FROM THE ARAL TO ROGUN: THE WATER SITUATION IN THE AMU DARYA BASIN TODAY

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ABSTRACT

Recently, the problems related to water usage in the Central Asia Region have not left the pages of the media and Internet websites. Particular attention is being focused on the most urgent topic—building hydropower stations on the upper reaches of the Amu Darya and Syr Darya rivers, which are the region's main water arteries.

This article presents an analysis of the water situation in the Amu Darya Basin, including the reasons for the shrinkage of the Aral Sea. It draws a picture of how water resources form, are distributed, and used in *the Amu Darya Basin, and gives probable forecasts of the potential positive and negative consequences of building the Rogun Hydropower Plant, keeping in mind the influence of the current global challenges and threats for the region. It draws attention to the weak regional cooperation and the possible development of negative trends caused by limited integration. The difficulties associated with stable water supply to the region's countries can only be avoided by establishing cooperation among them.*

KEYWORDS: ***water resources, water relations of the Central Asian countries, water rights, interstate water distribution, the Aral Sea, environmental protection, the Rogun Hydropower Plant, interstate water cooperation.***

Introduction

The Amu Darya is the largest river in Central Asia (CA); it runs from the Pamir to the desiccated Aral Sea and supplies five countries of the region with water—Afghanistan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. The basin of this great river also encompasses Iran, from where its former tributaries run into Turkmenistan territory.

In CA conditions, water is the wellspring of food and energy production. As the size of the population grows, as well as due to climatic changes and the state of the environment, these countries are beginning to gain a better understanding of the importance of water resources.

The way water is used in the region's countries is dictated by their natural climatic conditions. Whereas in the lower reaches, farming consumes the most water, in the mountains of Kyrgyzstan and Tajikistan, where the area suitable for land irrigation and hydrocarbon energy reserves are limited, it is mainly used for producing electric energy.

When the Central Asian republics were part of the Soviet Union, all of their engineering and communications infrastructure, industry, and even production facilities functioned as a single state system. After they acquired their independence and the former economic ties were broken, this system became one of the main reasons for an unprecedented economic slump in all the region's countries and caused tough competition among them. This was manifested most graphically in the use of the vast hydropower potential of the mountain rivers of Kyrgyzstan and Tajikistan. The matter primarily concerns the Vakhsh River, the second largest tributary of the Amu Darya after the Panj.

The numerous meetings, talks, and discussions between the upstream and downstream countries of the Amu Darya and Syr Darya rivers have not led to an agreement. This is slowing down development of the vast potential of the cheapest and purest electric energy source in the world. It should be noted that not only are Kyrgyzstan and Tajikistan interested in this development, the international community is too. It is expending enormous efforts and funds today to reduce the emission of carbon dioxide into the atmosphere.

The Main Hydraulic Characteristics of the Amu Darya River

The Amu Darya is formed from the confluence of the Panj and Vakhsh rivers. This river stretches for 2,540 km from the source of its main tributary, the Panj, while the basin occupies an area of

309,000 sq. km. The tributaries of the Amu Darya, the Kafirnigan, Kunduz, Surkhan Darya, and Sherabad, are formed and merge with it in the middle reaches. The Amu Darya does not have any more tributaries further down its course toward the Aral Sea. The Amu Darya is mainly fed by snow-melt water, therefore the maximum discharge is seen in the summer and the minimum in January-February.

According to the long-term average annual data, 78.46 cubic km of water forms in the Amu Darya Basin a year. Internal-drainage water courses are also included in the total volume of its water resources (due to their hydrographic pull toward it); among them are such rivers as the Zeravshan (with a long-term average annual runoff of 5.27 cubic km), the Kashka Darya (1.34 cubic km), and the Murgab, Tejen, Atrek, and northern rivers of Afghanistan—Khulm, Balkhab, Sari Pul, and Kaysar (the total volume of their runoff is equal to 4.86 cubic km). The total runoff of the mentioned rivers, keeping in mind subsurface and unaccounted surface runoff, amounts to 11.51 cubic km (see Table 1). Thus, the runoff the Amu Darya itself amounts to 66.9 cubic km.

Table 1

Formation of the Surface Runoff of the Amu Darya by River

River	Surface Runoff, *cubic km*		Subsurface Inflow, *cubic km*	Total	
	Accounted	Unaccounted		Volume, *cubic km*	Percentage
Panj	33.4			33.4	42.6
Vakhsh	20.1	0.05	0.07	20.22	25.8
Kunduz	3.47	0.01		3.48	4.4
Kafirnigan	5.49	0.12	0.05	5.66	7.2
Surkhan Darya	3.63	0.06	0.22	3.91	5.0
Sherabad	0.23			0.23	0.3
Kashka Darya	1.34		0.07	1.41	1.8
Zeravshan	5.27		0.03	5.3	6.8
Rivers of North Afghanistan	2.01			2.01	2.6
Rivers of Turkmenistan	2.79			2.79	3.6
Total	77.73	0.24	0.44	78.41	100

Source: *Clarification of the Scheme of Comprehensive Use and Protection of Water Resources of the Amu Darya River*, U.S.S.R. Ministry of Land Reclamation and Water Management, Moscow, 1984 (in Russian).

More than 80% (62.90 cubic km) of the runoff of the Amu Darya is formed in Tajikistan; 6% (4.70 cubic km) in Uzbekistan, 2. 24% (1.90 cubic km) in Kyrgyzstan, 3.5% (2.79 cubic km) in Turkmenistan (with Iran), and 7.9% (6.18 cubic km) in Afghanistan (see Table 2).

