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Changes in water volume and environmental impact in the Aydar-Arnasay lake system

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ABOUT ARTICLE

Key words: Mirzachul development, Chordara reservoir, Aydar-Arnasay lake system, natural dam, collector-drainage waters, arid years, water volume, water level fluctuations, maximum evaporation.

Abstract: This article analyzes the changes in the water balance in the Aydar-Arnasay lake system for half a century and its impact on the environment.

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Айдар-Арнасой кўллар тизимида сув ҳажмининг ўзгариши ва атроф-муҳитга таъсири

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МАҚОЛА ҲАҚИДА

Калит сўзлар: Мирзачўл ўзлаштирилиши, Чордара сув омбори, Айдар-Арнасой кўллар тизими, табиий сув тўғони, коллектор-зовур сувлари, қурғоқчил йиллари, сув ҳажми, сув сатҳининг тебранишлари, максимал буғланиш.

Аннотация: Мазкур мақолада ярим аср давомида Айдар-Арнасой кўллар тизимида сувнинг кирим-чиқим балансидаги ўзгариши ва унинг атроф-муҳитга бўлган таъсири таҳлил қилинган.

Изменение объема воды и воздействие на окружающую среду в системе озер Айдар-Арнасай

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О СТАТЬЕ

Ключевые слова: Мирзачульская разработка, Чордаринское водохранилище, Айдар-Арнасайская озерная система, природная плотина, коллекторно-дренажные воды, засушливые годы, объем воды, колебания уровня воды, максимальное испарение.

Аннотация: В данной статье анализируются изменения водного баланса в системе озер Айдар-Арнасай за полвека и его влияние на окружающую среду.

Introduction

Prior to the development of Mirzachul and the construction of the Chordara Reservoir, Aydar, Arnasay and Tuzkan lakes consisted of separate small lakes. During the rainy years, the lakes were flooded by rivers from the western part of the Turkestan ridge and the northern slopes of Mount Nurata, as well as from the Syrdarya. As a result, salt lakes were formed in the basins. During the dry years, the water in the basins evaporated and turned into salt and brine.

In 1969, the rarest year in Central Asia, the Tokhtagul, Kayrakkum and Chordara reservoirs of the Syrdarya River accumulated more than the useful water capacity. It was not possible to discharge excess water from the Chordara Reservoir downstream along the Syrdarya River. The reason for this was the high risk of flooding in the Kazakh city of Kyzylorda. As a result, from February 1969 to March 1970, 21.8 km^3 of water was discharged into the Arnasay basin through the Arnasay hydroelectric power station.

As a result of rising water levels in the Arnasay basin, a certain part of the water begins to flow into the Aydarkul basin. The water collected in Aydarkol, in turn, flows to Tuzkan. As a result, the natural dam in the middle is destroyed and, as a result, a large amount of water flows into Lake Tuzkon.

The main results and findings

From February to July 1969, 15,302 million m^3 of water flowed from the Chordara Reservoir into the Aydar-Arnasay Basin, and the water level of Aydarkol was 237.19 meters. At that time, the water level of Lake Tuzkon was 229.7 meters.

400 thousand m^3 of water passed from the Chordara reservoir to the Arnasay basin in 1971, and 580 thousand m^3 in March and April 1972. Due to the increase in water flow, the water level in Lake Tuzkon rose by 22 meters, and in Aydarkol - by about 10 meters. As a result, the Aydar-Arnasay Lakes System (AAKT) with an area of 2,300 km^2 and a volume of 20 km^3 was formed. In

1964-1974, 70% of the water coming to the AAKT falls on the Chordara reservoir [Alibekov L, 2012]. From 1974 to 1993, almost no water was pumped into the AAKT from the Chordara Reservoir. Only in some rainy years is a small amount of water discharged. Subsequent water inflows led to the preservation of water levels and the creation of large bases of fish stocks.

After the collapse of the former Soviet Union in the 1990s, the only energy system in Central Asia fell into disrepair. As a result, the sovereign states of Central Asia began to establish their own water and energy consumption regimes. For example, in the Kyrgyz Republic, the Tokhtagul Reservoir (284 km^2, volume 19.5 km^3), built for irrigation purposes, has been used for energy generation since 1993. As a result, the Tokhtagul Reservoir accumulated water in the spring and summer seasons, and began to make maximum use of the reservoir's water in the autumn and winter seasons, when electricity was in high demand. From this year, the excess water that flows into the reservoir in the fall and winter began to be discharged into the AAC.

