CLIMATE SERVICES FOR SUSTAINABLE WATER QUALITY MANAGEMENT IN THE BLACK SEA BASIN

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The hydrological and hydrochemical characteristics of rivers in the Black Sea basin are undergoing significant transformations due to climate change and anthropogenic factors. Climate services play a crucial role in managing these water resources by integrating monitoring, modeling, and forecasting systems to assess water quality and hydrological changes. The application of climate services ensures sustainable resource use, minimizes pollution risks, and enhances the resilience of aquatic ecosystems.

Long-term hydrological observations of the Sarata, Khadzhyder, Kaplan, Alkaliya, and Kogylnyk rivers indicate a declining trend in water flow and deteriorating water quality. Increasing extreme weather events, combined with agricultural runoff, have led to elevated pollutant concentrations and reduced freshwater availability. The accumulation of organic and mineral substances negatively affects aquatic ecosystems, exacerbating degradation processes that threaten biodiversity and limit the usability of water for drinking and irrigation. Changes in river runoff alter the dilution capacity of pollutants, worsening water quality under low-flow conditions.

This study assesses the ecological state of these rivers based on water quality indices such as the modified Water Pollution Index (WPI) and the Pollution Coefficient (PC), which offer a comprehensive evaluation from different perspectives. Results indicate that Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD5) significantly contribute to water pollution, exceeding maximum permissible concentrations (MPC) by 1.1 and 14.7 times, respectively, in 2013 (Fig.1). Additionally, ammonium nitrogen concentrations have remained consistently high across all study years, further signaling poor water quality.

Currently, the studied rivers exhibit a negative ecological state based on both methodologies (Fig.2). Without urgent intervention, excessive exploitation of water resources, river regulation, extensive water withdrawal for irrigation and domestic use, and the transformation of rivers into wastewater collectors could lead to irreversible degradation or even their disappearance.

Integrating climate services into water resource management allows for the development of targeted adaptation measures, including optimizing wa ter allocation, improving wastewater treatment, and implementing nature-based solutions.

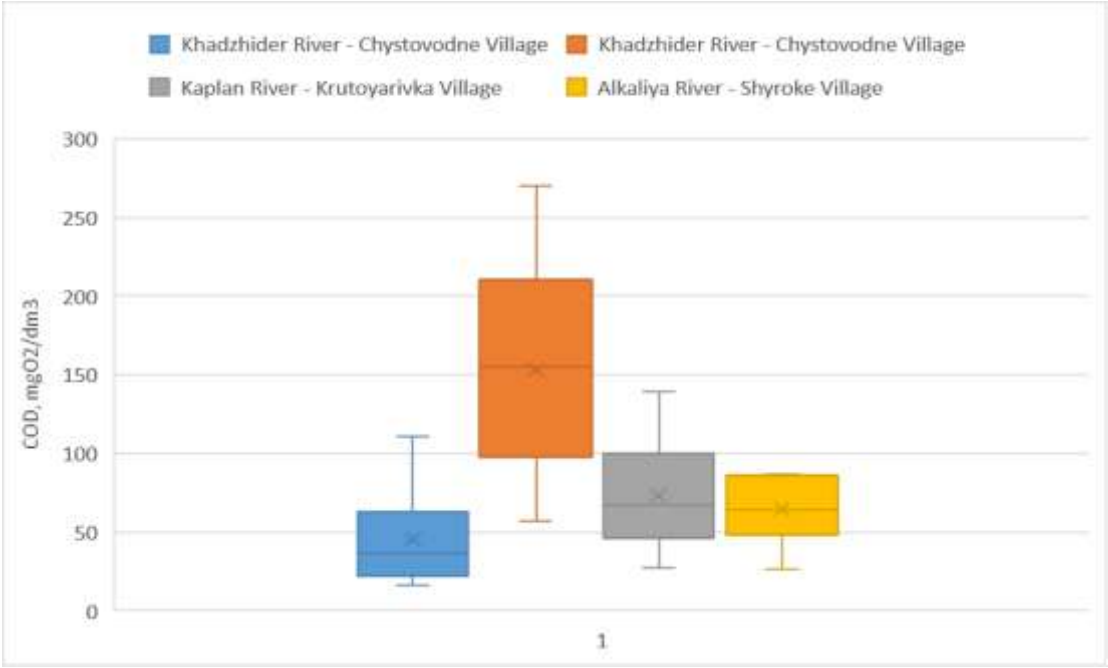

Fig. 1. Range of average annual COD values for the studied rivers of the Black Sea region for the period 2013 -2021.

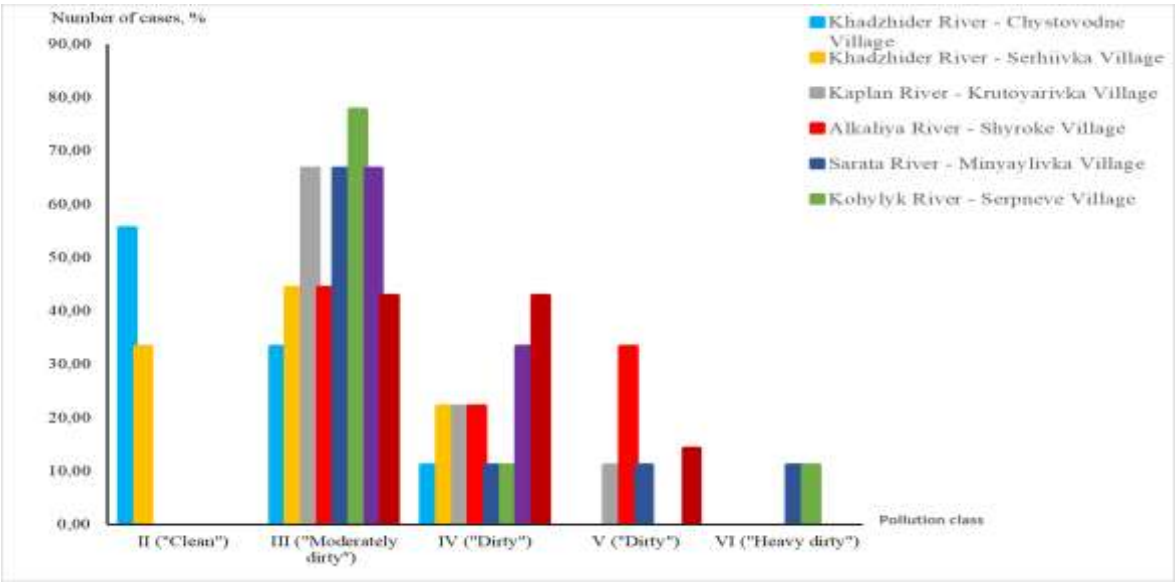

Fig. 2. Repeatability of pollution classes according to the modified ISR method in the studied rivers of the Black Sea region (2013-2021)

Forecasting models enable early identification of risks such as eutrophication, salinization, and contamination from industrial and agricultural sources. Given projected climate trends, future water resource planning should prioritize real-time data analysis, risk assessment, and mitigation strategies. Expanding the role of climate services in water management policies will enhance adaptive capacity, safeguard freshwater resources, and promote ecological stability in the Black Sea basin under changing environmental conditions.