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Socio-geographical and geoecological features of water supply in the Central Asian region

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Abstract. The article makes an attempt to highlight the issues of water resources management in the Aral Sea Basin (ASB), the problems arising on the way to their solution, or minimization from the standpoint of environmental sustainability and balanced nature management, as well as the problem of regional cooperation.

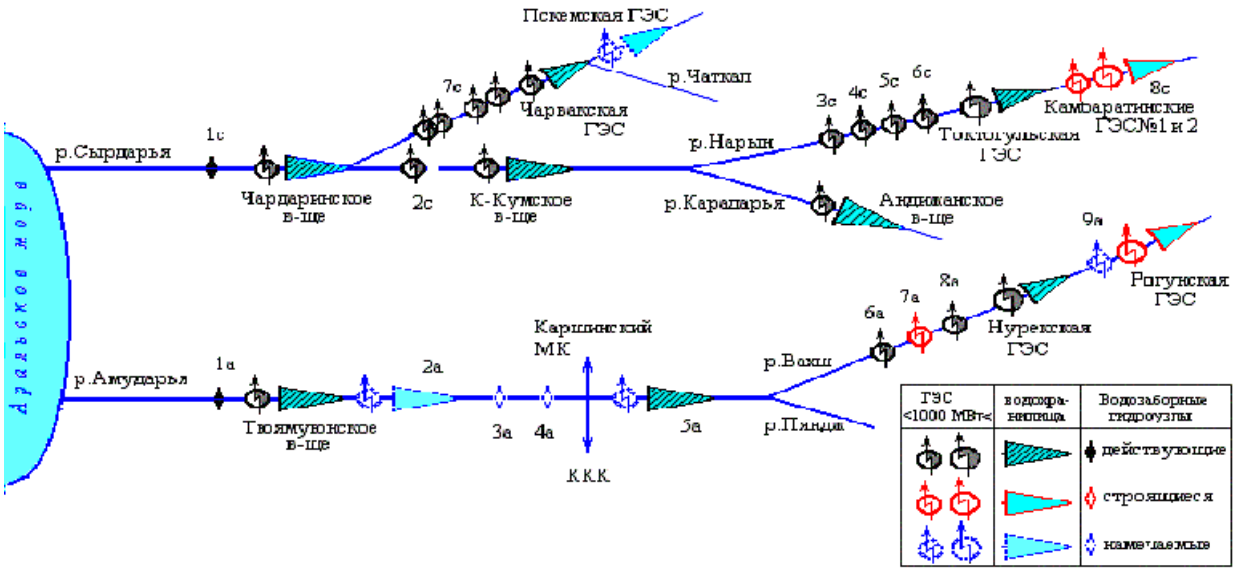
Keywords: Amu Darya, Syrdarya, transboundary rivers, water salinity, ecology, Central Asia, irrigated areas.

The state independence acquired by the countries of Central Asia contributed to the rupture of economic and interstate relations between them. The problems facing the Central Asian states of finding ways that will help them approach economically and technologically developed countries require finding new ways of integration, mutual understanding, especially in the area of water resources distribution.

The territory of the Central Asian states occupies a total area of about 4 million km^2. It covers the subtropical zone and the southern outskirts of the temperate latitudes and in the geographical aspect is a vast closed drainage area of the closed Aral-Caspian basin. Being in the zone of inland deserts and remoteness from seas and oceans, it is characterized by a purely continental climate.

According to forecasts of international research organizations, the next 20 years may become a turning point for the development of world civilization due to the threat of water shortage. In the states of Central Asia today, the "water issue" has become a serious factor in interstate relations and regional security. With high rates of population growth and a low level of economic development, the labor market now and in the future will experience significant demographic pressure. A significant increase in the demographic potential of the region with an underdeveloped economy can exacerbate the problems of employment, labor migration, and increase social tension. Analysis of available sources on this issue [3, 4] and our own calculations [1,2] allowed us to reach the next level of generalization.

Features of the planned socio-economic development of the countries of Central Asia and the region as a whole are largely determined by the availability of water and energy resources (WER), which are extremely unevenly distributed throughout the region. The main sources of water supply for the region - the Syrdarya and Amu Darya rivers, are mainly formed in Kyrgyzstan and Tajikistan.