According to the Uzbek Hydrometeorological Service, in the early 1990s the water level in the AAKT was 237 m, and in 1998 it reached 243 m, ie 6.0 m. The AAKT area has expanded to 1,074 km^2 over the years. As a result, pastures around the lake, shepherd's huts and barns, and highways were flooded.

According to the Main Hydrometeorology Department of the Republic of Uzbekistan - Uzhydromet, the absolute height of the AAC in November 1994 was 241 m, the area was 2810 km^2, and the water volume was 3100 km^3. Water surface fluctuations ranged from 0.8 to 2.3 meters. During the winter and spring, the water level rises due to the inflow of water from the Chordara, which is proportional to the volume. Maximum water levels in the lake are observed in May. In summer and autumn, the maximum evaporation was up to 3 km^3, and the lake level decreased to 0.5-0.7 meters.

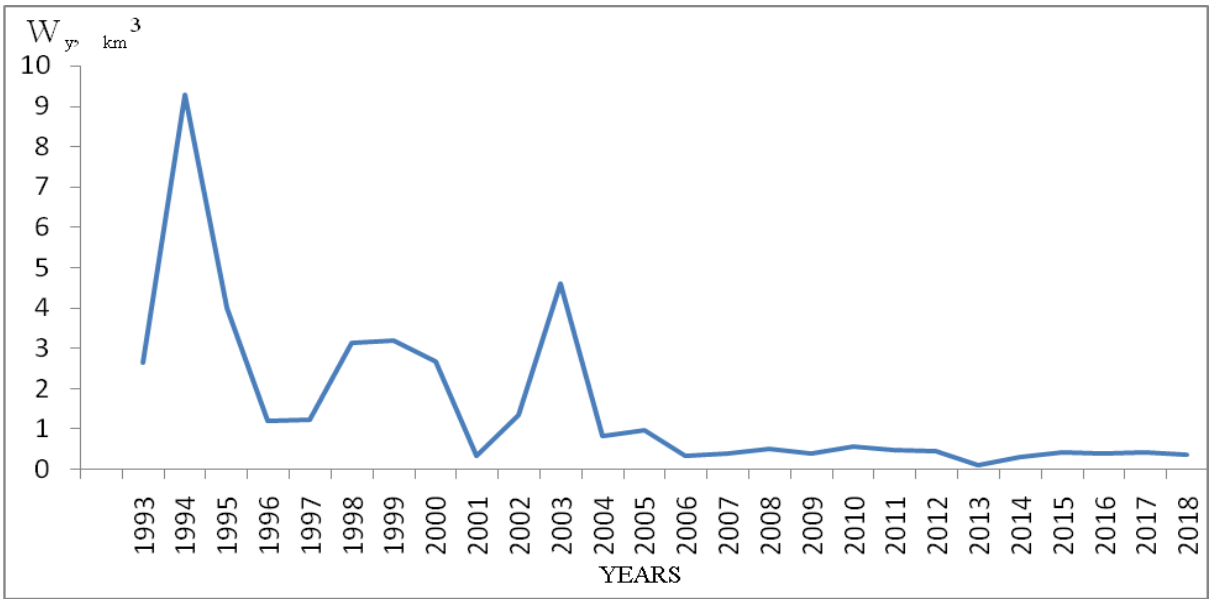

Figure 1. Annual chart of changes in the amount of water discharged from the Chordara Reservoir into the AAC

As can be seen from the graph, from 1993 to 2018, the highest value of water discharged from the Chordara Reservoir into the AAKT was in 1994, while the lowest value was in 2013. In 1994, more than 9 km^3 of water was discharged into the AAC, resulting in the flooding of more than 120,000 hectares of pastures.

In 2003, the Arnasay Reservoir was built to use the water from Chordara for irrigation and flood prevention. As a result, the water supply of 60.4 thousand hectares of land in Mirzachul, Dustlik and Arnasay districts has improved (see Table 1).

The inflow of the AACT water balance also includes groundwater. They come from the Nurata Mountains, the Kyzylkum Desert, the Mirzachul and the Chordara Reservoir. When the water level of Aydarkol and Tuzkon is 230-240 meters, the flow of groundwater is 1.4-1.6 m^3/sec. This is 40 million m^3 per year, which is only 0.7% of the water balance in the AACT [Rafiqov A, 2003].

