

Assessment of the effect of adjusted river flow on crops

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Abstract. In the article causes of various anthropogenic factors in the occurrence of adverse events at hydraulic structures on the banks of the river in the Khorezm region of the Amudarya and in the coastal areas of the Republic of Karakalpakstan and agricultural lands in the coastal areas were studied. Brief recommendations were given to improve the situation in the coastal areas of the Amudarya. The article also analyzes data on adjusted river flow and groundwater table changes.

1 Introduction

During floods, it is important to identify the causes of the negative impacts built on the river to protect coastal settlements and agricultural crops from flooding, and to ensure the safety and reliability of hydraulic structures in the adjustment and protection facilities. For this purpose, surveys were conducted in the lower reaches of the Amudarya [1–3].

2 Materials and Methods

In order to study the impact of the Amu Darya on the arable lands of the Khorezm region and districts of the Republic of Karakalpakstan in the southern regions of the Republic of Karakalpakstan Turtkul, Ellikkala and Beruni districts and Khorezm region along the river in Bagat, Khazarasp, Khanka, Urgench, Gurgench, Urgench

the situation was studied and ways to improve it were developed. During the survey, statistical analyzes were conducted with data from water metering points located in the lower reaches of the Amudarya in 2017, 2018, 2019 [4–7].

3 Object of Researches

The results of the analysis showed that the highest water flow from the Toyamoyin hydroelectric power station of the Amudarya to the river was 1500–1700 m³/s in April–May 2017, and 2700–2900 m³/s in May–June 2018. In 2019, in April–June, the water consumption began to rise to 3000 m³/s, in July–August this figure was 3500–4000 m³/s and almost reached the maximum capacity of the river. By September, water consumption in the river began to decline (Figure 1) [8].

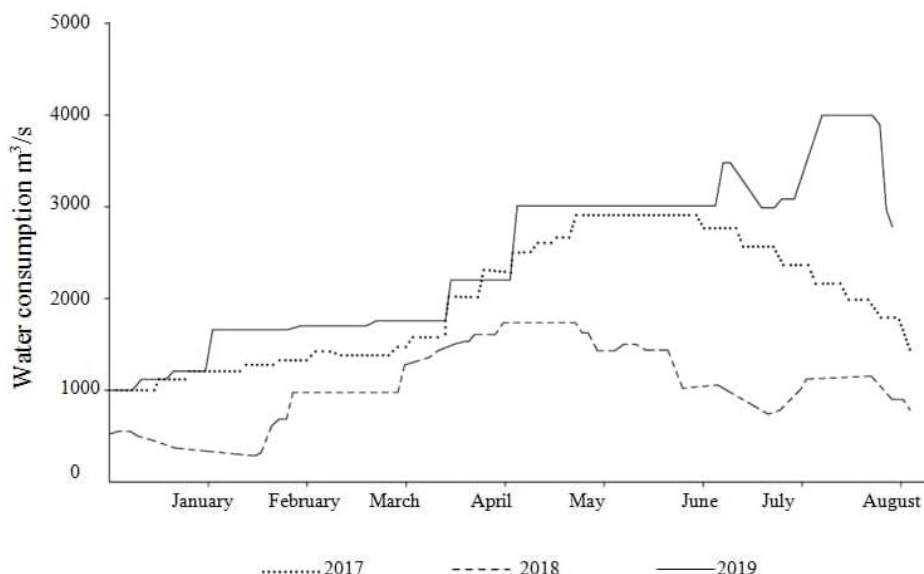


Fig. 1. Changes in water consumption of the Amudarya river below the Tuyamuyin hydroelectric power station.

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As a result of such high water consumption and the correspondingly high level of the river, the riverbed widened, the banks were partially washed away and the groundwater level rose in the arable lands located in the coastal zone of the river.

A study of the condition of the existing spurs and dams in the river showed that they could easily allow such a large amount of water to be wasted. But far; some of them have been partially washed and some have cracked due to the use of the term (Figure 2) [9].

In particular, in the Biybozor section of the 1st line of the protective dam of Beruni district, there is a condition of washing of the dam, the 20-meter part of the earth dam is completely washed away. In order to rectify this situation, the Department of Coastal Protection Dams and River Regulation Facilities is working to strengthen the flow-guided spur (by pouring stones) to divert the river flow from the right bank. In other areas, the work is being carried out according to the current plan. The results of the study of changes in land reclamation (groundwater level) as a result of the impact of Amudaryo on agricultural lands in Turtkul, Beruni, Ellikkala districts of the Republic of Karakalpakstan show that in August the groundwater table in Turtkul district averaged 1.62 m. In Ellikkala district – an average depth of 1.85 m, in Beruni district – an average depth of 1.44 m. These figures are 10–15 cm higher in Turtkul and Beruni districts compared to 2017, and lower than in 2017 in Ellikkala district (Figures 3, a–c).