Table 2

Formation of the Surface Runoff of the Amu Darya by Basin Country

Country	Water Resources Entering the Amu Darya	
	Volume, *cubic km*	Percentage
Kazakhstan	—	—
Kyrgyzstan	1.90	2.42
Tajikistan	62.90	80.17
Turkmenistan (with Iran)	2.78	3.54
Uzbekistan	4.70	5.99
Afghanistan	6.18	7.88
Total	78.46	100

Source: Main Water Strategy Provisions of the Aral Sea Basin, Tashkent, 1996 (in Russian).

Socioeconomic Value of Water Resources in the Amu Darya Basin

Development of the countries of the Amu Darya Basin depends on the river's water resources. They are indispensable in terms of energy and water supply and promote prosperity, food safety and employment of the population.

At the current stage, agriculture and the hydropower industry are the main water consumers in the Central Asia Region. Only around 7-10% of water resources is used to meet nutritional and industrial needs and develop the fishing industry and other sectors.

The hydropower industry uses only potential hydropower (without changing its amount or reducing its quality). This branch has special significance for Tajikistan, where more than 98% of electric energy is generated at hydropower plants. At present, the main problem in Tajikistan's energy sector is not enough water in the winter, when the natural river runoff is reduced to a minimum, as well as an insufficient volume of regulating reservoir capacity. This prevents long-term regulation of river runoff in favor of all the countries of the Amu Darya Basin.

The lion's share of water resources in the Amu Darya Basin (from 85% to 95% depending on the country) is used in irrigation farming (see Table 3). Irrigation farming began developing in the Amu Darya Basin in the 1960s; it mainly became widespread in the downstream countries that have extensive flatlands.

Table 3 does not include data on Afghanistan, where, according to different sources, more than 300,000 hectares of land are irrigated in the Amu Darya river basin. In particular, according to data

Table 3

Area of Irrigable Land in the Amu Darya Basin in 2000 (by Country)

Country	Irrigation Area	
	thou. hectares	Percentage of total area
Kyrgyzstan	22	0.48
Tajikistan	469	10.31
Turkmenistan	1,735	38.16
Uzbekistan	2,321	51.04
Total	4,547	100

S o u r c e: *Assessment of the Influence of the Rogun Reservoir on the Water Regime of the Amu Darya River*, Scientific Information Center, Interstate Commission for Water Coordination, Tashkent, 2007 (in Russian).

from the World Bank,[1] at present 385,000 hectares are irrigated in this zone with a presumed increase to 443,000 hectares, including 148,000 hectares directly from the basins of the Amu Darya and the internal-drainage Khulm, Balkh, Sari Kul, and Shirintagao rivers.

Fundamental Legal and Institutional Principles of Interstate Use of the Water Resources of the Amu Darya River

As early as Soviet times, a "Scheme of Comprehensive Use and Protection of Water Resources" was compiled for the Amu Darya river basin to assess the available water resources and land suitable for irrigation. This Scheme kept in mind further development of agriculture, industry, and other branches of the national economy, as well as population growth. It was drawn up by the Central Asian Hydro-Engineering Institute of the Cotton Industry under the U.S.S.R. Ministry of Land Reclamation and Water Management (Tashkent), which at that time had a regional status. Later, such schemes were used to determine the potential irrigation areas and corresponding limits of water intake for each republic.

The Scheme for the Amu Darya River was repeatedly re-examined and revised keeping in mind the comments and proposals of the region's republics. In 1984, this led to compilation of a clarified

[1] See: M. Ahmad, M. Wasiq, "Water Resource Development in Northern Afghanistan and Its Implications for the Amu Darya Basin," *World Bank Paper*, No. 36, 2004.

scheme approved by Protocol No. 566 of the U.S.S.R. Ministry of Land Reclamation and Water Management of 10.09.1987.

According to the Alma Ata Agreement of 1992 and the Nukus Declaration of 1995, the limits established by Record No. 566 were taken as a basis for further distribution and use of the water resources in the Amu Darya river basin.[2] These documents still play a determining role in managing the water resources of the interstate rivers in Central Asia and declare recognition by the region's countries of earlier established procedures and conditions of inter-republican water apportioning and water distribution. In particular, Part 1 of the Nukus Declaration titled "Adhering to the Principles of Sustainable Development" notes: "We agree that the Central Asian states recognize previously signed and valid agreements, contracts, and other regulatory acts that regulate relations among them regarding water resources in the Aral Basin and adopt them for unconditional execution."

In order to resolve problems relating to regulation, rational use, and protection of the water resources of the region's interstate sources, the Central Asian countries, guided by the Alma Ata Agreement of 1992 and current regulatory documents, created an Interstate Commission for Water Coordination (ICWC) on parity conditions.

The ICWC, the members of which are the leaders of the water management bodies of the CA countries, is called upon to adjust the set interstate limits and coordinate corresponding reservoir operating regimes in keeping with clarified forecasts (depending on the actual water content and the water management situation that has developed). For this purpose, four sittings are held at which water intake limits from the stem of the Amu Darya and Syr Darya rivers are approved for the summer and winter periods. Control over the management of the most important water intake facilities on the rivers was transferred to Amu Darya and Syr Darya Basin Water Management Organizations as early as 1987.

The Amu Darya Basin Water Management Organization, which has national branches in Tajikistan and Turkmenistan, is engaged in executing the decisions of the ICWC regarding the management and use of the water resources in the Amu Darya Basin.

Interstate Water Apportioning in the Basin of the Amu Darya River: Limits and Their Adjustment

During Soviet times, inter-republican water apportioning in the basin of the Amu Darya River was carried out on the basis of decisions of the Scientific-Technical Council of the U.S.S.R. Ministry of Land Reclamation and Water Management and in correspondence with the above-mentioned "Scheme of Comprehensive Use and Protection of Water Resources."

