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Forecasting Lake Malawi Water Level Fluctuations Using Stochastic Models

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Abstract : The study considered Seasonal Autoregressive Integrated Moving Average (SARIMA) processes to select an appropriate stochastic model to forecast the monthly data from the Lake Malawi water levels for the period 1986 through 2015. The appropriate model was chosen based on SARIMA (p, d, q) (P, D, Q)S. The Autocorrelation function (ACF), Partial autocorrelation (PACF), Akaike Information Criteria (AIC), Bayesian Information Criterion (BIC), Box–Ljung statistics, correlogram and distribution of residual errors were estimated. The SARIMA (1, 1, 0) (1, 1, 1)12 was selected to forecast the monthly data of the Lake Malawi water levels from August, 2015 to December, 2021. The plotted time series showed that the Lake Malawi water levels are decreasing since 2010 to date but not as much as was the case in 1995 through 1997. The future forecast of the Lake Malawi water levels until 2021 showed a mean of 474.47 m ranging from 473.93 to 475.02 meters with a confidence interval of 80% and 90% against registered mean of 473.398 m in 1997 and 475.475 m in 1989 which was the lowest and highest water levels in the lake respectively since 1986. The forecast also showed that the water levels of Lake Malawi will drop by 0.57 meters as compared to the mean water levels recorded in the previous years. These results suggest that the Lake Malawi water level may not likely go lower than that recorded in 1997. Therefore, utilisation and management of water-related activities and programs among others on the lake should provide room for such scenarios. The findings suggest a need to manage the Lake Malawi jointly and prudently with other stakeholders starting from the catchment area. This will reduce impacts of anthropogenic activities on the lake's water quality, water level, aquatic and adjacent terrestrial ecosystems thereby ensuring its resilience to climate change impacts.

Keywords : forecasting, Lake Malawi, water levels, water level fluctuation, climate change, anthropogenic activities
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