Table 1

Change in the amount of water collected in the Arnasay reservoir due to water discharged from the Chordara reservoir, mln m^3

№	Years	Water volume at the beginning of the year	The volume of water discharged from Chordara into the Arnasay Reservoir	The volume of water discharged from the Arnasay reservoir	Volume of water released for irrigation	Maximum water volume of Arnasay reservoir
1	2004	130,0	820,0	780,0	40,0	950,0
2	2005	130,0	976,2	582,2	75,0	1106,2
3	2006	394,0	336	176	160	730,0
4	2007	340,0	390,0	259,0	99,4	730,0
5	2008	471,0	501,0	642,0	101,0	972,0
6	2009	330,0	400,0	233,0	129,0	730,0
7	2010	497,0	553,0	340,0	150,5	1050,0
8	2011	710,0	498,0	307,0	183,4	1208,0
9	2012	624,0	450,0	456,0	200,1	1074,0
10	2013	655,0	106,0	201,0	162,9	761,0
11	2014	561,0	301,2	166,9	134,3	862,2
12	2015	650,0	424,0	378,0	262,2	1074,0
13	2016	696,0	48,0	86,4	41,6	744,0
14	2017	516,0	410,0	381,0	167,2	1062,0
15	2018	698,0	353,6	330,0	121,9	1051,6

Note: Data of the Jizzakh Regional Department of Reservoirs, 2019

Most of the water added to the AACT is collector-drainage water. These waters come through the Akbulak, Border collector, Qli, Jizzakh main ditch (JBZ) and Boylama (PK-6) collector ditches. The amount of collector water depends on the amount of water used for irrigation. Ўтган асрнинг 70-йилларида Мирзачўлни суғоришга сарфланадиган сув миқдори 196 м^3/сек дан 219 м^3/сек га ошди. Шунга боғлиқ ҳолда суғориладиган ерлардан коллектор-дренажлар орқали чиқадиган сувлар миқдори ҳам 43 м^3/сек дан 56 м^3/сек га ошди (2-жадвалга қаранг).

Table 2

Amount of water discharged from collector-drains into Aydar-Arnasay lake system *

Years	Collectors					Jami water amount mln m^3
	Akbulak mln m^3	Border collectors mln m^3	Qli mln m^3	JBZ mln m^3	Longitudinal (PK-6) mln m^3	
2012	187,9	87,0	282,9	234,3	57,1	849,2
2013	213,7	74,4	323,9	238,3	55,9	906,2
2014	139,8	48,9	394,1	312,2	75,3	970,3
2015	127,7	50,3	394,2	305,0	83,2	960,4
2016	123,5	88,1	364,2	258,6	110,3	944,7
2017	126,4	77,6	428,6	314,8	118,8	1066,2
2018	126,9	51,9	393,3	312,1	97,5	981,7

Syrdarya-Zarafshan ITXBQ melorative expedition data, 2018

* Indicators of collector-drains in the territory of Jizzakh region

In general, according to the Department of Ecology and Environmental Protection of Jizzakh region, the amount of water coming from the collectors in the regions of the Republic of Kazakhstan, Syrdarya, Jizzakh and Navoi regions during the year is 1.8-2.5 km^3.

When analyzing the water inflow after 2000, changes in the water area, rising water levels in the AAKT, from January of this year to May 2005, the water level in the lake system rose by another 3.6 meters. During this period, 11.2 km^3 of water was transferred to the Arnasay basin. The newly flooded area reached 477 km^2.

The water balance of the AAKT in 2004 was determined as follows when the water level was 243 meters [Gudalov M, 2019].

I. The revenue side of the water balance:

Water from the I_a Chordara reservoir is 2.4 km^3/year.

I_b Main canals, collector-drainage water-3.4 km^3/year.

The amount of precipitation on the surface of the I_v Water is 0.002 km^3/year.

A total of 5.8 km^3 / year.

II. Expenditure part of water balance:

II_1 -3.95 km^3 / year for evaporation and transpiration.

II_2 The water absorbed around the reservoirs and used to fill the ponds is 1.85 km^3 / year.

A total of 5.8 km^3 / year.

These figures show that in 2004 the amount of water entering and consuming the AACT was equal. In this case, the lake area is in a stable state. However, an increase in the amount of precipitation or new hydraulic structures under construction will disrupt this water balance.

As of 2005, the AAKT area was 3,610 km^2 and the water volume was 42.19 km^3. The analysis of the periods from 2005 to 2010 in the AACT shows that the surface area has increased proportionally depending on the volume of water. In 2018, the area of the AAC was 3,702 km^2, the water volume was 44.09 km^3, and the water level was an absolute height of 245 m (see Figure 2).