When compiling this scheme, primary attention was given to the existence of water resources suitable for use. According to estimates, the volume of water resources available in the Amu Darya Basin, consisting of surface, subsurface, and recycled waste and collector and drainage water, amounted to 93.42 cubic km/year.

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[2] See: *Agreement on Cooperation in Joint Management of the Use and Protection of Water Resources of Interstate Sources, 18 February, 1992, Almaty, Kazakhstan* and *The Nukus Declaration of the Central Asian Heads of State*, 20 September, 1995, Nukus, Uzbekistan.

Water apportioning among the countries is shown in Table 4. These data, which relate to the entire Amu Darya Basin, including the internal-drainage Zeravshan and Kashka Darya rivers, also reflect recycled water and unavoidable runoff discharge and losses.

Table 4

Distribution of the Water Resources Available in the Basin of the Amu Darya River

Country	Water Resources Coming into the Country	
	Volume, *cubic km/year*	Percentage
Kyrgyzstan	0.42	0.5
Tajikistan	10.63	12.61
Turkmenistan	27.07	32.1
Uzbekistan	46.2	54.79
Total	84.32	100

Source: *Protocol No. 566 of the U.S.S.R. Ministry of Land Reclamation and Water Management* (1987) (in Russian).

The schemes also established the volume of water resources for intake directly from the stems of the Amu Darya Basin rivers at the level of their complete exhaustion. It was presumed that this level would be reached by 1995-2000.

The proportion of water apportioning among the countries with intake of water directly from the stem of the rivers is shown in Table 5.

Table 5

Distribution of Water Resources from the Stem of the Amu Darya River

Country	Water Resources Coming into the Country	
	Volume, *cubic km/year*	Percentage
Kyrgyzstan	0.40	0.60
Tajikistan	9.50	15.40
Turkmenistan	22.0	35.80
Uzbekistan	29.60	48.20
Total	61.50	100

Source: *Protocol No. 566 of the U.S.S.R. Ministry of Land Reclamation and Water Management* (1987) (in Russian).

Since the collapse of the Soviet Union, the Interstate Commission for Water Coordination has been making annual adjustments to the fixed water quotas keeping in mind the water level forecast for the particular year. Table 6 shows the averaged data with respect to the fixed quota adjustment for 1992-2010.

Table 6

Distribution of ICWC Water Resource Limits from the Stem of the Amu Darya River

Country	Water Resources Coming into the Country	
	Volume, *cubic km/year*	Percentage
Kyrgyzstan	0.202	0.36
Tajikistan	8.8	15.61
Turkmenistan	20.1	35.62
Uzbekistan	21.3	37.74
The Aral and Aral Region*	6.014	10.67
Total	56.4	100.0

* By a decision of the ICWC member states, the Aral and Aral Region together are recognized as a separate consumer on a par with countries.

Source: Data of the Amu Darya Basin Water Management Organization for 1992-2010.

All the data on available water resources, on intake from river stems, and on limits adjusted by the ICWC are given in Table 7.

Table 7 shows that between 1992 and 2010, the average limits were much less than those set by the Scheme. In addition, the limits of all countries dropped, while the percentage of the Aral Sea (along with the Aral Region) rose almost two-fold. In so doing, the total limit was significantly reduced. Keeping in mind the percentage of the Aral Sea and Aral Region, it amounts to a total of only 56.4 cubic km/year, or 91.7% of the total limit established, with water intake from the river stems (61.5 cubic km/year). And if we take the limit with the percentage of the Aral Sea as the basis (64.65 instead of 61.5 cubic km/year), this figure will drop to 87.2%.

Thus, the difference between the limits set by Protocol No. 566 and the Interstate Commission for Water Coordination (1992-2010) amounts to 8.25 cubic km/year (64.65 – 56.4 cubic km/year). It should be noted that based on long-term observations, the Scheme envisaged average annual runoff losses from the streams of the rivers and reservoirs in the Amu Darya Basin equal to 3.85 cubic km, and they too were not included in the total volume of available water resources. Correspondingly, runoff losses should not be included in the volume of 8.25 cubic km/year, so, keeping this in mind, the difference will reach 12.1 cubic km.

It is also worth noting the difference in established limits both in percentage and in the absolute calculus. In percentages, the data for Kyrgyzstan (an almost two-fold decrease from 0.6% to 0.36%) and Uzbekistan (a decrease from 48.2 to 37.74%) significantly differ. Whereas for Kyrgyzstan this decrease does not have a great effect on the absolute indices (0.2 cubic km/year), for Uzbekistan it is an impressive amount (decrease in limit by 8.3 cubic km/year). A decrease in limit of 0.7 cubic km/year is seen in Tajikistan, and of 1.9 cubic km/year in Turkmenistan.

Table 7

Distribution of ICWC Water Resource Limits from the Stem of the Amu Darya River (A Summary Table)

Country	Available Water Resources		Water Resources from River Stems		Adjustment of ICWC Water Resource Limits	
	Volume, *cubic km/year*	Percentage	Volume, *cubic km/year*	Percentage	Volume, *cubic km/year*	Percentage
Kyrgyzstan	0.42	0.5	0.40	0.60	0.202	0.36
Tajikistan	10.63	12.61	9.50	15.40	8.8	15.61
Turkmenistan	27.07	32.1	22.0	35.80	20.1	35.62
Uzbekistan	46.2	54.79	29.60	48.20	21.3	37.74
The Aral and Aral Region*	3.15**		3.15**		6.014	10.67
Total	84.32	100	61.50	100	56.4	100

* By a decision of the ICWC member states, the Aral and Aral Region together are recognized as a separate consumer on a par with countries.

