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Evaluation of the method of territorial redistribution of the flow of the Irtysh river to the Central and Northern regions of Kazakhstan

Abstract: *The article provides an overview of the world experience of territorial redistribution of surface water resources, using the experience of the People's Republic of China, the North American continent, and the projects of the Soviet Union. Based on the world experience, it should be noted that large-scale river flow transfer projects are not effective for several reasons, such as a significant impact on the environment, the emergence of difficulties in regulating geopolitics, and the high cost of implementing projects. However, the diversion of many small and inter-basin transfers has shown positive results. Such river flow transfers allow us to solve several problems, such as socio-economic development of the region, maintaining the stability of the ecosystem, which is achieved by preserving local water resources. Taking into account the experience of other countries, it was proposed to design a canal to provide the Central and Northern regions of Kazakhstan to solve present water management problems and maintain the environmental stability of the region.*

Keywords: *water resources, flow regulation, territorial redistribution of water resources, river flow redistribution, inter-basin water transfer, development of water distribution systems, Irtysh river.*

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Introduction. «Water is the basis of life», this saying is as old as the world. Water is one of the main elements of life on Earth. Today, the relevance of the problem of water resources around the world has long been recognized and actively investigated, especially in the light of the lack of fresh water. The IV UN Report «Managing Water under Uncertainty and Risk» noted that water underpins all aspects of development. It is the only mediator, linking the various sectors of the economy and through a bridging role which can control all aspects of life together [1]. The Message of the President of the Republic of Kazakhstan to the people of Kazakhstan noted, «Water is an extremely limited resource and the struggle for the possession of water sources is becoming a major factor in geopolitics, being one of the causes of tension and conflicts on the planet. The year 2050 is the real term that the world community is currently focusing on in its development» [2]. In the coming decades, it is crucial to take decisive measures for the rational use of water resources, especially taking into account the natural distribution of resources.

Water distribution systems have a very long and rich history. Since the third Millennium BC, mankind has been using water distribution and water supply systems. One of these achievements is the Grand Canal in China. The length of the currently active section is 1,782 km (including branches to Beijing, Hangzhou and Nantong – 2,470 km), which is 20 times the length of the Panama Canal and 10 times the length of the Suez Canal. Moreover, some historians tend to believe that China has emerged as a prosperous empire due to this canal. According to China's strategic plans, work on the reconstruction of

the Grand canal is planned in the near future due to the increasing consumption of fresh water by the population, industry and agriculture. Measures are also being planned to divert some water from flood-prone rivers to water-scarce areas.

Diversion of part of the Yangtze River flow to northern China is another major project of the People's Republic of China. China's strong economic potential, its unified, well-thought-out state water management system and its centuries-long experience enabled it to embark on one of the biggest water projects in the history of mankind in 2002. The Implementation of this gigantic project, estimated at $62 billion, would make it possible to divert approximately 45 km3 of water annually to various regions in the north of the country by 2050, thereby providing water to 300 million people and ensuring strong economic growth. Three canals with a length of 1300 km each should be built. Once completed, the country's main waterways (the Yangtze, Huanghe, Huaihe, and Haihe rivers) will form a single multi-purpose water management system. This will be achieved by diverting the flow along three routes, stretching from south to north and originating in the east, center and west of the country.

The North American Water and Power Alliance (NAWAPA) has been carrying out work in this field since the 1950s. It was planned to move about 175 km per year to provide water to seven provinces in Canada, thirty-three states in the United States, and three states in Mexico. According to the designers, a depression in the Rocky Mountains 800 km long between the ridges from Northern British Columbia to the state of Montana could become a giant reservoir, where water was to be distributed through a complex network of engineering structures using pumping stations. The total length of canals and aqueducts was to be 10,800 km, and tunnels were to be 2,900 km. The cost of the project was estimated at $100 billion in the 1960s and 1970s, and the construction period could reach 30 years. One of the important problems was the need to relocate 60 thousand people. Another difficulty was the various interests of the partners of the project. The lack of water was primarily a concern for the United States and Mexico, and most water resources planned for redistribution belonged to Canada, and the country might need them soon. This has led experts to refrain from redistributing water resources from the north of the continent to the south.

