

THE RIVERS OF CENTRAL ASIA IN ELECTRICITY PRODUCTION AND WATER SUPPLY

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РЕКИ ЦЕНТРАЛЬНОЙ АЗИИ В ПРОИЗВОДСТВЕ ЭЛЕКТРОЭНЕРГИИ И ВОДОСНАБЖЕНИИ

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Abstract

Hydraulic dams play a dual role on the rivers of Central Asia: they contribute to the production of hydroelectric power and flood control, to keep the flow into his natural course, and are used to regulate the flow of river water for later irrigation of agricultural fields. In order to resolve the real problems on the use of water, in terms of increasing the deficit, it is necessary, in addition to developing new water management system, to study and to provide for the gradual conversion of agricultural production in Central Asia.

Key words: the rivers of Central Asia, the use of water, hydroelectric power, irrigation, water management system.

Аннотация

Гидравлические плотины имеют двойное предназначение на реках Центральной Азии: способствуют выработке гидроэлектроэнергии и борьбе с наводнениями. Для того чтобы сохранить естественный ход потока речной воды, их используют для его регулирования и последующего орошения сельскохозяйственных полей. Для решения реальных проблем использования воды, связанных с увеличением ее дефицита, необходимо в дополнение к разработке новой системы управления водными ресурсами, обеспечить постепенное преобразование агропромышленного производства в Центральной Азии.

Ключевые слова: реки Центральной Азии, использование воды, гидроэлектроэнергия, орошение, управление водными ресурсами.

Introduction

In modern conditions, and in the long term, the shortage of water resources in Central Asia is regarded as one of the major limiting factors in the development of the region. The expected increase in water consumption leads to competition for water at the regional and local levels between, first of all, irrigation and power, as well as other sectors of the economy. Irrigation accounts for more than 90% of the total water intake from the river basins of the region. The share of hydropower in the structure of power generation capacity in the region is 27.3% of the total electricity consumption of the region. In Tajikistan and Kyrgyzstan, this is more than 90%, indicating the dependence of these economies on the availability and usage of water resources. A main flow of the Aral Sea basin (almost 80%) is formed in Tajikistan and Kyrgyzstan. These countries are interested in the use of available water resources for hydroelectric power, whereas downstream countries - Uzbekistan, Kazakhstan and Turkmenistan, will continue to use the same resources for irrigation.

Intense global warming is celebrated across Central Asia and the prospective assessment of water resources in the region, taking into account climate change, shows that none of the existing climate scenarios of warming does not imply an increase in available water resources. Calculations show that by 2050 the volume of river flow in the Amu Darya river basin will be reduced by 10-15% and 6-10% Sur Darya [1, p.5].

Water resources of the rivers: the structure and water supply

Water resources of Central Asia include surface water, glaciers and groundwater sources. In this case, the most important feature of water resources is their uneven distribution throughout Central Asia. All water resources are owned mainly by river basins of Amu Darya and Sur Darya.

The Amu Darya River combines the basins of Surhandarya, Sherobod, Kashkadarya and Zarafshan rivers. The main flow of the Amu Darya is formed in Tajikistan. Sur Darya river basin is located on the territory of four countries- Kyrgyzstan, Uzbekistan, Tajikistan and Kazakhstan. Water resources of the Sur Darya are formed mainly in Kyrgyzstan (Naryn River – over 74%), 16.6% come from Uzbekistan, Kazakhstan accounts for 6.5%, about 3% from Tajikistan.

Table 1 – Natural river flow in the Amu Darya Basin (average annual flow for the period of three cycle of water availability, 1934-1992 km³ a year) [1, p.6]

River Basin	River flow formed within the state					Total river basin of Amu Darya
	Kyrgyz Republic	Tajikistan	Uzbekistan	Turkmenistan	Afghanistan and Iran	
Panj	-	31.089	-	-	3.200	34.289
Vahsh	1.604	18.400	-	-	-	20.004
Kafirnigan	-	5.452	-	-	-	5.452
Surhan-Darya	-	0.320	3.004	-	-	3.324
Kashka-Darya	-	-	1.232	-	-	1.232
Zarafshan	-	4.637	0.500	-	-	5.137
Murghab	-	-	-	0.868	0.868	1.736
Tejan	-	-	-	0.560	0.561	1.121
Atrek	-	-	-	0.121	0.121	0.242
Afghanistan rivers	-	-	-	-	6.743	6.743
Total river basin of Amu Darya	(km ³) 1.604	59.898	4.736	1.549	11.593	79.280
	(%) 2.0	75.6	6.0	1.9	14.6	100