** The Scheme established the limit for the Aral Region and Aral Sea as sanitary flow augmentations in the amount of 3.15 cubic km/year and it was not included in the total volume of available water resources. When this index is included, the total volume of available water resources will be equal to 87.47 cubic km/year, while the overall limit of water apportioning directly from the rivers will amount to 64.65 cubic km/year.

The ICWC limits were mainly established in keeping with the forecast data of hydrometeorological services. The analysis presented shows that at the interstate level, the current system for monitoring the formation of water resources, their use in the economy and for sanitary-environmental purposes, as well as runoff losses is in need of improvement.

Actual Use of Limits

Both objective (natural climatic) and subjective factors (managerial, organizational, economic, and so on) influence use by the individual countries of the basin of the limits established every year by the ICWC.

Objective factors in Tajikistan include the mountainous terrain, sloping land, areas with steep inclines, high natural draining, and relative absence of salinity of the irrigated soil. The main subjective factors are paid water supply to consumers, the high cost of spare parts for pumping power equipment, significant agricultural outlays, and breakdown of the unified Soviet irrigation farming management system.

By overcoming the influence of these factors, Tajikistan was able to save a large amount of agricultural water. Although water resource management system is still undergoing improvement, annual economy of water has already reached 1.54 cubic km. In the last 5-6 years, this figure amounted to 1.8 cubic km, or around 20% of the limit.

Use of the annual ICWC limits by other countries of the basin (without Afghanistan) (see Table 8) also depends on different factors inherent in one or the other of them. In so doing, free water supply, inefficient irrigation and drainage infrastructure, salinized soil, and inefficient watering methods mainly lead to wasteful use of water even in low-water years.

Table 8

Adjusted ICWC Limits and Actual Water Use in the Amu Darya Basin

Country	Water Resources Coming into the Country, *cubic km/year*		
	Limit	Actual	Percentage
Kyrgyzstan	0.202	0.008	4
Tajikistan	8.8	7.3	83
Turkmenistan	20.1	18.7	93
Uzbekistan	21.3	20.2	95
The Aral and Aral Region*	6.014	8.1	135
Total	56.4	54.31	

* By a decision of the ICWC member states, the Aral and Aral Region together are recognized as a separate consumer on a par with countries.

Source: Data of the Amu Darya Basin Water Management Organization for 1992-2010.

Water consumers on the middle and lower reaches of the Amu Darya most often encounter problems relating to the distribution of water resources. They experience particular difficulties when there is not enough water runoff to maintain the ecosystem of the marshes and natural delta zones of the Aral Sea. Despite the efforts undertaken, it is not possible to avoid the disproportions in water consumption.

An analysis of the data of the Amu Darya Basin Water Management Organization showed that a significant channel imbalance is noted in the Kelif-Samanbai section. In 2008-2010, its total amount in this section amounted to 32.1 cubic km, or more than 10 cubic km a year.[3] This is a very large figure, it is almost 1.5-fold higher than the amount of water actually used by Tajikistan.

This gives rise to the question: where is such a large amount of water going? Filtration and evaporation losses are excluded since, as noted above, they were taken into account back in Soviet times when drawing up the Amu Darya Scheme and were equal to only 3.85 cubic km (and were only from the streams of the rivers and reservoirs throughout the entire Amu Darya River Basin).

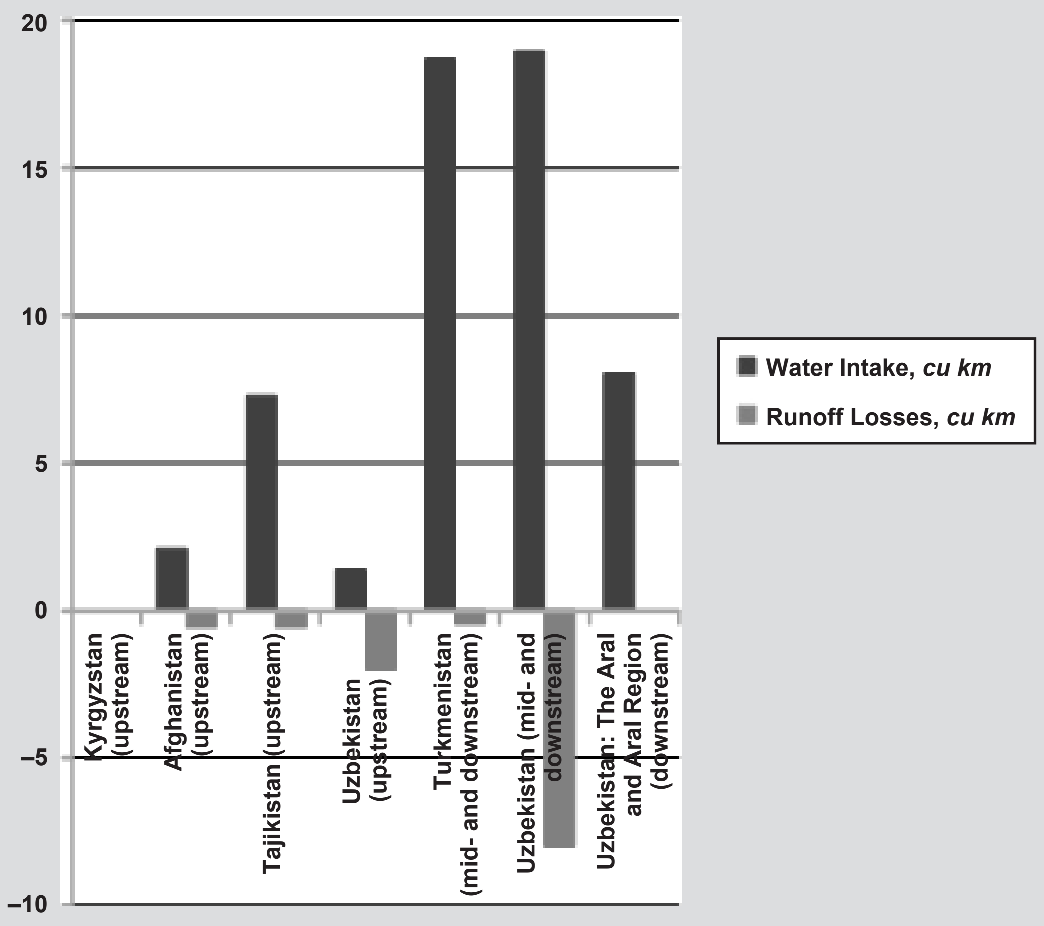
Due to a misunderstanding of the situation, the high water intake in the upstream countries is often given as the main reason for insufficient irrigation water and deterioration of the environmental situation on the lower reaches of the Amu Darya (including desiccation of the Aral Sea).