The level of groundwater in relation to the surface of arable land in all districts is close to the level of 2017, only in the areas near the river banks of the districts there was a slight increase in water levels [10–12].

In particular, the groundwater level rose during the growing season in the fields of Uzbekistan, Shurkhan and Sh. Rashidov in Turtkul district, Shobboz, Qiyatabad, Biybozor and Beruni in Beruni district, Bozyab and Chiysalang water consumers' associations in Elikala district. As a result, the humidity in the fields

was high and it was not possible to carry out agro-technical measures in a timely manner [13–17].

In Bagat, Khazarasp, Urgench, Gurlan districts of Khorezm region, in the area near the Amudaryo, the groundwater level (up to 1 m above the ground) also rose (Figure 4).



(a)



(b)

Fig. 2. Washing of river banks

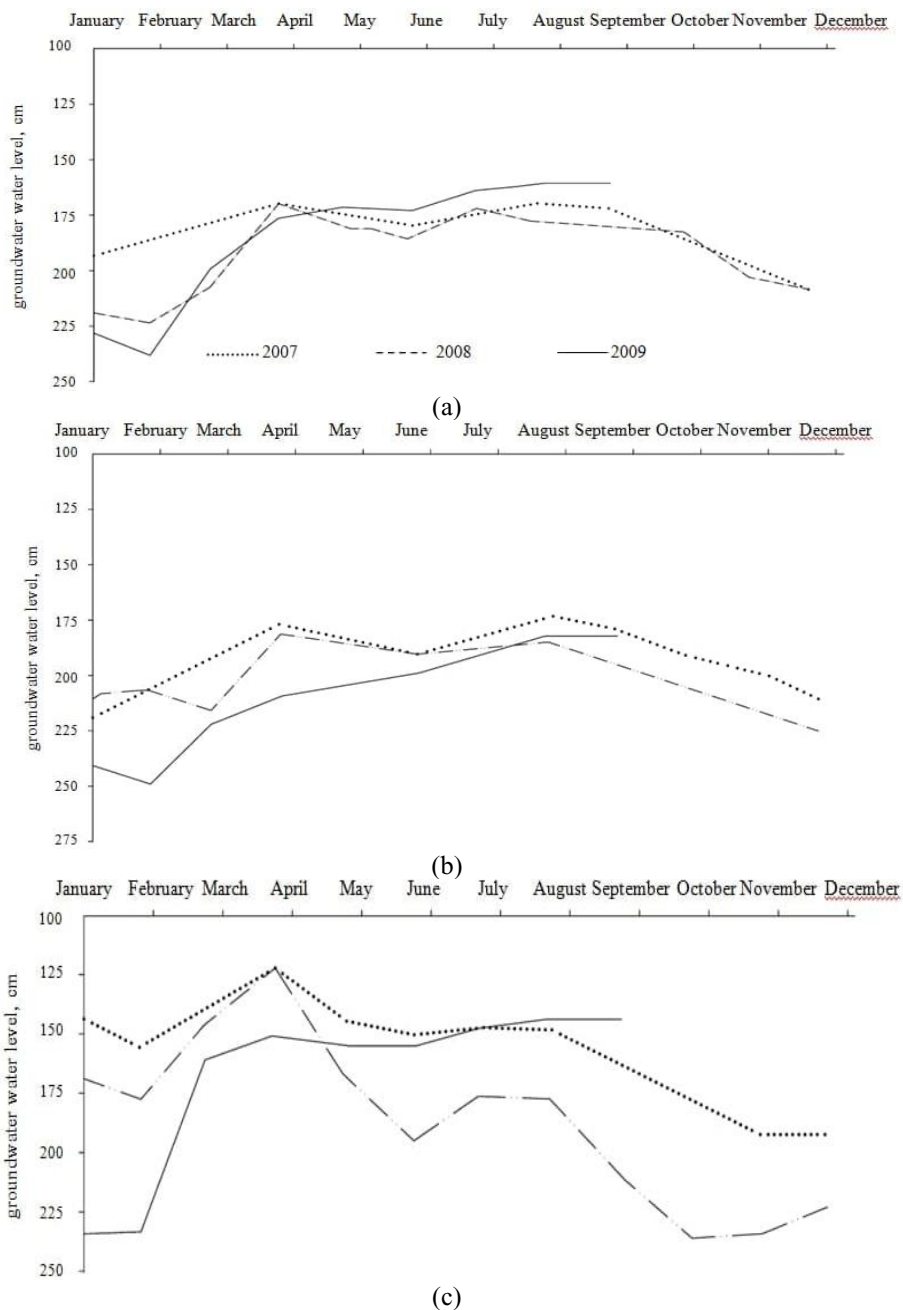


Fig. 3. Changes in the groundwater level in the arable lands of the Republic of Karakalpakstan: a) Turtkul district; b) Ellikkala district; c) Beruni district