Projects for diversion river flow were also developed in the Soviet Union. The first projects for diversion river flow were developed in 1868. The project «Transfer of part of the flow of Siberian rivers to Kazakhstan and Central Asia» is a Soviet project aimed at providing water to the arid regions of the country. It was one of the most ambitious engineering and construction projects of the XX century, which was never implemented. The project was suspended in construction due to discovered flaws in the project. The project provoked the processes of soil erosion and soil salinization, the emergence of new foci of water-borne diseases, such as tularemia outbreaks in Kalmykia, and the project also caused disruption of saiga migration routes, the death of sturgeon juveniles at the water intake site, etc.

Irtysh-Karaganda Canal. In the late 1940s, problems of water scarcity in Central Kazakhstan began to be raised more often. There were 2174 river flows through the territory of Kazakhstan, including the Irtysh, Ishim, Ural, Syr Darya, Ili and other rovers. However, only 5.5% of the river water reached Central Kazakhstan. The canal was constructed between 1962 and 1974. The issue of water scarcity in the city of Karaganda has been immediately resolved, and mechanical engineering, chemical industry, heat and power engineering, and irrigated agriculture began to develop rapidly. The canal became an important strategic water management object. Thereby the expansion and creation of new production facilities has begun. The total length of the canal is 458 km, 272 km of which runs through the territory of the Pavlodar region and 186 km – in the Karaganda region.

The main structures of the canal are 22 pumping stations, 14 reservoirs and 34 sections of the canal. The estimated water supply of the canal in its current state is 1200 million m3 per year. The construction of the Irtysh-Karaganda canal contributed to the active development of metallurgical production while preserving the region's water resources.

Based on international experience, it can be noted that large-scale transfers are not always justified for several reasons, such as significant environmental impact, geopolitics, and the cost

of implementing projects. And yet, a large number of moderate flow transfer systems are currently being designed, built and operated in many countries. Their total volume in the world is about 400 km3/year. In combination with flow regulation, they provide for large regions, while simultaneously solving problems of energy, transport, irrigation, recreation, and employment. Designing and managing such systems is one of the most important water management tasks.

The need for territorial redistribution of runoff in Kazakhstan lies in the uneven distribution of natural waters, the discrepancy in the distribution of water and other natural resources, the geography of the location of water-intensive sectors of the economy. In particular, the northern and central regions of Kazakhstan, where favorable agro-climatic resources are concentrated, are not sufficiently provided with water. Table 1 shows the total runoff for the water management basins of Kazakhstan [3].

Table 1 – Distribution of water resources by water management basins of the Republic of Kazakhstan

№	Water management basin	Total flow, mil. m^3/year	Average annual population, thsnd. people	Total flow per 1 person, thsnd. m^3/year
1	Aral-Syrdarya	17990	3174	5,7
2	Balkhash-Alakol	27681	3544	7,8
3	Irtysh	33660	2010	16,7
4	Ishim	2820	1969	1,4
5	Zhaiyk-Caspian	11238	2370	4,7
6	Nura-Sarysu	1365,7	1245	1,1
7	Tobol-Turgay	1926	932	2,1
8	Shu-Talas	4244	1078	3,9

According to the international classification of water availability, shown in Table 2, regions with water resources of less than 1,700 m^3 per person per year are classified as water-scarce [4].

Table 2 – Water resource availability indicators

Water availability indicator (thousand m^3/year per person)	Water resource availability category
> 1,7	water-supplied (no stress)
1,0-1,7	insufficient water supply (stress)
0,5-1,0	water-deficient (scarcity)
< 0,5	extremely water-deficient (absolute scarcity)

In accordance with the forecast of socio-economic development in the Central Northern regions of Kazakhstan, intensive development of economic sectors is planned.

The perspective economic specialization of the Northern and Central regions is defined as agro-industrial complex, metallurgical and coal industry, electric power industry, in the Pavlodar region – oil refining, in the capital of the Republic, the city of Nur-Sultan – administrative, business, financial and educational services [5, 6].

Planned measures for the development of agriculture in the Central region: the construction of new processing plants include: large dairy farms and livestock farms in all the districts; establishment of procurement and marketing cooperatives for the purchase and implementation of livestock production, creation of large complexes and feedlots for growing out and fattening of cattle, obtained from private farms in each area; construction of plants for deep processing of grain and production of gluten and starch; construction of poultry farms, production complexes for processing meat products, production of sausages and semi-finished products, canned food; expansion of sown areas of grain and oilseeds,

creation of appropriate vegetable and grain storage facilities [7, 8, 9, 10].