Table 2 – Natural river flow in the Sur Darya Basin (average annual flow for the period of two cycle of water availability years 1951-1974, km³ a year) [2, p.7]

	River flow formed within the state				Total river basin of Sur Darya
	Kyrgyz Republic	Kazakhstan	Tajikistan	Uzbekistan	
Naryn	14.544	-	-	-	14.544
	River flow formed within the state				Total river basin of Sur Darya
	Kyrgyz Republic	Kazakhstan	Tajikistan	Uzbekistan	
Kara-Darya	3.921	-	-	-	3.921
River watershed of Naryn and Kara-Darya	1.760	-	-	0.312	2.072
Right bank of the Ferghana valley	0.780	-	-	0.408	1.188
Left bank of the Fergana valley	3.500	-	0.855	0.190	4.545
Middle stream rivers	-	-	0.150	0.145	0.295
Chirchiq	3.100	0.749	-	4.100	7.949
Akhanganan	-	-	-	0.659	0.659
Keles	-	0.247	-	-	0.247
Aris and Bugun	-	1.183	-	-	1.183

Downstream rivers	-	0.600	-	-	0.600	
Total river basin of	(km ³)	27.605	2.426	1.005	6.167	37.203
Sur Darya	(%)	74.2	6.5	2.7	16.6	100

The main watersheds of the rivers Amu Darya and Sur Darya are located in mountainous and highland areas. The main origins of these rivers are seasonal melt water snow cover, rain water and a less significant volume is ice. Depending on the altitude position of the catchment, the extent and time of precipitation, its share in the power of the rivers or other sources of significant changes in this regard, in one way or another changes the flow regime. Surface runoff is generated mainly in the mountainous parts of the region due to precipitation of the winter season and glaciers concentrated in the mountainous regions of Central Asia and being a perennial reserve of fresh water. At the exit of the rivers from the mountains, share of ice supply does not usually exceed 25% of the annual runoff volume, and total annual runoff of rivers in Central Asia glaciers is only slightly more than 6%. A significant role of rivers nutrition belongs to the ground waters, whose role is especially great in the winter. In most of the rivers ground waters make up 10-25% of the annual flow, some up to 50%. Thus, a feature of hydrograph mountain rivers is the uneven flow distribution within a year or a twenty-four hour period. The share of river flow during the growing period is an average of 74% of the year, in the fall-winter and early spring periods – 26%. The western and north-western parts of the river Sur Darya and Amu Darya, where mountain systems of Pamir- Alai and Tien Shan transfer into a plain, are located on the territory of Uzbekistan. This explains the relatively low river flows in Uzbekistan compared to those in Tajikistan and Kyrgyzstan.

Tablo 3 – Total natural river flow in the Aral Sea basin (average annual flow, km³a year) [2, p.7]

State	River Basin		Aral Sea basin	
	Sur Darya	Amu Darya	km ³	%
Kazakhstan	2.426	-	2.426	2.1
Kyrgyz Republic	27.605	1.604	29.209	25.1
Tajikistan	1.005	59.578	60.583	52.0
Turkmenistan	-	1.549	1.549	1.2
Uzbekistan	6.167	5.056	11.223	9.6
Afghanistan and Iran	-	11.593	11.593	10.0
Total Aral Sea basin	37.203	79.280	116.483	100

It should be noted that almost all the water resources of the region are provided by the snows and glaciers located on the territory of Kyrgyzstan and Tajikistan, and irrigated agriculture is concentrated in the densely populated valleys of the Amu Darya and the Sur Darya, which flow into Uzbekistan, Kazakhstan and Turkmenistan. Despite this situation, nowadays many years of observations of the run-off, for example, in Uzbekistan there is no consistent trend indicating the reduction of water resources. Expected future changes in natural water resources are defined, first of all, with the change in climate parameters in general.