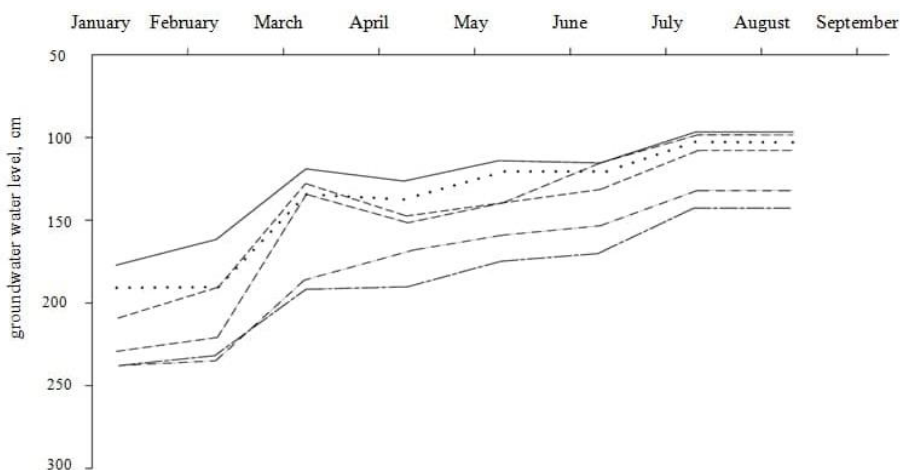


Fig. 4. Changes in groundwater level in the fields adjacent to the Amudarya in Khorezm region (2019)

4 Results and Discussion

One of the main reasons for the situation was the rising river water level, on the other hand, the unsatisfactory operation of inter-farm and farm ditches.

The rise in river water levels was mainly due to the increase in groundwater levels in the area of the belt zone up to 1 km along the river. Outside, groundwater levels have risen due to the inability of ditches to fully drain groundwater. The reason why the ditches do not work well is that they quickly fill up under the influence of water from the rice fields [18–22].

The oversupply of rice-planted areas in the studied areas caused the ditches to fill with water quickly, and the ditches were unable to perform their groundwater drainage function. As a result, the groundwater level in the cotton fields began to rise (to the level of irrigation water in the adjacent rice field) and did not allow to carry out agro-technical measures in the field.

The first reason for such suffering of cotton fields began with the incorrect placement of crop fields. The reason is that, as mentioned above, the ditches designed (designed) to serve the cotton fields had to carry more water to the ditches than planned due to the large amount of rice placed in the service areas. As a result, the ditches were unable to drain the water and water began to accumulate in them. As a result, flooded ditches rise instead of lowering groundwater levels in the fields (the “subirrigation effect”).

In the K-5-1 ditch in Turtkul district, the failure of the floating pump at the foot of the ditch (due to a power outage) also caused water to accumulate in the ditch and raise groundwater levels in the area served by the ditch.

It should be noted that the proper use of existing ditches in the area is an important task to alleviate the situation [23].

As a precautionary measure, it was recommended that the 369th floating pump in the K-5-1 ditch be operated continuously for 10 days. This measure will allow to quickly reduce the water level in 201 hectares of arable land of water consumers' associations of Turtkul district of Uzbekistan (7 f/x – 95 ha), Shurkhan (4 f/x – 82 ha) and Sh. Rashidov (2 f/x 24 ha)

It is recommended to reduce the amount of water supplied for irrigation in Beruni and Ellikkala districts.

It is recommended that the uninterrupted operation of the Atov reclamation pumping station in Khazarasp district of Khorezm region will allow to quickly improve the reclamation of 180 hectares of land in the district.

Most of the cropland affected by rising groundwater levels is located on the banks of the river. However, according to Article 22 of the Regulation, which came into force by the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 174 of April 7, 1992 (water consumption is more than 100 cubic meters per second (300–500 meters from the banks of rivers) – they have limited economic activity. If the placement of agricultural crops is carried out in accordance with this rule, there will be no room for inefficient labor (crop destruction) [24].

Along with the initial measures to be taken, measures to be taken in the near future to protect river banks and improve the reclamation of arable lands should be developed.

5 Conclusion

In conclusion, it is necessary to develop biological methods of river bank protection (planting of soil-strengthening trees on the banks), taking into account the biological drainage properties of trees to prevent rising groundwater levels in crop fields. It is also advisable to turn the part of the river up to the 1st row of protective dams into an ecological zone.

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