р.Сырдарья		р.Амударья	
1с - Кзылординский г/у	5 с - Ташкумырская ГЭС	1а - Тахиаташский г/у	5а-контррегулирующее вод-ще
2с - Фархадская ГЭС	6с - Курпсайская ГЭС	2а - Сазанакское в-ще и ГЭС	6а - Головная ГЭС
3с - Учкурганская ГЭС	7с - 18 ГЭС Чирчик-Бозсуйского каскада	3а - Чарджоуский г/у	7а - Сангтудинская ГЭС
4с - Шамалдысайская ГЭС	8с - Камбаратинское вод-ще	4а - Кызылаякский г/у	8а - Байпазинская ГЭС
			9а - Шуробская ГЭС

Fig. 1. Simplified linear diagram of the Syrdarya and Amudarya river systems (according to Starikov N.P., 2006, funds of the SHC "Barki Tojik")

These states today do not have the technological capabilities to discover commercial reserves of oil and gas, although, according to experts' forecasts, there are industrial reserves of hydrocarbons in the depths of these republics. For Kazakhstan, Turkmenistan and Uzbekistan, this ratio develops in the opposite way, and they are the largest regional exporters of hydrocarbon raw materials. In the structure of energy production in the upstream countries, over 80% is accounted for by hydropower, while about half of their domestic needs for primary energy resources they have to meet through imports from downstream countries. The presence of SER in the runoff formation zone and the absence of technologically and economically accessible industrial reserves of organic fuel there dictate the need to develop the hydropower potential of rivers. The problems of further development of the SER countries of the region, the maintenance of water facilities require their resolution, taking into account the emerging economic contradictions and the need to develop mechanisms for economic integration. The destruction of stable ties that operated within the framework of the previous water-energy scheme, economic and financial difficulties, deterioration of the technical condition of the water-management and energy infrastructure, the different periods of economic reform in the countries of the region, the resource-absorbing style of management predominantly determine the ineffective use of SER, the deterioration of the technical condition of the water management and fuel and energy infrastructure of the countries of the region.

The measures taken to control the state and use of water resources of transboundary rivers, accounting for water intake and making forecasts of water resources are insufficient. Existing intergovernmental agreements on the procedure for the use of SER, weaken the economic, energy and environmental security of the region. Of the two components necessary for agriculture in these conditions, it is possible to note the availability of free land reserves (tab. 1) and the fact that all countries in the region, to one degree or another, plan to use them in the future (tab. 2).

Table 1

Availability of free land reserves

Country	Area, ha	Suitable for processing	Worked area	Actual irrigated area
Kazakhstan	34440000	23872400	1658800	786200
Kyrgyzstan	12490000	1570000	595000	422000

Tajikistan	14310000	1571000	874000	719000
Turkmenistan	48810000	7013000	1805300	1735000
Uzbekistan	44884000	25447700	5207800	4233400
ASB	154934000	59474100	10140900	7895600

Table 2.

Past and forecasted data on the areas of irrigated land, thousand hectares

Year	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan	Total
1990	782	410	706	1329	4222	7449
1995	786	416	719	1736	4298	7955
2000	786	415	719	1714	4259	8101
2010	806	434	1064	2240	4355	8899
2025	815	471	1188	2778	6441	11693

This table shows that a relatively small increase in the area of irrigated land is predicted in Kazakhstan, Kyrgyzstan and Tajikistan. However, in countries with the largest area of irrigated land (Turkmenistan, Uzbekistan), a significant increase in the area of irrigated land is expected by 2025 and, accordingly, an increase in water consumption in the agricultural sector of the region's economy, which will significantly increase the shortage of water resources in it and increase competition for water, both inside countries and between them. At the same time, the ecological allowable volume of water use in - 5 Central Asia should be at least 78-82 km per year. Cotton, undoubtedly, remains the leading export item for the future, and the countries of the region will increase its production. The first three countries predict that the increase in the average annual yield by 2025 will be 3.0 t/ha. This figure is 10% higher than in 1990. In Turkmenistan and Uzbekistan, the projected yield for 2025 is significantly higher and will amount to 4.7 and 5.0 t/ha, respectively, which is almost twice the current level of production and the level of production in 1990 (Table 3)

Table 3

Gross production (thousand tons) and average annual yield * (t/ha) of cotton in Central Asia and their forecast

Year	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
1990	323	218	377	*927*	4900

	2.7	2.7	*2.8*	*2.3*	*2.8*
1995	154 *2.2*	88 *2.3*	314 *1.4*	*1.035* *2.2*	3.438 *2.6*
2000	296 *1.9*	91 *2.6*	330 *1.4*	*1.407* *2.2*	3.280 *2.2*
2010	320 *2.8*	107 *2.9*	810 *2.8*	*3.000* *4.5*	4.500 *3.2*
2025	330 *3.0*	140 *3.0*	1.050 *3.0*	*3.600* *4.7*	7.250 *5.0*

*** Average annual yield data are shown in italics.**

At the same time, agriculture itself also does not have sufficient funds to expand production. The yield of the main crops in the Central Asian countries is very low. Naturally, such agricultural production is unattractive for external investors as well.

