

## **Experience of coordinated water resources use of the Syrdarya river basin states**

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The Syrdarya river basin covers an area of 485 ths km<sup>2</sup> in the territory of four sovereign states: the Kyrgyz Republic, Uzbekistan, Tajikistan and Kazakhstan.

At present, more than 25 million people live on the banks of the Syrdarya river, thus requiring using the most part of available water resources for their subsistence and development.

The Syrdarya river water resources amount to more than 40 km<sup>3</sup>, the most or more than 60% of which come from highlands. The flows of the river and its main tributaries are regulated by the Naryn-Syrdarya reservoir cascade and distributed using hydroschemes, intakes and canals. The total effective capacity of the cascade's reservoirs amounts to 24 km<sup>3</sup>, and 9 major hydroelectric power stations have a total installed capacity of 3720 MW. These structures were constructed mainly in the middle of the last century, and over the past 30 years they have enabled to increase the agricultural production by 2.5 times and provide employment for the major part of the growing rural population constituting 60% of the population living in the Syrdarya river basin.

As new structures, hydroschemes and reservoirs were put into operation on the Syrdarya river and its tributaries, a complex engineering system functioning under the conditions of intensively growing water consumption and limited water resources formed. At that, difficulties with water resources management in the basin grow inevitably. As early as the mid 1970s, under practically complete flow regulation, water deficiency began to emerge in low-water years. To optimize the management, in the mid 1980s an Automated Control Complex in Tashkent was established as well as territorial control offices in Andizhan, Leninabad, Chirchik and Gulistan that were reorganized into "Syrdarya" Water Administration in 1987. Controlling water withdrawals from rivers of the basin into canals in the republics, the Water Administration was charged with assisting to reduce water deficiency arising at that time in southern provinces of Kazakhstan and removing obstacles in passing water to the Syrdarya river downstream areas and the Aral Sea. Then the emergence of such problems resulted in a need to organize, at the height of the growing season, offices through involving a number of specialists, which helped to supply water to users and carry out measures for water passage, making great efforts. However, the effectiveness of actions taken by the Water Administration was found insufficient, since its functions, which were limited to water supply control only, forbade directly managing the operation of structures being under the jurisdiction of the union republics. Therefore, BWO "Syrdarya" was founded in early 1988, which was then given major hydroschemes and intakes for temporary use. Just in the first years of its operation, BWO "Syrdarya" ensured observance of limited water supply and appropriate accounting of river water resources. The effectiveness of management and prompt regulation of water resources improved, and water losses reduced to 1 km<sup>3</sup>. The water user republics began to regularly receive water quantities foreseen by limits, and the required inflow to the Chardara reservoir was provided.

After the emergence of five sovereign states in Central Asia, the Syrdarya river turned into an international watercourse according to the current terminology. A need for coordinating actions of the riparian countries in its water resources management arose. Toward this end, an Interstate Commission for Water Coordination (ICWC) was established in early 1992, which led the work on water resources management in the Aral Sea basin. In the 1992 Alma-Ata Agreement, water sector leaders on behalf of the five Central Asian national governments proclaimed their interest in strengthening and development of the cooperation in water use, further improvement of water resources sharing, and their adherence to the joint transboundary water management principles.

Special attention to environmental protection and the Aral problem was highlighted. BWO "Syrdarya" became an ICWC executive body to implement its decisions and directly manage water resources in the Syrdarya river basin.

At present, BWO organizes water supply to ICWC member states, conducts the operation of hydroschemes and intakes, and carries out measures for improving the environmental situation and controlling the quality of used water resources. BWO controls the regime in Naryn, Karadarya, Chirchik and Syrdarya rivers from the Uchkurgan and Andizhan hydropower stations to the Chardara reservoir.

BWO also exercises online dispatch control of water and energy (together with UDC "Energy") resources in the Syrdarya river basin, and operational control over the observance of water withdrawal limits and electric power overflows.

Every month BWO presents ICWC members full information on present water resources use.

Having transferred major interstate hydro structures to BWO for temporary operation, the Syrdarya river basin states assumed obligations to finance the BWO's activities based on share holding in proportion to water quantities used by them. At that, it was determined that all hydroengineering infrastructure objects of BWO, wherever they are located, directly or indirectly ensure equitable water resources distribution between the countries. Therefore, each participant makes a certain contribution to financing the operation and maintenance of any of them.

At the disposal of BWO, there are head intakes on the Syrdarya river, its major tributaries and main canals as well as 260 km of interstate canals - Dustlik and Big Fergana Canal (BFC). BWO operates 203 hydraulic structures, 21 of which are located on the main channels of the Naryn, Syrdarya, Karadarya and Chirchik rivers. They have different flow capacity from 20 to 2500 m<sup>3</sup>/sec.

In addition, BWO has at its disposal 165 km of collector-drainage networks, 250 units of motor transport, machines and mechanisms, 35000 m<sup>2</sup> of office and production premises, 3200 ha of water protection zone.

