

Anthropogenic change of transboundary Syrdaria River regime

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ABSTRACT

Syrdarya River is one of greatest transboundary rivers in Central Asia. The river was intensively affected by economic activity in several last decades. Change of the river regime in time along the river are shown in the paper.

Key words: Central Asia, Syrdaria River, water runoff, anthropogenic influence.

Syrdarja River is one of the largest and most important water arteries in former Soviet Central Asia. It runs along territories of four new states – Kyrgyzstan, Uzbekistan, Tajikistan, and Kazakhstan and supplies by water a large part of population of the region. In particular it flows along the well known Fergana valley which is the most populated area in Central Asia.

Area of the river watershed coming out the Fergana valley is equal to 142,000 km². Total area of glaciers in the river basin was 2550 km² in the middle of 50th of last century and occupied 1.8 % of the watershed area. Glacierization was reduced as much as 25-30 % to present day (Glazirin, 2009) and covered approximately 1.3 % of the watershed area.

Several large reservoirs were constructed on the river and its tributaries for rational control of its runoff before destruction of Soviet Union. Their total volume reached 40 km³ (Resources..., 1969). The regime of the reservoirs and water offtake to numerous irrigational channels were controlled by centralized direction. It allowed to distribute water optimally in time and over the territory. This system was collapsed and every state have used water for its own purpose only and did not takes into account interest of neighbors. The situation causes already serious economic losses and political conflicts.

Regular hydrologic observations at the river were organized in the begin of the past century. However long time data turned out being unusable for standard normal statistical processing because of essential anthropogenic runoff modification. Cross statistical analysis was applied for restoration of the natural runoff on some gouging stations. It was succeeded to restore characteristics of the natural runoff. Long-term change of calculated "natural" annual water discharges of Syrdarya River at Bekabad gouging station, located at coming out of the river from Fergana valley, is shown in figure 1 (Chub, 2000).

One can see that the natural runoff did not change systematically for the period. No significant trends were found. The runoff varied around average value 830 m³/s only. It can be explained by the fact that annual precipitation was the same and just increased a little bit for the period (Spectorman & Nikulina, 2002). It should be noted that the considerable glaciation shrinkage did not result in run-off loss. The measured run-off is shown in figure 1 too. No explanation required.

It is clear that the river regime is subjected more and more anthropogenic influence downstream. We tried to estimate the distortion of the Syrdarya River natural run-off by economic activity, as well as track modification of this process at time and along the river. Data of the long-term measurements on several hydrologic gouging stations were analyzed. The stations are located along the river at distances from 2173 km (Kal' station) to 181 km (Kazalinsk station) from its flowing into Aral Sea.

Run-off change along the river is shown in figure 2 for 4 selected years: in 1942 before big reservoirs construction; in 1962 in the start of Golodnaya Stepp area agricultural developing; in 1991 on the eve of USSR collapse; and present day situation in 2008. The run-off is shown in percent from its value at Kal' gouging station. Is it distinctly seen how the share of water decreased reaching lower

course of the river. This fact and reduction of Amudrya River run-off due to economic activity are a reason of Aral Sea tragedy.

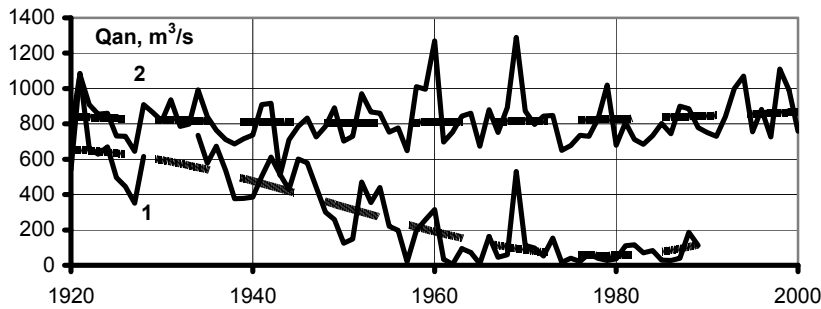


Fig. 1. Long-term change of annual run-off (Qan) of Syrdarya River at Bekabad gauging station. 1 - measured run-off; 2 - calculated natural run-off.

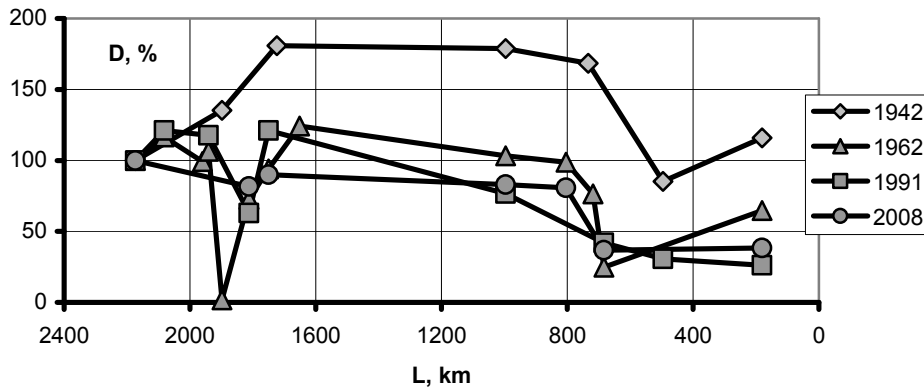


Fig. 2. Dependence of ratio (D) of annual run-off at gauging stations located at distance (L) from the Aral Sea on annual run-off at Kal' station .

Annual distribution of the run-off was intensively subjected too and changed drastically. The annual run-off distribution at Kal' station and Kazalinsk station is shown in figure 3. One can see that the run-off annual distribution is completely distorted even at the upper station by an above located Toktogul reservoir located at Naryn River.

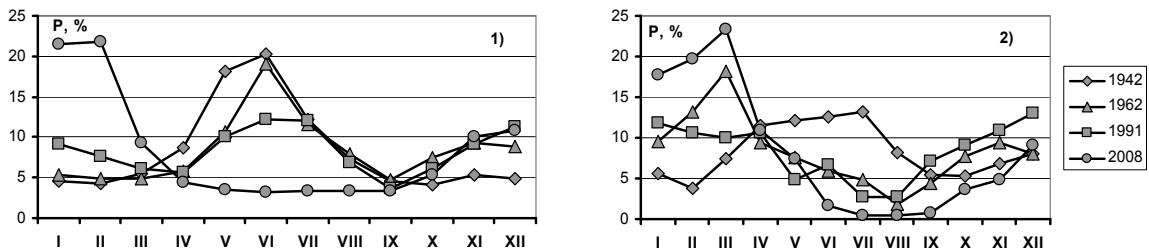


Fig. 3. Annual distribution of run-off at the Kal' station and Kazalinsk station in four years. P is share of monthly run-off in annual one.

Now minimal run-off takes place in summer time whereas in former time maximal run-off took place at this time. In lower course of the river annual run-off distribution was heavily distorted also. The share of the summer run-off gradually approaches to zero.

The results permit to evaluate the anthropogenic influence to the transboundary Syrdaria River runoff and should help in planning of optimal management by water resources of the region.

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