Title: Spatiotemporal trend analysis of hydroclimatic variables and their probable causes of changes in a hoar basin.

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Abstract: Understanding trends in hydroclimatic variables is crucial for linking local climatic drivers with regional water use practices, particularly in a vulnerable Haor basin in tropical country like Bangladesh. This study evaluated the spatiotemporal trends in hydroclimatic variables at annual and seasonal scales using advanced statistical methods, including the Modified Mann–Kendall (MK) test, Sen's slope, Sequential Mann-Kendal, Pettitt test, and linear regression model. Additionally, Detrended Fluctuation Analysis (DFA) and Morlet Wavelet Analysis (MWA) were utilized to analyze historical periodic cycles and predict future trends. Results show a significant decrease in annual and seasonal surface water levels (SWL) and rainfall, except for the monsoon, while both maximum and minimum temperatures simultaneously increased. The decline in annual SWL at a rate of 1.18 m/year was influenced by an increase in maximum temperature at a rate of 0.03 °C/year and a decrease in annual total rainfall at a rate of 5.25 mm/year. DFA analysis suggests long-term correlations among these variables, predicting future increases in temperature but continued decreases in rainfall and SWL. Periodic cycles with various frequencies were observed in rainfall, maximum, and minimum temperatures. ECMWF ERA5 reanalysis datasets attribute these changes to higher pre-monsoon geopotential heights, lower relative humidity, and higher monsoon rainfall associated with lower surface pressure. The findings of the study will help develop targeted climate adaptation strategies to mitigate the adverse effects on agriculture, biodiversity, and freshwater availability in the region. The overall study provides essential data that can inform water resource management strategies.

Keyword: Hydroclimatic Variables, Climate Change, Haor Basin, Bangladesh, Surface Water Level (SWL), Rainfall Trends, Temperature Trends.

DOI: https://doi.org/10.1007/s00704-024-05074-7