BWO maintains accounting of water withdrawals from rivers and lower canals by 445 items. They include 21 head intakes to main canals, 36 fixed and 172 temporary pumping plants, and numerous outlets from main canals. Water accounting on intakes from main canals is carried out together with water authorities of Central Asian states.

Every year BWO control water resources amounting on average to 34 of 37 km<sup>3</sup> or over 90% of the annual river flow in the Syrdarya basin that indicates the high responsibility of BWO to ICWC member states, which have entrusted the implementation of their decisions to it.

To fulfill tasks given by ICWC, BWO always tries to support the management capacity at the level that ensures solving given problems in a well-timed and high-quality way.

Since 2001, BWO has been introducing automated control and management systems with the support of ICWC. At present, BWO has at its disposal ten of such systems on interstate headworks and unique hydroschemes. Moreover, a data transmission system is being introduced on structures in Fergana Valley. It will integrate the Uchkurgan and Kuyganyar hydroschemes, the head intake at the Big Fergana Canal on the Naryn river, the Khakulabad distributor on the Feeder Canal, structures on the Big Andizhan Canal, head and escape structures on the Akhunbabayev Canal into one system of automated technological information transmission. The automation enables to achieve high accuracy of regulation and keep assigned discharges, reduces the inaccuracy of water accounting, improves the quality and lightens the work of operating personnel. Through a twofold increase in the accuracy of regulation and water accounting, reduction in non-productive water losses is achieved that is especially important under the deficiency. Electronic means for information receipt, storage and transmission included in the automation provide an open access to data of interest. At that information transparency is ensured, which eliminates doubts of users about water supply accuracy, favors raising the trust in BWO activities, and helps solve the issues of water resources management in a conflict-free and trusting climate.

Over the last years BWO has been working on the creation of information systems, considering that large bodies of different information are used in the management. The information database of BWO "Syrdarya" launched in 2000 contains complete data on water availability and use for a long period. The actual data on daily water discharges and levels of all hydraulic structures as well as on water volumes in Naryn-Syrdarya cascade reservoirs form its basis information. The natural inflow to reservoirs is represented beginning from 1911, but the lateral inflow is accounted from 1948. Information input is carried out regularly during a day, as online data come to the BWO's Central Control Office in Tashkent.

Furthermore, BWO uses the System for hydrometeorological information transmission of Central Asia using meteor burst communication on the terminal, through which hourly information on most important basic gauging stations in the Syrdarya river basin is continuously represented in the Central Control Office in Tashkent. These data are irreplaceable in water-balance calculations, which form the basis for online water resources management and control over their distribution among water users of neighboring countries. For example, information received from the Uchkurgan gauging station enables to previously track flow characteristics while approaching to structures and timely adapt the Uchkurgan hydroscheme and the complex irrigation system on BFC to the operation under the conditions of rapidly changing power-generating regime of releases of the Naryn cascade. The use of data on water discharges at the Kyzylkishlak gauging station continuously transmitted by the system provides an opportunity for well-timed control over releases through the Kayrakkum hydropower station, due to which at the height of the growing season an equal water supply without detriment to users of Tajikistan, Uzbekistan and Kazakhstan according to assigned limits is ensured.

Thus, the existing potential enables BWO to solve facing problems of water resources management.

At the same time, today, being on the verge of acute water shortage, it is necessary to dwell on a question, which should probably be solved in the near future to keep economic security in all the countries of the region.

It is a question of the operation mode for the Naryn-Syrdarya reservoir cascade.

Initially, the main function of the Toktogul reservoir was to provide long-term regulation of the Naryn river flow in order to increase water availability for irrigated lands in an area of 918,000 ha, ensure growth in new lands by 400,000 ha in the Syrdarya river basin, and generate electric power amounting to 4.1 billion kWh a year.

Under the long-term regulation, the operation mode for the Toktogul reservoir is made up on the condition of guaranteed water supply to ensure sustainable crop yields. Its releases increasing in low-water years and decreasing in high-water years amount in average water years to  $9.43 \text{ km}^3$  or three fourth of the annual volume in growing season, and no more than  $2.85 \text{ km}^3$  in non-growing season. This makes it possible to keep as much water in the reservoir bowl as possible and maintain high pressure. Thus, while satisfying irrigation needs, the largest energy output of installed capacities is provided not only for a particular year, but also for the whole hydrological period of alternation of high and low water years. Moreover, a proper river regime adequate to natural river hydrograph is arranged. Normal sanitary and environmental flows are maintained, and land-reclamation regime of areas adjacent to the river is conserved.

