, the Netherlands, USA, Germany, Sweden and Great Britain can be considered the leaders of research, who in turn have introduced many new concepts. In theory, the studies pay more attention

to the countries of the Middle East, Central Asia and Africa, which are currently considered the driest regions with water deficiency.

The range of implementation of related water protection tasks should be limited to the most urgent and socially significant ones, as well as those implemented by the state within the framework of state and regional programs for the protection and restoration of water resources and water users at the expense of their own profits in the framework of economic activities in accordance with the current legislation .

Most of the water used in the region is taken from the two main rivers, the Syr Darya and the Amu Darya, which form in the Pamir and Tien Shan mountains. The Syr Darya flows from Kyrgyzstan through Tajikistan to Uzbekistan (including through the densely populated Fergana Valley) and Kazakhstan, the Amu Darya - from Tajikistan to Uzbekistan and Turkmenistan. The water resources of the Syr Darya, the average annual flow of which is 37 km^3, are distributed as follows: 74% falls on Kyrgyzstan, 14% on Uzbekistan, 9% on Kazakhstan and 3% on Tajikistan. More than 80% of the Amu Darya runoff, the average long-term runoff of which is 78 km^3, is formed in Tajikistan, 6% in Uzbekistan, 2.4% in Kyrgyzstan, 3.5% in Turkmenistan (with Iran) and 7.9% in Afghanistan [10, 15].

Water bodies on the territory of the South Kazakhstan region (hereinafter - water bodies) are represented by the main reservoirs, the Syrdariya and Amudaria rivers and their tributaries, natural and artificial reservoirs, rivers, lakes, ponds and swamps.

The modern structure of water management in Kazakhstan and on the territory of the South Kazakhstan region, the main direction of water use in the lower reaches of the Syr Darya is agriculture, mainly regular irrigation. The main water users: the North Aral Sea and the Saryshyganak Bay, the Syrdarya river delta, ecosystems on the Syrdarya river section from the Shardara reservoir to the city of Kazalinsk [10].

The developed joint operating mode of the Shardara reservoir and the Koksaray counter-regulator, as well as the reconstruction of irrigation networks with an increase in the efficiency, allow achieving sufficient water content in the planned irrigated areas for the entire period. The reserve for growing fodder is the Koksarai counter-regulator operating in the mode of deep-water estuaries, which will compensate for the shortage of products associated with the exclusion of flooded hayfields in very dry years (95% supply). The requirements of other sectors of the economy are small compared to the requirements of regular irrigation and are constantly met.

As a rule, programs for the protection and rational use of water are

initiated at the local level, either by local municipal authorities or regional structures.

The modern structure of water management in the Republic of Kazakhstan on the territory of the South Kazakhstan region is shown in Figure 3.

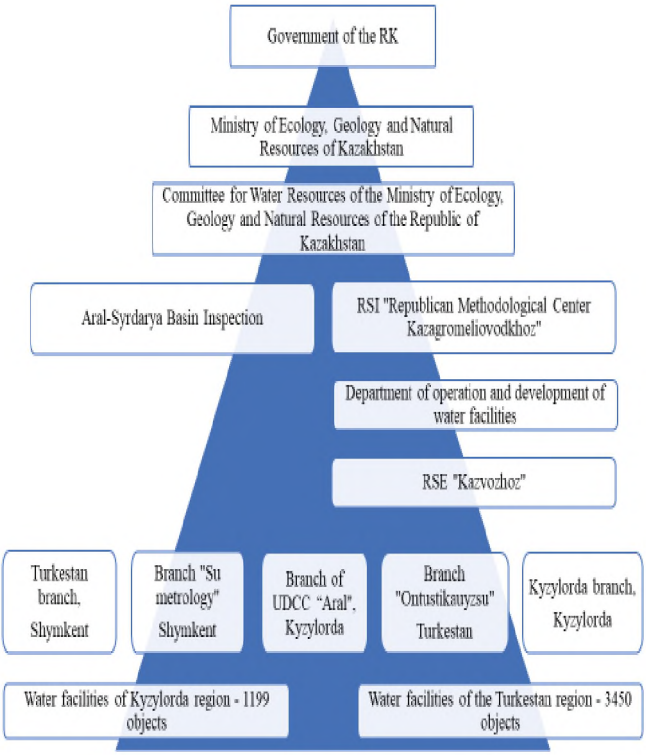

Figure 3 - The structure of water resources management of the Republic of Kazakhstan on the territory of the South Kazakhstan region

By the Decree of the President of the Republic of Kazakhstan dated June 17, 2019 No. 17 “On measures to further improve the system of public administration of the Republic of Kazakhstan”, the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan was created with the transfer of functions from the Ministry of Agriculture of the

Republic of Kazakhstan in the field of use and protection of the water fund, water supply, sewerage, forestry. Thus, the quality and quantity of water resources are the main development criteria for any state, on which the health and well-being of citizens of the republic directly depends [8-11].

The concept of the new State Program for Water Resources Management of the Republic of Kazakhstan was developed in accordance with the Water Code of the Republic of Kazakhstan and the Protocol of the Security Council meeting dated June 26, 2019 “On ensuring water security”.

In this regard, the main goal of the Concept is to determine the main ways to solve the problems of conservation and rational use of the country’s water resources, to ensure the balance of socio-economic development and the possibility of reproduction of water resources at the level of the requirements of the standard water quality - “sustainable water use”. The concept will serve as a basis for improving the legal framework, developing measures for the development of the water sector of the economy and state policy on water resources management and water use.

Thus, water resources are a factor of life and habitat, as well as the most important economic resource for all spheres of human economic activity. Currently, it is necessary to ensure the rational use of natural resources, their protection from pollution and degradation, as well as skillfully restore, multiply and control them for the benefit of human society.

Conclusions

1. The urgency of the problem of water management is determined by the deplorable state of the industry, and repeated attempts to solve separate issues did not change the situation as a whole.

2. There is a need for a transition to modern methods of management, active involvement of the experience of developed countries. For the most efficient use of water resources and sustainable economic growth, a coordinated development of economic sectors is required, taking into account the limited water resources and variability of surface and ground waters within river basins and the permissible environmental load on water bodies.

3. In connection with the uneven territorial distribution of water resources, it is advisable to allocate areas for the development of water-intensive industries, increasing the development of hydropower potential, the development of irrigated agriculture, fisheries, etc.

4. Water resources as an object of management are a complex phenomenon and require a special approach for the formation of governing bodies with a clear division of their sphere of influence and responsibility. The main drawback of the existing management system is its excessive centralization.

5. The issues of improving the economic mechanism for stimulating rational water use in the South Kazakhstan region, in particular, increasing the functional effectiveness of the restrictive and incentive tools of this mechanism, remain insufficiently studied. Also, the interaction of elements of the economic mechanism has been little studied.

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