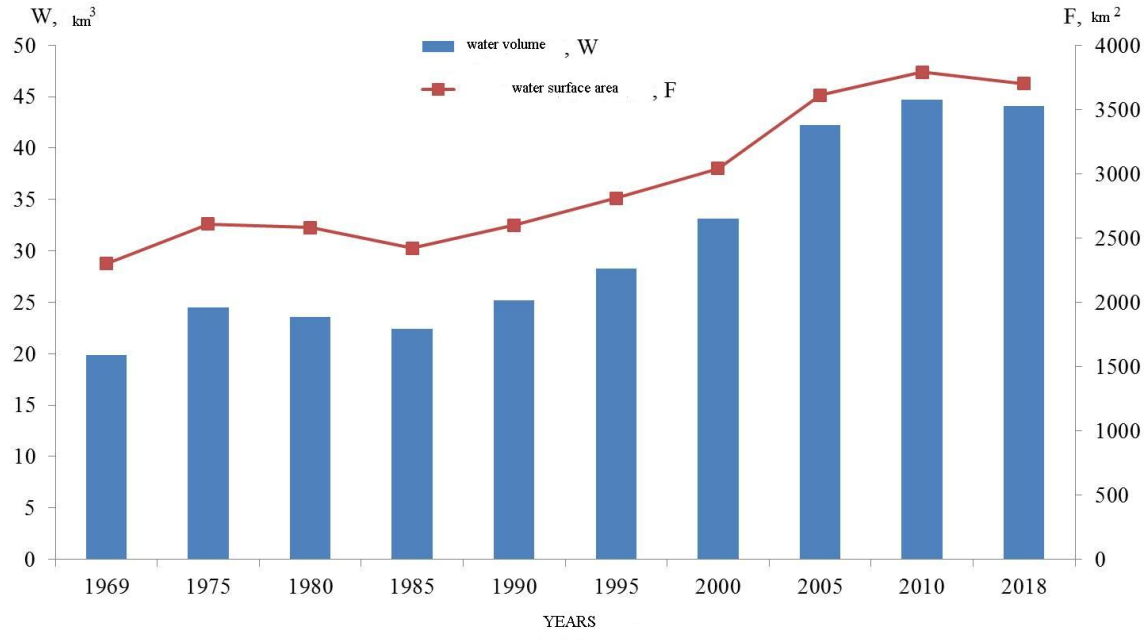

Figure 2. Changes in the surface area of the Aydar-Arnasay lake system depending on the volume of water

Conclusion

The amount of salinity in the AAKT is increasing due to the decrease in the inflow of water from the Chordara reservoir, on the contrary, the increase in the proportion of water from the collector-ditches. In the lake system, the salinity of the water increases from east to west. The salinity of the water is up to 7.4 g / l in the eastern part (Lake Arnasay), up to 7.6 g / l in the south-east (Lake Tuzkon), up to 7.9 g / l in the central part, and 8.6 g / l in the western part. to l (Aydarkol).

During the period from 1970 to 2018, changes in other morphometric parameters were also observed in the AACT, depending on the volume and area of water. The effect of AACT on

environmental landscapes can be assessed by determining changes in morphometric parameters over half a century (see Table 3).

Table 3

Analysis of morphometric parameters of the Aydar-Arnasay lake system

№	Morphometric indicators	1970 y *	2018 y **	Differences in performance
1	Water level, H, m	237,1	245,0	7,9
2	Water surface area, F, km^2	2300	3702	1402
3	Water volume, W, km^3	19,94	44,19	24,25
4	Length, L, km	155	350	195
5	The widest point, B_{max}, km	33	40	7
6	Average width, B_{urt}, km	15	19	4
7	The deepest point, h_{max}, m	22	27	5
8	Average depth, h_{ort}, m	8,6	9,5	0,9

*Note: * N.E.Gorelkin and A.M. Based on data from Nikitin (1976)*

*** Based on satellite images (Google earth pro.) And data from the Aydar-Arnasay Lakes Directorate (2018).*

In general, maintaining the level of the AAC at a height of 245 m will allow for the sustainable development of the organism and the surrounding landscape, as well as the development of coastal tourism on a large scale. As mentioned above, the water balance in the AAC is formed by the interaction of natural and anthropogenic factors. It requires the establishment of a single management system to control the inflow and outflow of water in the lake system and the rational use of biological resources.

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