It is also necessary to note that since 1974 the Toktogul reservoir has not had an opportunity to be filled a long time, and its volume has not exceeded  $5\text{-}6 \text{ km}^3$ . When the long-term regulation regime is kept, 9 successive average or 2 high water years are required for its filling. Over the high water years 1987 and 1988 by August 1988, maximum volume of  $19.5 \text{ km}^3$  was achieved, and the reservoir entered the period of its total efficiency.

In 1988 when the Toktogul reservoir first filled, a gradual deviation from the long-term regulation regime began. At the beginning, releases from the Toktogul reservoir increased in non-growing season from  $3.9 \text{ km}^3$  in the hydrological year 1989/1990 to  $5.1 \text{ km}^3$  in 1991/1992. These changes did not strongly affected water supplies, since they took place at the peak of high water

availability in the year 1987/1988. The tendencies to increase of releases further intensified, and the Toktogul reservoir is currently operated in power-generating regime.

As a result, the largest part of water releases and hydropower generation now take place in the winter period, and releases from the reservoir in growing season are reduced for water accumulation. Such a change in the operating schedule led to complete deformation of river hydrograph, to floods in winter and to artificial water shortage in summer.

The rejection of the long-term regulation regime leads to the following negative consequences:

- Acute water deficiency for irrigation;
- Increased winter releases, which flood the locality and settlements adjacent to the channel, cause damage to whole infrastructure in the Syrdarya river downstream when it is impossible to pass them to the Aral Sea due to ice conditions;
- Loss of environmental sustainability of water systems on the Syrdarya river due to underflooding and return water stoppage in winter and channel drying-up in summer;
- Emergence of the environmental problem in Aydar-Arnasai lake system;
- Possible deep drawdown of the Toktogul reservoir with the coming of sequence of low-water years.

Considering the objective character of the reasons, which induced the Kyrgyz Republic to changing the regime of the Toktogul reservoir, it was acknowledged that in order to prevent negative consequences it is necessary to make compensations for water released from the Toktogul reservoir.

At the same time, the practice of compensations according to the agreements of Kyrgyzstan with Kazakhstan and Uzbekistan established after 1995, enabling to satisfy needs of irrigated agriculture in the region in growing season, does not concerns in non-growing season the Toktogul reservoir regime made up based on electric power requirements of the Kyrgyz Republic. Under natural conditions the average inflow to the Toktogul reservoir amounts to 11-12 km<sup>3</sup> a year, and in recent years 15 km<sup>3</sup> a year is released from it, but it is clear without complicated calculations that during the last years the reservoir is inevitably being emptied. Foreseeing complications in the operation of the cascade, the states agreed and fixed in the Agreement of 17 March 1998 principles for making compensations to provide rational use of water-energy resources in the Syrdarya river basin. This document confirms that deliveries and regimes of hydroschemes will be determined in yearly interstate agreements. However, in practice, since then the difficulties with negotiations on preparation of yearly agreements have not decreased but grown. The Toktogul reservoir still has double load, which it is not able to carry. The situation fraught with deep drawdown of the Toktogul reservoir arose by winter 1998 and in 2001. The current ending non-growing season passed again for the regime of releases from the Toktogul reservoir without any limitations, as a result of which up to 8.5-9 km<sup>3</sup> will be released from it. The water level approached to the dead volume mark by the beginning of the growing season, and only high-water growing season can save the situation.

At the same time, deep drawdown of the Toktogul reservoir can be avoided through following the range, in which non-growing releases should be changed, and accordingly compensating the Kyrgyz Republic for water retained in it in non-growing season. This will make it possible to gradually accumulate water supplies in the reservoir and eliminate water losses and damage caused by winter releases. BWO "Syrdarya" already offered an intermediate version of the regime for the Toktogul reservoir: releases of 6.5 km<sup>3</sup> is kept in growing season, and releases of 4.9-5 km<sup>3</sup> from the reservoir in non-growing season are recommended, at that the volume of the Toktogul reservoir ensures pressure needed for installed capacity generation of 1200 MW. Thus, we proposed a technical decision principally different from those being implemented in recent years, namely to compensate the Kyrgyz Republic for reduction of non-growing releases from the Toktogul reservoir, and release water saved in this season on request in growing season. We many

times brought our point of view to the attention of water authorities and Cabinets of Ministers of Central Asian states.

It is clear from the abovementioned that the operation mode for the Naryn-Syrdarya cascade approved by ICWC is fulfilled with substantial deviations due to the lack of an agreement on compensatory deliveries or non-fulfillment of the obligations stipulated in them. As a result, a discord in the water-management activities in the region arises. The operation modes of reservoirs are redesigned contrary to the schedules of ICWC, but it is not always possible to overcome the consequences of such failures. Water is lost nonproductively, and damage is done to both water user sectors and the environment.

To solve this problem, in our opinion, water resources management and use should completely be concentrated in the hands of ICWC, which has all necessary rights and powers delegated by the countries of the region for that. Only ICWC should determine the implementation of the regional water-management activities and a strategy for interstate water resources management in the Aral Sea basin.