Figure 1 clearly shows in which part of the basin the main water intake and so-called water losses occur. It is entirely clear that the upstream countries cannot play a significant role in improving the water supply and the environmental situation in the lower reaches of the Amu Darya.

[3] See: Report of the Commission Sitting on a Data Analysis of the Amu Darya Basin Water Management Organization, 17-19 February, 2011, Tashkent.

Figure 1

Volume of Water Intake in Different Countries of the Basin



Source: The figure is drawn in keeping with the data of the Amu Darya Basin Water Management Organization.

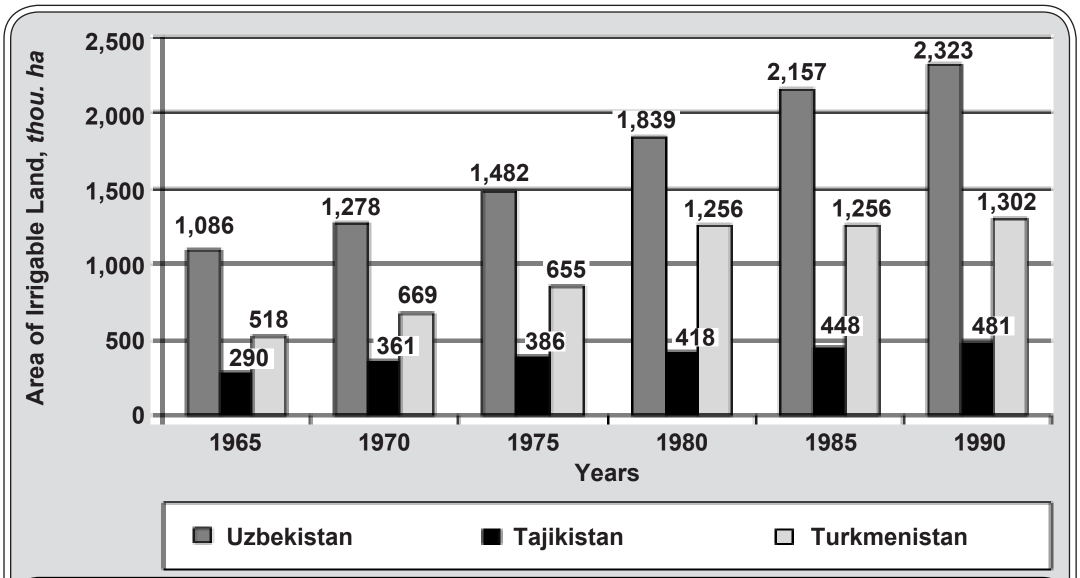
Weak management, poor quality planning, and inefficient use and unreliable control of water use plan performance in the mid- and downstream countries have caused the water supply problems on the lower reaches of the Amu Darya.

Environmental Aspects

The main components of the ecosystem are water and land. Water plays a much more important role in retaining the environmental balance in an arid zone than in zones with sufficient moisture. The environmental problems in the Amu Darya Basin began as a result of intensive expansion of the area of irrigable land that occurred in the 1950s-1980s; over the span of three or four ten-year plans, this area increased from several hundred thousand to 2.3 million hectares (see Fig. 2).

Figure 2

Increase in the Area of Irrigable Land in the Amu Darya Basin in the Downstream Countries



Source: The figure is drawn in keeping with the data from [www.cawter-info.net].

Despite the fact that the Scheme established irrigation limits for each of the basin's countries, according to some information, the unofficial development of new land continues. For example, according to V.A. Dukhovny and A.N. Sorokin,[4] as early as 2000, Uzbekistan and Turkmenistan exceeded the limits for irrigable land area established by the Amu Darya Scheme by 47,000 and 385,000 ha, respectively. In so doing, the areas of irrigable land in these republics reached a total of 4,547 thou. ha.

The increase in area of irrigable land led to an increase in water intake, particularly since the specific water consumption per hectare of land in the Amu Darya Basin is very high and is much higher than the corresponding international indicators. As of today, between 12,000 and 18,000 cubic meters of water per hectare of land is used for irrigation in the Amu Darya Basin, which leads to an increase in the amount of salinized and swampy land. The river basin is becoming more salinized down stream. This is largely related to the abundant watering and unprecedented accumulation and rise in mineralized groundwater.

