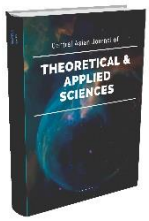

CENTRAL ASIAN JOURNAL OF THEORETICAL AND APPLIED SCIENCES

Volume: 03 Issue: 01 | Jan 2022 ISSN: 2660-5317

International Experience on Inter-Basin Distribution of Water Resources

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Received 29th Nov 2021, Accepted 29th Dec 2021, Online 21st Jan 2022

Abstract: *The inter-basin water transfer and derivation projects are an effective engineering countermeasure to alleviate the pressure in water-stressed areas and balance uneven distribution of water resources. The framework proposed in this article is intended to assess the overall impact of inter-basin water transfer projects that contribute to water resource management.*

KeyWords: *water transfer projects, water supply management, water transfer, derivation canal, water security.*

Introduction. The volume of available water resources on the Earth is about 1400.0 million km^3. From the 2 percent or 39,500 km^3 of the available water resources, only 22.8 percent are available for use and consumption. The geographical distribution of water resources is as follows: 55 percent in Asia, 19 percent in North America, 9.2 percent in Europe, 3.3 percent in South America, and 8.8 percent in other parts of the world. Distribution of water resources by sectors of the economy: 70% in agriculture, 22% in industry, 8% in domestic use [1,2].

According to the analysis, the majority of inter-basin water distribution forms are in developed countries (127 forms, the amount of water discharged is 195 billion m^3/year). The contribution of developing countries (86 forms) is estimated at $ 400 billion. m^3/year of water volume. Many of the proposed inter-basin drainage schemes (59, with a planned discharge of 380 billion m^3/year) are being implemented in China and India. Certainly, inter-basin drainage is carried out through the construction and operation of large hydraulic and hydropower facilities [1,2,3].

There are schemes of inter-basin uneven water supply and distribution on water bodies by regions (table-1).

Table-1 Available and proposed inter-basin discharge forms on all continents

Continents	Number of countries	Available forms of inter-basin discharge		Proposed forms of inter-basin discharge	
		Number of forms	The amount of discharged water, bln. m^3/year	Number of forms	The amount of water to be discharged, bln. m^3/year
Asia	10	62	393	46	315
North America	5	78	164	11	700
Europe	11	52	126	11	35
Africa	8	21	9	9	37
Australia	1	6	5	2	2
Total	35	219	597	79	1089

Materials and Methods. At present, water resources of 15.0 billion m^3 per year are distributed between basins in Russia through a system of 34 hydraulic structures with a length of 3.0 thousand km. Including the Big Stavropol (180 m^3/s) canal on the Kuban River and the Kuban (180 m^3/s) irrigation system, the Don (250 m^3/s) canal on the Don River, and the Moscow (Moscow canal) on the Volga River (125 m^3/s) are being used [2].

Figure 1. Moscow Canal

In Ukraine, 588.4 m^3/s of water resources are distributed between basins through 7 large canals, such as 1353.2 km long Dnepr-Danbass, Dnepr-Ingulets, Dnepr-Krivoy Rog, Inguleits, Kakhov, northern Crimea and North-Donetsk [2].

Figure 2. North-Donetsk Canal

In Kazakhstan, the Irtysh-Karaganda canal supplies water to Astana and other settlements and industrial enterprises. This canal was built in 2002 and is 458 km long, 40 m wide and 5-7 m deep. Through 22 pumping stations in the canal, the water rises to 418 meters. There are 14 reservoirs and more than 39 large hydraulic structures in the canal system [2].

Figure 3. Irtysh-Karaganda Canal

The largest inter-basin canal in China is called the Grand Canal of China. It is 1,930 km long and connects Beijing in the northeast and Hangzhou in the south. Currently, large-scale projects are being implemented in China within the framework of inter-basin water discharge forms. In particular, the design and construction of a canal project to discharge water from the Yangtze River into the northern Hai River Basin is underway. Design parameters of this canal: length 1300 km, average width 40 meters, water capacity 250 m^3/s, estimated cost 59 billion [2].

Figure 4. The Grand Canal

The Suez Canal, which connects the two oceans, connects Port Said in the Mediterranean and the Suez Canal in the Red Sea. Its main part passes through the territory of the Sinai Peninsula, with a total length of 168 km and an average depth of 20 meters [2].

