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Theme: Foundation Of Aydar-Arnasay Lakes System And Their Effects On The Environmental Landscape

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Abstract: In this article you can find the history of the Aydar-Arnasay lakes system and changes in the volume of lake water that have learned from the environmental effects of landscapes.
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Prior to the development of Mirzachul and construction of the Chardara reservoir, the lakes Aydar, Arnasay and Tuzkon consisted of separate lakes. The lakes have been flooded for many years from the rivers on the western slopes of the Turkestan Mountains and on the northern slopes of the Nurata Mountains, as well as on the Syrdarya river. As a result, salty lakes are formed in the swamps. In the dry season, the water in the lakes evaporated and became salty and salt (M. Gudalov, 2014).

In the 1960s, intensive land development in Mirzachul resulted in the creation of collector-drainage systems. Due to the fact that the surface of the area is sloping towards the Aydarkul Battalion, collector-drainage waters and groundwater have been moving towards Aydar and Tuzkon. In 1957, the highest collector-drainage water flow into Aydar, Arnasay and Tuzkon was 82 million m^3. In 1968, it increased by 880 million m^3. As a result, water was always stored in the Tuzkon swamp. Separate small lakes have been formed in the deepest parts of Aydarkul and Arnasai swamps (E. Kholmatov et al., 2000).

The Aydar-Arnasai swamp is composed of saltwater and marshes, and separate shallow small lakes, where the water is dried up and salt free in the summer. Basically, the plants in the galophite group grew. The water level of the Aydar, Arnasay and Tuzkon lakes coincides with the rainy 1969 year (E. Kholmatov and M. Gudalov, 2005).

In 1969, one of the driest years of the twentieth century for Central Asia, water was more than the water of the Toktogul, Kayakkum and Chordara reservoirs. The excess water cannot be discharged from the Chardara reservoir downstream of the Syrdarya River. This is because the city of Kyzylorda was in danger of flooding. As a result, from February 1969 to March 1970, 21.8 km^3 of water was flown through the Arnasay Dam into the Arnasai Dam.

Due to rising water levels in the Arnasai swamp, part of the water flowed into the Aydarkul Basin. This was 400,000 m^3 in 1971 and 580,000 m^3 in March and April in 1972. Due to increased inflow, the water level increased by 22 meters in Tuzkon Lake and by about 10 meters in Aydarkul. As a result, the Aydar-Arnasai Lakes System (AALS) of 20 km^3 and 2,300 km^2 was formed here. Subsequent inflow led to the preservation of water levels and the creation of large fish bases. In the 1980s, the water level began to decrease due to evaporation (1,100-1200 mm per year).

After the collapse of the Soviet Union in the 1990s, the only power system in Central Asia collapsed. The sovereign states of Central Asia have independently established their water and energy consumption regimes. Since 1993, the Kyrgyz Republic has started to use the Toktogul reservoir (area is 284 km^2 and capacity is 19.5 km^3) for irrigation purposes. As a result, water accumulated in the Toktogul reservoir in spring and summer, making maximum use in the autumn and winter, when there is a high demand for electricity. Starting this year, excess water flowing from the Chordara reservoir to the AALS began to flow during the fall and winter.

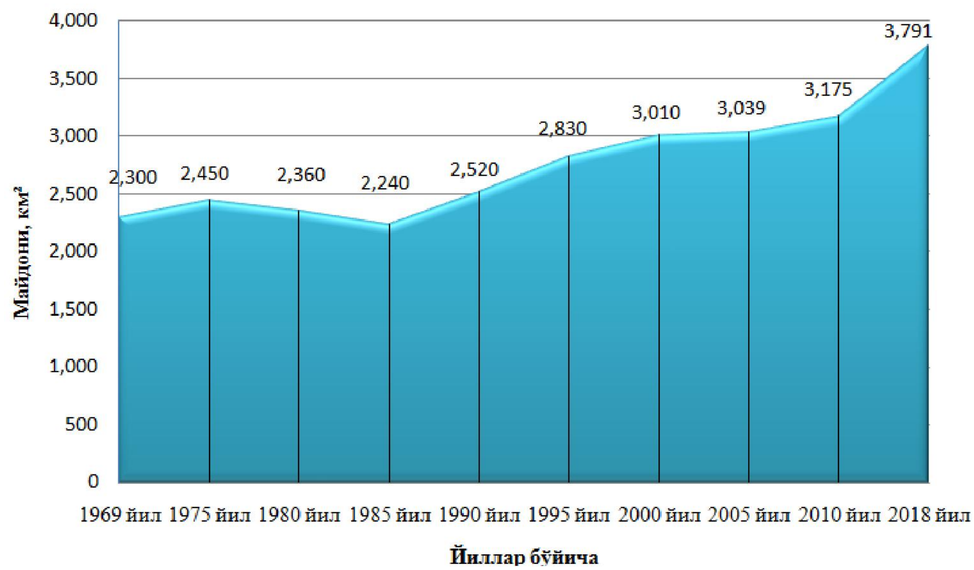
According to the Center of Hydrometeorological Service of Uzbekistan (Uzhydromet) in the early 1990s, the water level in the AALS was 237 m, and in 1998, 244.2 m. Compared to the water levels of the 1990s, it rose to 6.5-7.0 meters. The AALS has expanded to 1074 km2 over the years. As a result, the surrounding pastures, shepherd's houses and shelters, and the highways were flooded.