Thus, about 52.0% of the total flow of the Aral Sea is formed within Tajikistan, 25.1% in the Kyrgyz Republic, 10.0% on the territory of Afghanistan and Iran, 9.6% – Uzbekistan, 2.1% – Kazakhstan, and 1.2% – Turkmenistan [3, p.1].

The hydropower potential of Central Asia

Total theoretical hydropower potential of Central Asia is estimated at 750.000 GWz/h, 305.800 GWz/h of which accounts for its technical capacity, which is distributed in the following way: Tajikistan – 143.600, Kyrgyzstan – 72.900, Kazakhstan – 61.900, Uzbekistan – 27, 400. Currently about 11% is domesticated in Tajikistan, about 14% in Kyrgyzstan, about 13 % in Kazakhstan and about 23% in Uzbekistan. These figures themselves indicate significantly unused and sufficiently

studied resources, technically advanced and environmentally friendly ways to generate electricity [3, p.1].

General potential reserves of hydropower resources of Tajikistan are 527100 GWz/h per year, of which 220.600 GWz/h are technically suitable for the development. According to its absolute reserves Tajikistan is ranked eighth in the world. Thus, its reserves of hydropower resources of Tajikistan can not only fully meet its own needs in the very distant future, but also have a strong export potential for sale not only in the Central Asian region, but also abroad. It is necessary to take into account that during the development of hydropower resources by building large hydro power plant with reservoirs, another problem, extremely important for the entire region can be solved. This is a regulation of river flows for irrigation, to export water.

Hydropower resources in Kyrgyzstan are 162.000 GWz/h per year. This potential is currently used only by 10%. Aside from the ability to create large and medium hydropower plants, there are great possibilities of construction micro hydropower plants.

The hydropower potential of Kazakhstan is estimated at 17.000 GWz/h per year, taking into account the possibility of using wind power and bio plants.

Thus, the availability of hydropower resources in Central Asia , their low degree of development , existing experience of utilization, high economic and ecological competitiveness of the thermal stations , and even more so with solar and biogas generation technology , allow us to conclude that in the near foreseeable future, there are no serious grounds to refuse from the development of hydropower.

Effective management of water resources

Priority to water in all the countries of Central Asia is the drinking water supply, but the main participants and consumers of water complexes of Central Asia is irrigation and hydropower, whose departmental interests in the region sometimes do not match. Irrigation, as it is known, is extremely wasteful economic sector on the use of water, besides water distribution infrastructure is significantly outdated and in is need of major renovation.

The collapse of the Soviet state has led not only to the creation of new states in Central Asia, but also the loss of the existing system of water management. The main content of the Soviet system of water management has been centralized distribution of water resources between the countries of Central Asia. This meant, for example, that in Soviet time, Kyrgyzstan was given the right to use only 25% of the water that is formed on its territory, at the same time Uzbekistan and Turkmenistan were allowed unlimited use of water, without compensation the water source to Kyrgyzstan. All costs of Kyrgyzstan were «covered» by subsidies from the central budget.

Based on the foresaid, it should be noted that the issue of water use, to the full extent, emerged relatively recently, after the collapse of the Soviet state. In Soviet times, all decisions on water management were carried out exclusively by Moscow. It was Moscow, who determined the main specialization of the CA countries on cotton production. It was not a choice of the Central Asian countries. Each country of the former USSR in this respect was on equal terms. In a command economy, each country in the Soviet Union, as well as in Central Asia, was required to execute those decisions. This decision by the Moscow defined mono-specialization of agricultural production of the Central Asian countries, which largely relates to the Republic of Uzbekistan, which has to this day the largest area of cotton in their territory.

In these circumstances, in order to develop optimal solutions for water use in Central Asia, it requires not only new solutions for water management, but also new approaches for the gradual reform of agricultural production in Central Asia. It is clear that the change of specialization of agricultural production represents a very complicated task, but it is solvable. Because, despite of all the efforts of the Central Asian countries, at both regional and local levels, the presence of multiple agreements and arrangements between countries, the problem of water resources, still remains unsolved. Cotton cultivation is known to require huge amounts of water, much of which goes beyond retrieve. Given the shortage of water resources, because of a number of natural and socio-economic reasons, Central Asian countries will almost never come to a consensus on the management of wa-

ter resources in the region. This is not because the upstream countries (Kyrgyzstan and Tajikistan) do not always agree with the «proposed» solutions of the downstream countries (primarily Uzbekistan and Kazakhstan) but because such decisions should be accepted by all the countries of Central Asia without damage to any of the countries. That is why it is difficult not to agree with the opinion of foreign experts (Ms. Jennifer Zering, Germany) on the issue. «Many solutions in Kyrgyzstan and Tajikistan are dictated perhaps to the current economic situation, the problems of the budget deficit, external debt, and others. And it would be incorrect to seek their causes in neighboring countries; their allegedly privileged position, their development at the expense of the upstream countries» [2, p.22].

