The dual challenge of climate change and water scarcity: Assessing long-term impacts on global water resources in Tunisia

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ABSTRACT

Tunisia, a country characterized by a predominantly semi-arid to arid climate, is facing increasing challenges in the management and preservation of its water resources. These resources are naturally limited, highly variable in space and time, and subject to growing anthropogenic and climatic pressures. The irregular distribution of rainfall, combined with high evaporation rates and recurrent drought episodes, has made water scarcity one of the most pressing environmental and socio-economic issues in the country. In this context, the impacts of climate change are emerging as a critical factor that further aggravates existing water stress.

This study investigates the effects of climate change on the availability and quality of water resources in Tunisia. By analyzing recent hydro-climatic data, long-term meteorological trends, and case studies conducted in two representative regions — the North (Cap Bon Basins) and the Center (Merguellil Basin) — the research highlights several worrying developments. These include a consistent rise in average temperatures, increased evapotranspiration rates, declining precipitation patterns, the extension and intensification of drought periods, and the growing salinization of groundwater. Together, these phenomena illustrate a significant deterioration of both surface and groundwater resources, which poses a serious threat to their long-term sustainability.

The research illustrates comparison of results obtained for several watersheds—Lebna, Oued El Bey, and Merguellil—located in northern and central Tunisia. Changes and trends in annual, seasonal, and monthly rainfall distributions were assessed using data from 40 meteorological rain gauges covering the period 1980–2023. The non-parametric Mann–Kendall test and Sen's slope estimator were applied to identify positive or negative trends in the rainfall series and assess their statistical significance.

The main objective of this study is to offer a scientific basis for understanding the links between climate dynamics and water resource degradation, while offering actionable insights for policymakers and stakeholders. The findings underline the urgency of adopting a practical approach to climate adaptation, in order to safeguard the country's water security and ensure sustainable socio-economic development in the face of an increasingly arid future.

Keywords: Climate change; Semi-arid context; Trend analysis; Tunisian basins.