The region is characterized by population growth [tab. 4]. There are various estimates of the region's population in the near future and their incorrect application, for example, underestimation of labor migration processes [33, 62], can significantly affect the choice of strategic approaches to the parameters of sustainable development.

Table 4

Population of Central Asian countries, million people

Year	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan	Total
1990	16.7	4.3	5.4	3.7	20.3	50.4
1995	16.0	4.6	5.9	4.6	22.9	54.0
2000	14.9	4.9	6.1	5.4	24.3	55.6
2016	17.9	6.0	8.7	5.5	31.85	69.3
2025	25.9	8.4	9.0	13.1	40.3	96.7

Forecasts for 2025 for all five Central Asian republics show a gross population growth in the region compared to 2016 in the amount of 18.9 million people. Based on these data, it follows that by 2025 the size of the entire population of the region will increase with the rate of average annual population growth, in the amount of 1.9%.

In addition, the situation is aggravated by the constantly progressing salinization and degradation of lands, primarily irrigated ones. The area of irrigated land in the ASB, where the salinity of

the top 1 meter soil layer is classified as moderate or severe, accounts for about 35% of the total irrigated land in the basin.

An important role in the deterioration of water use in transboundary rivers of the macroregion is played by the quality of water in these water basins. Using data from the United Nations Economic Commission for Europe (UNECE), the Central Asia Region Environmental Center (CAREC), an analytical report on water quality in the Amu Darya and Syrdarya river basins can be compiled. The analysis showed that an important role in the deterioration of water quality in these water basins is played by collector-drainage waters with an increased content of salts of sulfates, magnesium, nitrite nitrogen, fluorides, and pesticides. In addition to oxygen starvation of rivers, these components lead to the degradation of their biological components, and the ionic and biogenic composition of water deteriorates. Using published statistics on the chemical composition of the river. Syrdarya, the authors provide data on the influence of collector-drainage waters on the total salinity of water in this river basin from the source to the mouth (tab. 5).

Table 5

The influence of collector-drainage waters (CDW) on the total salinity of the river. Syrdarya in modern conditions

Water management area	CDW volume, million m^3/year	Average mineralization, g/l	The volume of salts entering the river, million tons/year
Syrdarya from the source to the Toktogul hydroelectric complex	190	0.75	0.143
From Toktogul hydroelectric complex to Kairakkum reservoir	8680	2.205	19.139
From the Kairakkum reservoir to the Chordara reservoir	3360	3.005	10.097
From the Chordara reservoir to the mouth	1860	3.20	5.952
Total: on the river Syrdarya	14090	9.16	35.331

This table shows that due to the inflow of more than 14.0 million m^3/year of collector-drainage water into the Syrdarya river, the average salinity increased to 9.16 g/l, and more than 35 million tons of mineral salts. Kazakhstan is already sounding the alarm about the incompliance of the water composition of the Syrdarya river with environmental requirements. In particular, the maximum permissible concentration of a harmful substance per unit volume of water (MPC) for chlorine is 0.7 g/l. In fact, this figure is 1.5-2.0 g/l. An important "merit" is also borne by mining and processing enterprises

located in the immediate vicinity of this river, which extract tin, lead, tungsten and other heavy metals. It is long overdue to consider the ecological aspects of the atmosphere together with the problems of respect for the ecology of water basins.

All the above-mentioned problems of water supply and lack of respect for the ecological aspects of water resources are becoming a problem not only economic, but also social. The resources of irrigation and the agricultural production based on them in Central Asia have practically exhausted themselves today and cannot further serve the goals of sustainable economic development of countries and the region as a whole.

It can be seen from this table that due to the flow of more than 14 million m^3/year of collector-drainage water into the Syrdarya river, the average salinity increased to 9.16 g/l, and more than 35 million tons of mineral salts enter this river per year. Kazakhstan is already sounding the alarm about the incompliance of the water composition of the Syrdarya river with environmental requirements. In particular, the maximum permissible concentration of a harmful substance per unit volume of water (MPC) for chlorine is 0.7 g/l. In fact, this figure is 1.5-2.0 g/l.

It is necessary to determine the approaches that control the directions of transformations of the socio-geographical and ecological-demographic positions of the territories neighboring Tajikistan, and to identify the peculiarities of their influence on the socio-economic development of not only Tajikistan, but also neighboring states.

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