Results and Discussions. Scientific and technical problems of dumping water resources from the Chirchik-Ahangaron river basin to the Mirzachul region have been in the spotlight of water management scientists since the 90s of the last century, and a number of options have been proposed. The water resources of the irrigated lands of Tashkent region, as well as the water resources formed in the region provided to the needs of industry, manufacturing enterprises and for the drinking purpose are not fully

untapped. Therefore, options for discharging some of the excess water formed in this basin into the Mirzachul area and into the Aydar-Arnasay system of lakes have been considered (Figure 5). In the 70s and 80s of the last century, the Aydar-Arnasay system of lakes was formed as an inland water basin, and since 2008 it has been the second largest in the territory of the Republic of Uzbekistan.

According to the proposed option, 1.8 km^3/year of water resources will be delivered from the source of the Gazalkent hydroelectric power station on the Chirchik River through the Karasuv canal in Tashkent region, then along the Ahangaron river, by passing the Tuyabuguz reservoir to the Syrdarya river. Passing through the Syrdarya River through the duke structure and its hydraulic calculations were carried out. The scheme of connecting the project canal route with the interstate Dustlik canal in the left bank of the middle reaches of the Syrdarya River and the location of a new canal route and hydraulic structures from the Dustlik canal to the Aydar-Arnasay lake system have been developed.

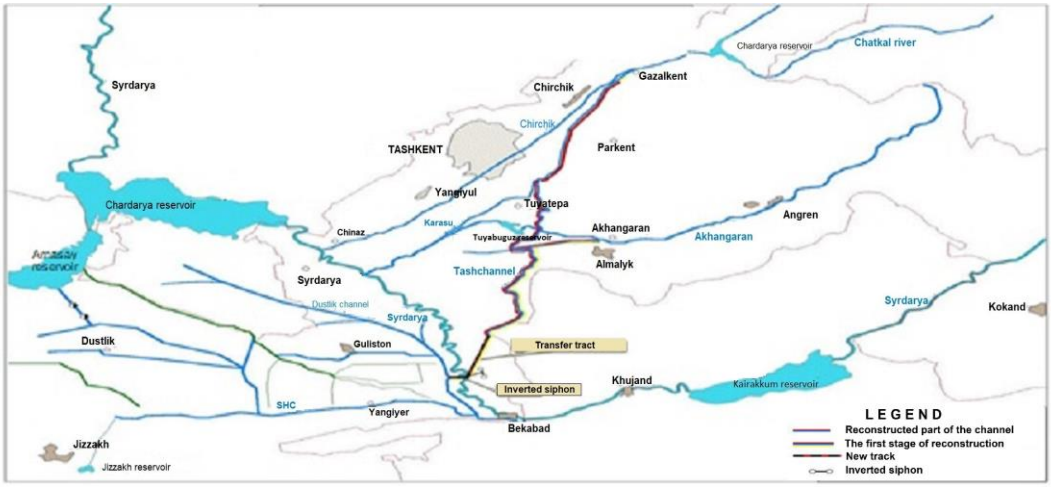

Figure 5 Canal route for discharge of water resources from the Chirchik-Ahangaron river basin to the Mirzachul area

However, the project was not supported, given that the implementation of this option will reduce the amount of water required for the Bozsuv tract and negatively affect the implementation of the state program for the development of hydropower in the country for the 2017-2022 years.

In addition, 100 km of the canal was to pass through densely populated areas and large industrial enterprises in Tashkent and Syrdarya regions, as well as irrigated areas with high score bannet, which could cause major social and economic problems.

Therefore, this project was not implemented. However, currently, on average, 1.2 billion m^3/year of water resources are discharged in vain into the territory of the Republic of Kazakhstan via the Syrdarya River within a year within the limits of the Republic of Uzbekistan through the Bozsuv diversification canal.

Conclusion:

The world experience of construction and operation of large facilities shows that the connection of water basins poses natural, environmental and man-made problems, as well as social and economic benefits. Therefore, before implementing any major project, it is necessary to research the soil and climatic conditions of the region, the design of the canal route and research work on its hydraulic parameters, including the methods of hydraulic calculations of inter-basin derivation canals and hydraulic structures and the widespread requires wide using of innovative developments.

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