

## **Probable dynamics of hydrological regime of the Northern Aral Sea under given economic activity and climate change in its basin**

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Hydrological regime of the Northern Aral Sea depends on the changes in the Syr Darya River Basin. Water resources of the Syrdarya river are formed mainly outside Kazakhstan: over 74% belong to Kyrgyzstan (Naryn river), about 14% - to Uzbekistan, about 3% - to Tajikistan, 9% - to Kazakhstan (Arys river and Keles river). Until 1970, the water amounted in average of 22.6 km<sup>3</sup> per year was flowing to Kazakhstan from neighboring countries. Water resources decreased by 33% under stable water use. In the modern period, the total water resources of the Syr Darya river including runoff of rivers flowing into the Syrdarya river on the Kazakhstan part are equal to 17.4 km<sup>3</sup>. In 1965-1985, the reservoirs cascade with over-year and seasonal regulation was built in the upstream of the Syr Darya river: Toktogul, Andijan, Charvak, Kairakkum and Shardara, with the total capacity of 32 km<sup>3</sup>. Until 1991, these reservoirs have been operated mainly in the irrigation mode. Following independence, Uzbekistan and Kyrgyzstan utilize water to generate electricity. In order to evaluate the economic activity in the Kazakh part of the Aral Sea basin the channel water balance of some rivers was calculated; the water losses and intra-annual flow distribution were determined. The largest water intake for economic activity is observed in the middle section of the river from G/S Tyumen-Aryk to G/S Dzhusaly, but the minimal one is observed in the lower reaches of the river. The maximum water withdrawal from the Syr Darya river was observed in 1974-1984. During these years, only 20% of water reached the sea. Even in the high-water years 2003-2007, only 50% of the Syr Darya waters reached the sea, the rest of water resources were used for economic activities. After changing the reservoirs' operation mode, the within-year flow distribution also has changed almost along the whole length of the river. The sizeable winter floods are observed instead of the relatively low winter runoff. During the conventional-natural period, when water resources were equal in average to 24.7 km<sup>3</sup> per year, half of them were flowing to the Aral Sea, and the sea level was maintained at 50 - 53.0 m. During the period of stable water use, water resources decreased only by one third, while their inflow into the sea has decreased by two thirds because of economic activity, resulting in the level fallen to 10 m. During the dry years, the Aral Sea received only 8% of available water resources. During these years, the sea level was equal to 38.6 m. The same anthropogenic load on river runoff was considered to estimate changes in water resources for the future. Water resources and their inflow into the North Aral Sea, according to our calculations, will decrease by 7% due to climate change by 2050. A series of numerical experiments using the water balance model were implemented to assess possible changes in the Northern Aral Sea level. The main conclusion is that the future available water resources of Kazakhstan to maintain the level of the Small Aral Sea at the current level will not be enough under current economic activity and future climate change. This work was implemented within the program "Assessment of resources and prediction of natural water use in Kazakhstan under anthropogenic and climate-driven changes".