According to Uzhydromet experts, in November 1998 the absolute height of the lake was 243.7 m, the area was 3039 km^2, and the water volume was 31 km^3. The water level fluctuated from 0.8-2.3 meters. In winter and spring, the water level increases due to the fall of the Chardara in proportion to the volume. Maximum water levels in the lake are observed in May. During summer and autumn, the maximum evaporation was up to 3 km^3 and the lake level decreased by 0.5-0.7 m.

The water level rose by 3.6 meters from January 2000 to May 2005 when analyzing water inputs, changes in aquatories, and rising water levels in the AALS. During the same period, 11.2 km^3 of water was lost to the Arnasai Plateau. The area under flooding was 477 km2.

As of 2005, the AALS area was 3175 km^2 and the water volume was 34 km^3. An analysis of the AALS from 2005 to 2010 shows that, in proportion to the increase in area and volume, water levels have also increased. In 2018, the area of the AALS was 3719 km^2, the water volume was 44.19 km^3, and the water level was slightly lower, reaching 241 m.

Dynamic variation of the Aydar-Arnasay lake system area



There have also been changes in the AALS from 1970 to 2018 in other morphometric parameters, depending on the size and area of the water. It is possible to estimate the impact of AALS on environmental landscapes by detecting changes in morphometric indicators for half a century (M. Gudalov, 2012).

Comparative analysis of morphometric parameters of the Aydar-Arnasay lake system

№	Morphometric parameters	1970	2018 **	Differences in parameters
1	Maximum water level, m	239,3	241	1,7
2	Water surface area^2	2323	3791	1468
3	Water volume, km^3	19,94	44,19	24,25
4	Length, km	155	350	195
5	The widest area, km	33	40	7
6	Average width	15	19	4
7	The deepest place	22	27	5
8	Average depth	8,6	9,5	0,9

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

** Based on cosmic data (Google earth pro, 2018)

The morphometric indicators of the AALS's water balance for half a century can serve as an indicator of environmental landscapes.

The flooding of the Aydar-Arnasay dam caused groundwater levels to rise by several hundred meters in some areas and even up to 10-12 kilometers in some areas. This effect extends to different distances depending on the slope size and the rocks of the coastal zone. The greatest impact is found on the northern shores of Aydarkul and on the western shores of the Arnasay lakes. This is a strong disintegration of the coastline, the deep penetration of water into the shore, and the islands and the peninsula. The strong effect of lake water on the coast is due to the relatively low altitude between the water and land areas, the low slope, and the coastal zone composed of soft lake beds and alluvial rocks, which cover 15 to 30 meters thick sand beds.

Hydrostatic pressure in the lakes depends on the elevation of the water level. In this connection, observational artesian wells show that the groundwater level has increased up to 20-25 km on the northern shores of Aydarkul. The biggest rise is seen by the lake shores a few hundred meters, sometimes 2,000 meters. As a result, wetlands, water logging and waterlogged sandy loam are common along the coast. There are wetlands, swamps and meadow soils.

The southern coastal area of the Aydarkul is composed of relatively dense, proluvial and alluvial genesis beds with sands of up to 4-5m thick. These hard rocks protect the coast from strong erosion. On the other hand, the elevation to the Nurata mountains varies considerably. Therefore, the rise of groundwater levels on the southern coast of Aydarkul is not as short as the northern coast. In the south coast zone, the effects of groundwater on landscape formation are well known to several tens, sometimes several hundred meters. Wetlands, swamps, meadows and pristine soils are developed on the shores of the lake, which is very close to the surface. The hydromorphic properties are variable, and the lakes are associated with changes in water levels.

To the east of the AACT, the plains are composed of ancient alluvial rocks, and the upper part is covered by thick limestone. In this coastal zone, the rate of filtration of water is much lower than that of sandy areas, so waterlogged soils are mostly developed in lowlands near the coast line. The eastern shores of Lake Tuzkon are less fragmented. Only the northeastern coast of the Tuzkon Lake is lower than the lake's water level, when the water level rises a few kilometers, the water recedes back and forms swamps and salts on previously flooded lands. About ten collector-drainage waters from Mirzachul will flow into Arnasay and Tuzkon Lake. Waterlogged soils have also been developed in the lowlands intersected by these streams. Similar to landscapes in other coastal areas in general, this landscape also has widespread wetlands and meadows near the lake. As they move away from the lake, these soils are replaced by grasslands, and meadow soils.

The aim of analyzing the variability of water volume in the AALS is to study the natural geographical processes that may or may not occur in the area of the lake with increasing and decreasing water levels, including:

- Increased water availability in the AACC will undoubtedly increase the lake's shores, and grazing areas, irrigated arable land will be submerged, and within a few kilometers, the groundwater levels will rise, creating wet, saline and waterlogged soils. Landscapes are hydromorphic, semi-hydromorphic;
- If water volume decreases in AALS, the area occupied by water will be reduced, the area under water will be dried up, salts and other chemical elements in the mud will be removed by the wind and will have a negative impact on the environmental conditions of the surrounding landscapes. As the AALS decreases with water, salinity increases, which affects fish and other organisms in the lake. Without examining the water balance of the lake, it is difficult to analyze its impact on the landscape;
- As mentioned above, the AALS is the evaporator of water from the lakes, the largest indicator of the water balance in the outflow. If the amount of evaporation water is greater than the amount of water flowing into the lakes, the salinity will increase. This process has a great effect on the organisms in the lake, especially the fish. Coastal areas also increase saline soils, and the range of plants adapted to saline environments expands.

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