It is assumed that by 2030, the joint development of the region will contribute to the growth of the gross regional product by 5,5 times, the volume of investment in fixed assets and industrial production – by 3,1 times, the volume of gross agricultural output – by 4,6 times.

Research results. To successfully implement the planned development parameters, it is necessary to provide water resources to economic sectors. Meanwhile, based on water management balances developed within the framework of integrated use and protection of water resources of the Ishim, Nura and Tobol rivers, which cover the territory of Northern and Central Kazakhstan respectively, the availability of local water resources is no longer sufficient in the long term.

On the territory of Kazakhstan, the only source that can increase water availability in the Esil basin is the Irtysh donor river, where up to 33% of the country's total surface runoff is formed.

According to the recommendations of the Committee on Water Problems of the United Nations Economic Commission for Europe, it is considered that the intensity of water use, at which less than 10% of the river flow is withdrawn, is satisfactory, 20% – require restrictions on water use and the implementation of measures to regulate the flow, if more than 20% – the water body will not be able to ensure the socio-economic development of the territory [11].

With equal water allocation of the Irtysh river flow with the Russian Federation, it is possible to take up to 4,5 km3 of water for transfer to the Central and Northern regions of the country, which is less than 15% of the flow [12].

The water intake of the proposed canal will be carried out from the Shulba hydroelectric power plant (hereinafter referred to as HPP). The construction of the second stage of the Shulba HPP will increase the level of the normal retaining level to 252,5 meters with a useful reservoir capacity of 7,5 km3. The proposed canal to provide for the Central and Northern regions of Kazakhstan can be laid within the Kazakh Uplands, which is characterized by the general elevation of the territory with a range of heights from 200 to 1500 m. The scheme of the projected canal is shown in Figure 1.

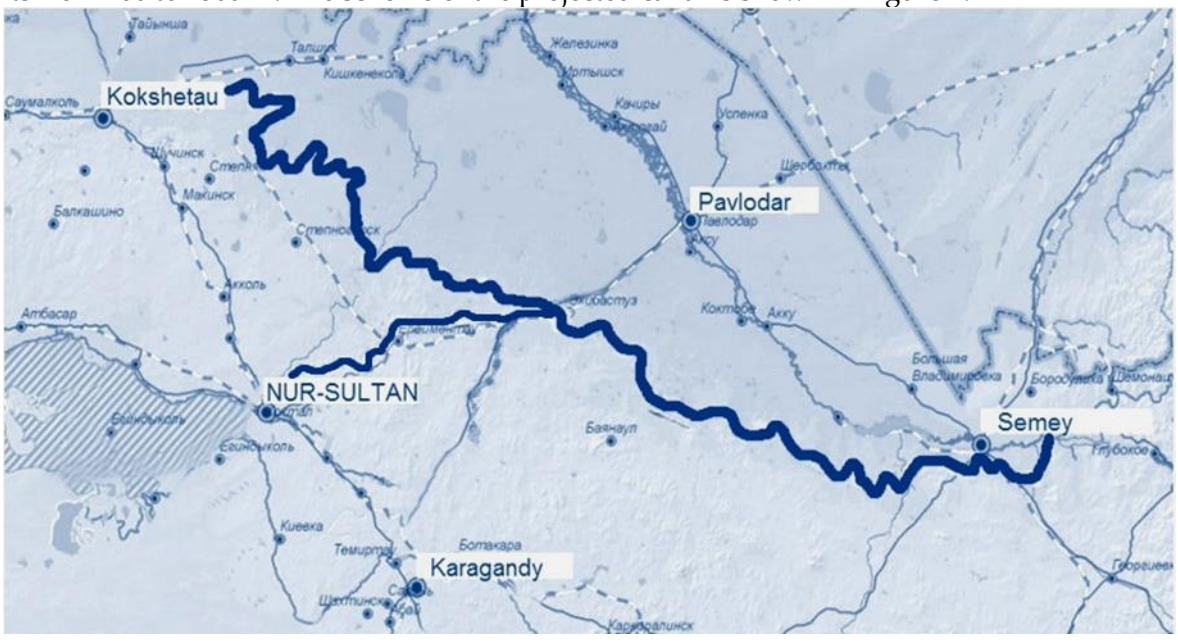

Figure1 – Scheme of the projected flow transfer canal

The route of the canal will mostly run along the western part of the Kazakh Uplands, where two low-mountain massifs stand out – the Kokshetau upland (947 m) and Ulytau (1133 m), separated by a vast Tengiz-Kurgaldzhin depression with a flat plain terrain [13]. Such conditions make it possible to implement a self-flowing option, which reduces the cost of building pumping stations and subsequent operating costs for machinery water supply.

