Forecasting Reservoir Water Quality Using Stochastic Models: The Case of Gaborone Dam, Botswana

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Abstract

With the objectives of integrating knowledge related to surface water pollution, pollutant magnitudes, health consequences and control of these pollutants, this paper deals with the issue of forecasting of pollutant magnitudes for better operation and management of water treatment plants. It is based on trend and intervention analysis of monthly time series of three typically chosen pollutants viz; the total dissolved solids (TDS), Nitrate and Conductivity in the reservoir waters of the Gaborone dam in Botswana and then its modeling using an appropriate stochastic model to forecast the magnitude of water pollutants. Results from this forecasting exercise can help water chemists to prepare on how much pollutant to expect and the quantity of chemicals to apply in order to make the water safe for drinking.

Analysis using 35 months of observed pollutant values, showed a very marginal increasing trend of the pollutant and a marginal intervention in the first five months, suggesting the use of next thirty months values for modeling. The data thus followed an Auto-Regressive Model of order 1 (AR(1)) with least Akaike's Information Criteria (AIC) indicating the goodness of fit of the chosen model. One month lead forecast of the TDS, Conductivity and Nitrate, using the developed model showed an error of 0.31, 2.88 and 23.17% respectively when compared to the actual observation and therefore can be said to be reliable. In case of Nitrate, though the percentage error was a bit high, the forecast magnitude was still quite close to the observed values and was not in the alarming range of the pollutant. So, the technique can reliably be used for short term forecast of water quality variables of reservoir waters.

Key Words: Surface water, Pollution, Health consequences, Pollutant magnitudes, Trend Analysis, Intervention Analysis, Auto-Regressive Model, AIC