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ARIDITY INDEX OF THE DRIED-UP ARAL SEA BED AREAS IN RECENT YEARS

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Abstract. This scientific paper describes the aridity index observed in recent years in the area of the dried-up Aral Sea bed. Calculating the aridity index (AI) based on the ratio of precipitation to potential (reference) evapotranspiration to assess the degree of aridity in the study area. In the territory of the Muynak district of the Republic of Karakalpakstan, the values were 1 – (year 2000) AI = 0.45; 2 – (year 2010) AI = 0.23; 3 – (year 2020) AI = 0.12; and 4 – (year 2025) AI = 0.15, indicating the prevalence of semi-arid and arid conditions.

Keywords: Aral sea, aridity index, precipitation, potential (reference) evapotranspiration, World Atlas of Desertification

Introduction. Today, the problems caused by global warming and climate change are increasingly attracting the attention of the scientific community [1]. The Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) has demonstrated a significant rise in global surface temperatures. According to the report, global surface temperature increased by 0.99°C between the 1850–1900 and 2001–2020 periods; when comparing these periods, the rate of warming reached 1.09°C [5].

Disasters resulting from climate change have affected many countries around the world. Examples include droughts in some regions, floods, famine, the spread of various diseases, and earthquakes in others. The process of desertification is accelerating due to climate change, particularly in areas with scarce water resources.

Drought is a complex phenomenon that is difficult to observe and identify. For instance, storms have distinct starting and ending points, and their movement and development are easily visible. Drought, conversely, is a process that emerges gradually and insidiously, impacting numerous sectors of the economy. Climate change can intensify the effects of drought.

There are currently arid regions in our country. One of these is the Aral Sea region, located in the south of the republic. During the research, the aridity index for the dried-up bed of the Aral Sea was calculated [8]. Analysis was conducted based on recent weather data; specifically, annual data from the Muynak meteorological station, located on the dried-up bed of the Aral Sea, were utilized. The aridity index (AI) was calculated using the following formula (1), based on the UNEP/UNCCD methodology:

$$AI = \frac{\sum_{i-1}^{30} \left(\frac{P_i}{PET_i} \right)}{30} \quad (1)$$

Figure 1. Formula for calculating the aridity index [2]

Where AI is the aridity index; $\mathbf{P_i}$ is the precipitation amount in year i (mm); $\mathbf{PET_i}$ is the annual potential evapotranspiration in year **i** (mm); and **30**- is the 30-year climatic normal period recommended by the WMO (World Meteorological Organization).

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Land areas	AI
Hyper-arid	AI < 0.05
Arid	0.05 ≤ AI < 0.2
Semi-arid	0.2 ≤ AI < 0.5
Dry sub-humid	0.5 ≤ AI < 0.65
Humid	AI ≥ 0.65
Cold	PET <400 mm

Table 1. Climate classification based on the aridity index and subtypes of drylands [3,6,7]

The Earth's land area is classified based on the aridity index (table 1). According to this classification, areas are designated as hyper-arid if the AI is less than 0.05, arid if the AI is between 0.05 and 0.2, semi-arid if 0.2 < AI < 0.5, dry sub-humid if 0.5 < AI < 0.65, and humid if the aridity index is 0.65 or greater.

The aridity index for the study area was calculated based on the methodology of UNEP (United Nations Environment Programme) and UNCCD (United Nations Convention to Combat Desertification), using formula (1) mentioned above.

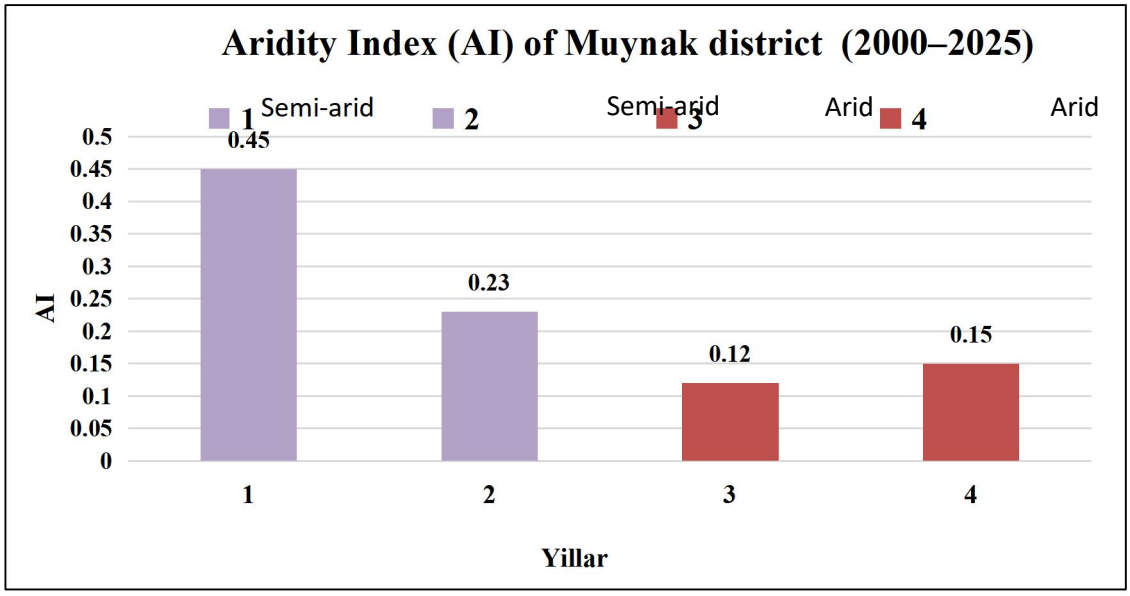


Figure 2. Aridity index of the Muynak district, covering the dried bed of the Aral Sea from 2000 to 2025

In the territory of the Muynak district of the Republic of Karakalpakstan, the values were 1 – (year 2000) AI = 0.45; 2 – (year 2010) AI = 0.23; 3 – (year 2020) AI = 0.12; and 4 – (year 2025) AI = 0.15, indicating the prevalence of semi-arid and arid conditions (figure 2).

Given Uzbekistan's strong dependence on agriculture and irrigation—sectors expected to be most affected by climate change—the results of this study serve as a basis for policy decision-making. It highlights the need for climate adaptation strategies at the national level to mitigate the impacts of extreme heat events, particularly in the fields of agriculture and water resource management [4].

The research results serve as a practical basis for a comprehensive assessment of the current ecological state of the soils and substrates on the dried bed of the Aral Sea, as well as for monitoring the processes of their formation and the initial developmental stages of the soil cover emerging in the area.

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