Thus, currently, when there is an active search for mutually acceptable solutions for the effective management of water resources in Central Asia, it is necessary that all the interested parties' exhibit prudence and serious scientific account. We do not need political solutions of «superiority» of one country over another, but solutions that need to provide a safe and stable development of Central Asia.

Even though the situation on water consumption, the paradox is that the water in Central Asia is enough. Excessive loss of water use due to the archaic system of farming in which water consumption per unit of production is three, sometimes ten times the world total. According to specialists, the transition to modern agricultural technologies and efficient water use will save up to half a year flow of transboundary rivers in the region (about 50 km³, which is 4 times greater than the volume of flow, which is formed in the downstream countries – Uzbekistan, Kazakhstan, Turkmenistan) (Kirsanov I., 2006).

International cooperation

International cooperation in the management of water resources can include both development and implementation of joint research projects in Central Asia, the involvement of international organizations in decision-making on management of water resources, and the establishment of an international commission on water resources in Central Asia. In the latter case, we should discuss not only about the representatives of the countries of Central Asia, but first and foremost representatives of international institutions such as the UN.

Among the promising research projects on water and natural resources in Central Asia can be attributed a number of projects proposed by a group of researchers from the American University of Central Asia (AUCA), the Kyrgyz Republic, and Michigan State University (MSU), USA. These are CARIN and CARAN projects.

Main content of CARIN – the creation of the Central Asian Regional Information Network. The creation of such an information network assumes solution of not only creating a database on water resources of Central Asia, but also the use of GIS techniques for monitoring changes in the natural state, including water resources in Central Asia. It is planned to create ground-based information centers for the concentration of information on the state of water resources and for the subsequent use of water users, both on the local and regional levels.

As noted above, in order to resolve the real problems of regulating the use of water resources in Central Asia, efforts should be made towards gradual conversion of agricultural specialization of the Central Asian countries. Policy of mono-specialization on cotton production in the face of declining prices on such raw materials on the international market, despite some temporary benefits in one or two countries in the region, is doomed to failure. Ultimately, it is necessary to understand what is more important – to preserve nature, fertile land, resources, or receive revenues, perhaps significantly, but for a short period of time. In this regard, on the basis of the project CARIN, international research team from AUCA and MSU offers studies in the next project – the CARAN. The essences of the CARAN project – the creation of agriculture network of Central Asian countries. In other words, by conducting the agro-ecological zoning of Central Asia, offer new solutions for agricultural specialization of CA. Such studies in the CARAN should help the countries of Central Asia provide a gradual transition to a specialization, which would be adequate in regard to climate, land

and water resources of Central Asia, i.e. it will developed under the concept of the sustainable management of land and water resources in the direction of climate-smart agriculture in Central Asia.

Conclusion

The main feature of the territorial nature of CA is the presence of two major natural elements. This mountainous area is just over 30% of the total area and plains occupied by deserts and semi-deserts. Such areas are characterized by a significant amount of heat for growing different crops. However, the choice of cotton, in addition to sufficient heat and huge amounts of water and other conditions. These conditions are «successfully» resolved in the administrative-command system in the Soviet Union. The collapse of the Soviet Union has led not only to the destruction of the Soviet system of management of natural resources , including water, but provoked serious problems of mutual regulation of water resources in Central Asia. In fact, these problems began in the time of the union (the water of the rivers Amu Darya and Sur Darya did not reach the Aral Sea, as seen from satellite images 1974-1976.). Now, for real win-win solutions to problems of water management should develop measures to address not only the consequences of past mistakes, but also solutions to address the causes of this situation in Central Asia. Use new possibilities of solving the problem of water resources, thus ensuring a sustainable water management towards climate-smart agriculture of Central Asia.

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