In order to carry out leaching operations on this land in the winter and improve its productivity, the downstream countries of the Amu Darya Basin had to use additional billions of cubic meters of water which, without reaching the Aral Sea, are diverted into special reservoirs. The latter are located in hollows and depressions and cause the level of groundwater to rise even more.

[4] See: V.A. Dukhovny, A.N. Sorokin, *Otsenka vliianiia Rogunskogo vodokhranilishcha na vodny rezhim reki Amudarii* (Assessment of the Influence of the Rogun Reservoir on the Water Regime of the Amu Darya River), Scientific Information Center, Interstate Commission for Water Coordination, Tashkent, 2007.

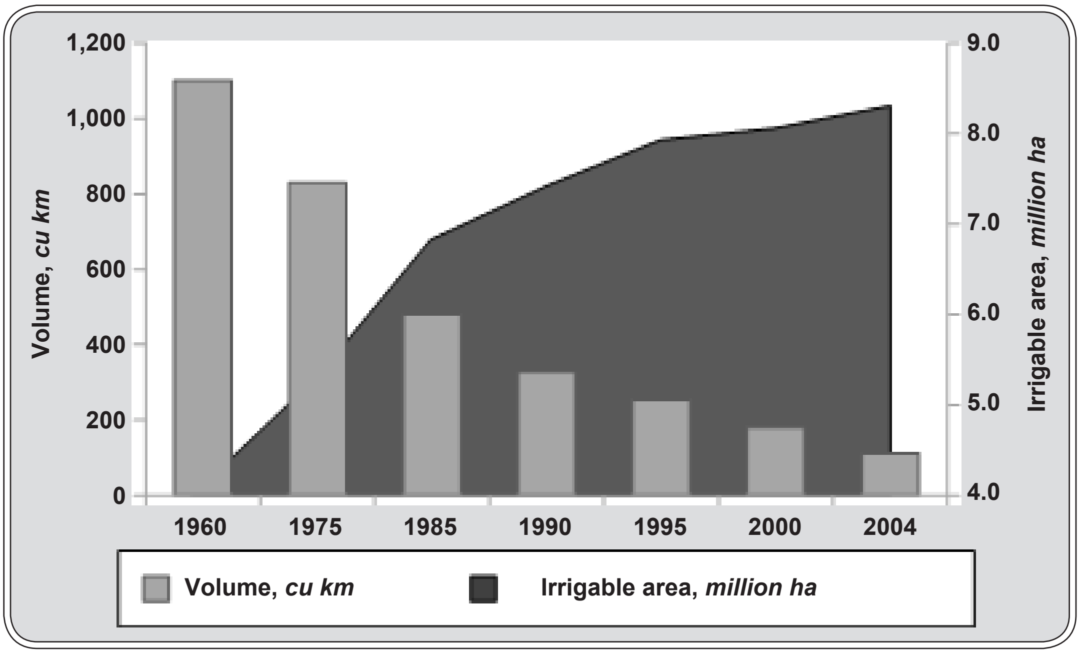
The salination of increasingly larger areas of land in the Amu Darya Basin can be stopped by using water-saving and other modern irrigation technology, as well as modernizing the rest of the irrigation-drainage infrastructure. This would also save large amounts of water, the supplies of which are shrinking with each passing year due to climate changes, while the growing population is making an increasing demand on them.

Problem of the Aral Sea

The Aral Sea, once the fourth largest internal saltwater lake in the world, is shrinking due to assimilation of its water resources and development of irrigation farming. At the beginning of the 1960s, up to 60 cubic km of water reached the Aral Sea from the region's two main rivers—the Amu Darya and the Syr Darya. In so doing, keeping in mind precipitation and evaporation, a certain balance in the level of the sea was retained. However, the increase in area of irrigable land caused an increase in water intake from these rivers, which ultimately led to desiccation of the Aral Sea (see Figs. 3, 4).

Figure 3

Change in the Volume of the Aral Sea and Increase in the Area of Irrigable Land in the Aral Sea Basin

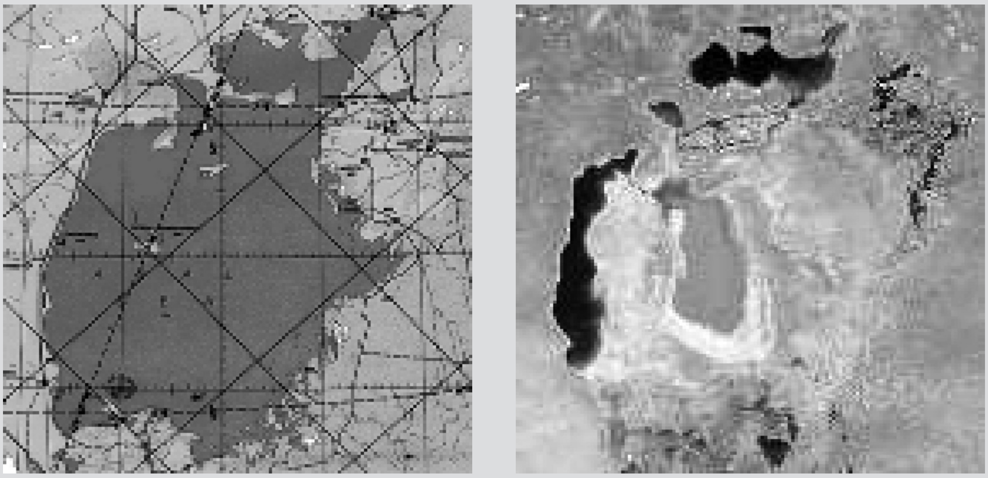


Between 1960 and 2000, the irrigable area in the region increased almost two-fold, reaching more than 8 million hectares[5]; the matter primarily concerns downstream countries with large areas of flatland.