Conclusion. Many projects on the territorial redistribution of water resources started in the Soviet era. But there hasn't been conducted research in this area in modern Kazakhstan with a focus on the balance between the interests of economic development and ecological stability. In recent years, countries participating in the Water Convention of the United Nations Economic Commission for Europe, as well as many experts on water resources and ecology, have concluded that a global assessment of the «water-food-energy-ecosystems» relationship called Nexus is significant. Within the framework of this initiative, various activities are being carried out to improve intersectoral interaction at the local and transboundary levels. Based on the above, the solution to the problem of water scarcity through the territorial redistribution of river flow to the Northern and Central regions of the Republic of Kazakhstan should be developed taking into account the environmental component as an integral part of the sustainable development of the affected regions.

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Ертіс өзенінің ағынын Қазақстанның Орталық және Солтүстік аудандарына аумақтық қайта бөлу әдісін бағалау

Аннотация: Мақалада жер үсті су ресурстарын аумақтық бөлудің әлемдік тәжірибесіне, атап айтқанда Қытай Халық Республикасының, Солтүстік Америка континентінің тәжірибесіне, Кеңес Одағының жобаларына шолу жасалады. Әлемдік тәжірибеге сүйене отырып, ағынды суларды бұрудың кең ауқымды жобалары қоршаған ортаға айтарлықтай әсер етуі, геосаясатты реттеудегі қиындықтардың туындауы, жобаларды іске асырудың жоғары құны сияқты бірқатар себептері бойынша тиімді емес екенін атап өткен жөн. Алайда, көптеген шағын және ішкі бассейнаралық ағынды суларды бұру оң нәтиже көрсетті. Мұндай ағынды суларды бұру аймақтың әлеуметтік-экономикалық дамуы, экожүйе ортасының тұрақтылығын сақтау сияқты бірнеше мәселелерді шешуге мүмкіндік береді, сондай-ақ жергілікті аймақтық су ресурстарын үнемдеу арқылы қол жеткізіледі. Басқа елдердің тәжірибесін назарға ала отырып, су шаруашылығының өзекті міндеттерін шешу және өңірдің экологиялық тұрақтылығын сақтау мақсатында Қазақстанның орталық және солтүстік аумақтарын қамтамасыз ету үшін арнаны жобалау ұсынылды.

Түйін сөздер: су ресурстары, ағынды реттеу, су ресурстарын аумақтық қайта бөлу, өзен ағынын қайта бөлу, бассейнаралық ағынды суды бұру, су тарату жүйесін дамыту, Ертіс өзені

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Оценка метода территориального перераспределения стока реки Иртыш в Центральные и Северные районы Казахстана

Аннотация. В статье представлен обзор мирового опыта территориального перераспределения поверхностных водных ресурсов с использованием опыта Китайской Народной Республики, североамериканского континента и проектов Советского Союза. Исходя из мирового опыта, следует отметить, что масштабные проекты по переносу речного стока неэффективны по ряду причин, таких как значительное воздействие на окружающую среду, возникновение трудностей в регулировании геополитики и высокая стоимость реализации проектов. Однако перенаправление многих небольших и межбассейновых трансфертов показало положительные результаты. Такой перенос речного стока позволяет решить такие проблемы, как социально-экономическое развитие региона, поддержание стабильности экосистемы, что достигается за счет сохранения местных водных ресурсов. С учетом опыта других стран было предложено спроектировать канал для обеспечения центральных и северных регионов Казахстана с целью решения существующих проблем управления водными ресурсами и поддержания экологической стабильности региона.

Ключевые слова: водные ресурсы, регулирование стока, территориальное перераспределение водных ресурсов, перераспределение речного стока, межбассейновый водообмен, развитие водораспределительных систем, река Иртыш.

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