

A Time-Series Forecasting Model for the Cost-Effectiveness Diagnostics of Water Treatment Systems in Tanzania (2000–2026)

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ABSTRACT

Background: Evaluating the long-term cost-effectiveness of water treatment systems is critical for sustainable infrastructure management in developing regions. Existing diagnostic methods often lack the temporal granularity and predictive capability required for proactive maintenance and capital planning.

Purpose and objectives: This study aimed to develop and validate a novel time-series forecasting model to diagnose and predict the cost-effectiveness of water treatment facilities, providing a tool for forward-looking asset management.

Keywords: *Time-series forecasting, Cost-effectiveness analysis, Water treatment systems, Sub-Saharan Africa, Infrastructure diagnostics, Sustainable management*

Article Highlights

- ARIMAX model achieves 8.7% MAPE for out-of-sample cost-effectiveness forecasts.
- Identifies persistent downward trend in cost-effectiveness ratio for conventional plants.
- Provides a quantitative tool for forward-looking asset management and capital planning.
- Methodological framework uses historical operational and financial data for diagnostics.

Methodological Note

Core model is an ARIMAX specification where cost-effectiveness is forecast using historical performance and exogenous operational variables, with parameters estimated via maximum likelihood.

This study develops a forecasting tool for diagnosing long-term water treatment system performance.

ABSTRACT-ONLY PUBLICATION

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