[5] See: Data from the Scientific Information Center of the Interstate Commission for Water Coordination, available at [http://www.icwc-aral.uz/general_ru.htm].

Figure 4

Change in Area of the Aral Sea from 1973 to 2007



1973 2007

As early as Soviet times, a certain quota of water was established that had to enter the Aral Sea from both of the mentioned rivers in order to save it. For example, the Schemes of Comprehensive Use of Water Resources stipulated an average quota of 6.42 cubic km, including 3.15 cubic km from the Amu Darya River (these quotas could vary depending on the water volume for the year).

Every year, the region's countries supply huge amounts of water for the Aral Sea and the Aral Region. According to ICWC data, in 1992-2010, the average annual water supply volume to the Aral Sea and the Aral Region amounted to 14.9 cubic km, which is 2.3-fold higher than the quotas set by the schemes. In so doing, the actual annual average water supply for the same period amounted to 17.2 cubic km, being twice as high as the actual annual water intake of Tajikistan from the Amu Darya and Syr Darya basins.

The Aral Sea should also receive additional unused annual water quotas from other countries, including 244.3 million cubic meters from Kyrgyzstan and 1,495.46 million cubic meters from Tajikistan (average data for 1992-2010). A simple arithmetic calculation shows that keeping in mind the unused quotas, the Aral Sea should receive an additional quota of around 19 cubic km of water every year.

However, reality presents a very different picture. The Aral Sea neither receives its due quota, nor the unused water from Tajikistan and Afghanistan. The reason is that a large portion of the water is lost as a result of the inefficient irrigation systems, which barely reaches 30-40%. The largest losses in filtration and lowest efficiency indices are seen in the middle and lower reaches of the Amu Darya. The research carried out showed that only 20% of the total water volume is productively used, while the other 80% is irretrievably lost.

All of this has led to the previous volume of water in the Aral Sea shrinking more than 10-fold (from 1,015 to a little more than 90 cubic km), while its area has decreased almost 6-fold (from 68,000 to 12,000 sq. km). It is obvious that an increase in water intake volume due to lagging irrigation technology and the rapid population increase in the water consumption countries is inevitably leading to the sea disappearing completely.

The existing data show that desiccation of the Aral Sea has already become irreversible. Its restoration is impossible without impermissible detriment to the economies of the region's countries. In so doing, the main blow will be dealt to the downstream countries, where more than 85% of the region's irrigable land is located.

Building Hydropower Plants and Their Contribution to Improving the Socioeconomic and Environmental Situation in the Basins of Interstate Rivers

The world's developed and developing countries that have common river basins are actively cooperating with each other in the joint use of water and hydropower resources, promoting a general increase in prosperity. The need for and benefit of this cooperation is confirmed by a whole series of examples, among which the agreement between the U.S. and Canada on the Columbia River, between the U.S. and Mexico on the Colorado River, between SAR and Lesotho on the Orange River, and others can be mentioned.

More than 450 dams with hydropower stations and a total reservoir volume of around 77 billion cubic meters have been built in the basin of the Columbia River, which produces half of the electricity used by the northwest districts of the U.S.[6] (see Fig. 5). The hydraulic engineering installations on the river protect the population settlements from flooding, supply the irrigation systems with water, and create conditions for navigation and the cultivation of valuable fish species. The revenue received by the U.S. and Canada from mutual cooperation amounts to hundreds of millions of dollars.

Ten comprehensive reservoirs located in the Colorado River Basin supply the irrigation systems and many branches of the U.S. and Mexican economy with water. The total regulating volume of only two of them (Lake Powell and Lake Mead) amounts to approximately 73 cubic km/year, which is four times higher than the average long-term runoff of the Colorado River (18.6 cubic km/year).[7]

According to some estimates, the absence of cooperation in joint use of CA's water and hydropower resources, which leads in particular to a lack of price coordination for electric power, leads to losses at the interstate, regional and international levels in Tajikistan and Uzbekistan alone of no less than $160, 280, and 800 million, respectively. In the current economic conditions of the region's countries and with the high level of poverty of their population, such omissions are impermissible. In this respect, I would like to note that nature has blessed Tajikistan with unique geomorphologic and hydraulic resources for producing hydro power and their integrated use in the interests of all the countries of the Amu Darya Basin.

However, the water supply situation is deteriorating from year to year, which is related to population increase and climate change. For example, according to experts, during the 20th century, the region's glacier resources shrank by almost 30%, and this trend is steadily continuing. The forecasts presume further melting of glaciers and a change in river runoff from insignificant (5-10%) to extremely significant indices (10-40%) in the long term.

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[6] See: *Columbia Riverkeeper. Columbia River Facts*, available at [http://columbiariverkeeper.org/the-river/facts/].

[7] See: Ch. Cullom, Colorado River Programs Manager, *Binational Water Management in the Face of Climate Change and Increasing Demands: Examples from the Colorado River System—United States and Mexico*, 8/25/2013 (PPT-Report Presentation).

Figure 5

Reservoirs in the Columbia River Basin

Who the dams belong to:

- **U.S. Federal government**
- **Public Utilities**
- **State, provincial, or local government**
- **Private**

The CA countries have a high demographic potential. Their population is growing at an annual rate of 1.5-2%; as of today, more than 60 million people live in the region. It is obvious that population growth will lead to an increase in water consumption, which, according to some estimates, will reach 15-20% by 2030.

At the same time, natural runoff resources in the Aral Sea Basin have been totally exhausted. Today their total use amounts to 130-150% in the Syr Darya Basin and to 100-110% in the Amu Darya Basin. The region's economy is developing in conditions of a growing water shortage.

This situation cannot help but cause alarm; in addition, it could lead to very serious consequences. Urgent measures must be taken to adapt to the severe climate changes and to ensure stable management of water resources.

As the International Water Management Institute (IWMI)[8] report points out, one such measure is building reservoirs and using them to ensure water safety and productivity of farm land (in conditions of fluctuating water volume of the rivers under the impact of climate change). The simplest calculations show the efficiency of building such reservoirs in mountainous regions, from which it is clear that evaporation and filtration losses, just like environmental costs, in such reservoirs are much lower than in reservoirs in flatlands.

Further Construction of the Rogun Hydropower Plant and Its Importance for Regulating the Runoff of the Amu Darya and Improving the Socioeconomic Situation in the River Basin

Disputes about further construction of the Rogun Hydropower Plant are still going on today; they mainly focus on the possible change in the water supply and the environmental situation in the downstream countries. In so doing, the public is deprived of reliable and consistent information.

In order to obtain a realistic picture, it is enough to carry out the simplest calculations based on the following basic data:

1. Average long-term runoff of the River Vakhsh—20.1 cubic km/year.
2. Total reservoir volume— 13.3 cubic km.
3. Available capacity—8.6 cubic km.
4. Projected dam height—335 m.

According to high dam construction technology, reservoirs should not be filled at an accelerated rate. What is more, as the experience of building the Nurek Hydropower Plant shows, erecting dams of such dimensions will take at least 15 years.

On the other hand, Tajikistan, keeping in mind the position of the downstream countries, is planning to fill the reservoir using its own quota from the Amu Darya, amounting, as indicated above, to more than 1.5 billion cubic meters a year. According to some estimates, the annual water intake from the runoff of the River Vakhsh will amount to around 1.2 cubic km/year. Depending on the water

[8] See: *Water Storage in the Era of Climate Change: Addressing the Challenge of Increasing Rainfall Variability*, IWMI, 2010.

content of a particular year, it will either be down or up (in order to avoid the likelihood of flooding). In low-water years, Tajikistan, at the request of the downstream countries, could supply water from the accumulated amount in the reservoir with subsequent compensation filling in high-water years.

The calculations show that 1.2 cubic km/year amounts to 4% of the runoff of the Amu Darya river in low-water years and 2.3% in normal water years (not counting the Zerafshan River), while in particularly high-water years it will be 1.0-1.5%. However, keeping in mind that construction of the Rogun reservoir will take at least 15 years, it can be presumed that its filling will have a minimum effect on the overall runoff of the Amu Darya. The results of the model analysis to be performed by independent consultants currently compiling a feasibility report of the Rogun Hydropower Plant will help to provide the most accurate forecast.

Tajikistan has repeatedly stated at different official levels that during filling and operation of the Rogun Hydropower Plant, the right of the downstream countries to water resources will not be infringed upon. Correspondingly, the Tajik side has confirmed its adherence to the agreements reached on water apportioning and consistency of the water discharge regime in keeping with the quotas set by Protocol No. 566. This position is the main condition for conducting an independent expertise of the Rogun Hydropower Plant project and modeling the filling and operation of its reservoir.

Completion of the Rogun Hydropower Plant and reservoir and their subsequent use in the economic life of the region will be a driving force behind the development not only of Tajikistan, but also of other CA countries. Implementation of the Rogun Hydropower Plant projects and building the high-voltage CASA-1000 power transmission line will help to resolve many interstate problems. For example, CASA-1000 will make it possible to export electric power to Pakistan and Afghanistan in the summer when water is needed for irrigation in the downstream countries.

In this way, the following goals will be reached:

1. The downstream countries will receive their water intake quota from the Amu Darya in the sufficient amount and at the necessary time, and the available reserves will make it possible to supply the irrigable land with enough water even in dry years.
2. By using the capacities of the Nurek and Rogun hydropower plants, Tajikistan will be able to produce additional electric power for meeting the needs of its population in the winter and, at the same time, save a sufficient amount of water for irrigation in the summer.
3. Surplus summer electricity via the CASA-1000 power transmission line will be exported to the countries of South Asia, Central Asia, and Russia. This can promote significant economy of oil and gas reserves now used by the countries of the region for generating electricity. It should also be noted that further intensive consumption of these non-renewable resources will lead to their rapid exhaustion.
4. The production of environmentally pure electric energy will reduce carbon dioxide emissions into the atmosphere, which today is one of the key tasks for transferring to a green economy.
5. The electricity produced by the Rogun Hydropower Plant will be several times cheaper than that generated at thermal power stations. The use of expensive electric energy leads to a rise in the price of the manufactured product, including in conditions of pump irrigation. At present, the indicated price difference is, in most cases, compensated for by the state, but this cannot go on forever.
6. Due to climate changes and glacier shrinkage, reservoir capacity will partially act as compensator, ensuring water security in the region.
7. The tandem of the Nurek and Rogun reservoirs can play a significant role in reducing the risk of flooding in the lower reaches of the Amu Darya.

8. Implementation of the Rogun Hydropower Project and CASA-1000 projects, in addition to everything else, could speed up integration; the countries linked by this power transmission line will begin cooperating more intensively among themselves.

As follows from the above, delay in construction of the Rogun Hydropower Plant will deprive the region's countries of great advantages. Implementation of this project would undoubtedly resolve many socioeconomic and environmental problems, as well as strengthen interstate cooperation, which is a key factor not only of sustainable development, but also of regional security.