

A Time-Series Forecasting Model for Efficiency Diagnostics in Tanzania's Water Treatment Infrastructure (2000–2026)

Aisha Mwinyi¹|Grace Mwakapenda^{2,3}

Juma Mkumbo⁴

¹ Ardhi University, Dar es Salaam

² Department of Sustainable Systems, University of Dar es Salaam

³ Department of Electrical Engineering, Ardhi University, Dar es Salaam

⁴ University of Dar es Salaam

Correspondence: amwinyi@hotmail.com

Received: 13 September 2015 | Accepted: 08 December 2015 | Published: 04 February 2016 | DOI:

[10.5281/zenodo.18969204](https://doi.org/10.5281/zenodo.18969204)

ABSTRACT

Chronic inefficiencies in water treatment infrastructure undermine public health and economic development across many African nations. In Tanzania, operational data has been historically fragmented, impeding systematic performance analysis and targeted policy interventions for efficiency gains. This policy analysis develops and applies a novel time-series forecasting model to diagnose operational efficiency trends within the country's water treatment infrastructure, aiming to provide a robust evidence base for infrastructure investment and maintenance policy. A seasonal autoregressive integrated moving average (SARIMA) model, specified as $\varphi(B)\varphi(B^S)(1-B)^d(1-B^S)^D yt = \theta(B)\theta(B^S)\epsilon_t$, was fitted to historical national performance data. Model diagnostics, including analysis of robust standard errors, confirmed the specification's validity for forecasting key efficiency indicators. The model forecasts a gradual but significant efficiency decline in key infrastructure components if current maintenance and investment policies remain unchanged. A projected 12% reduction in overall plant efficiency by the forecast horizon was identified, with uncertainty intervals indicating this trend is statistically robust. The forecasting exercise reveals a clear negative trajectory for system efficiency, signalling that existing policy frameworks are insufficient to ensure sustainable infrastructure performance. Policy must prioritise predictive maintenance regimes informed by such models and reallocate capital budgets towards rehabilitating the most critical assets identified by the efficiency diagnostics. Infrastructure diagnostics, SARIMA modelling, predictive maintenance, water treatment efficiency, policy analysis This article provides a novel, transferable methodological framework for evidence-based infrastructure policy, moving beyond descriptive analysis to predictive diagnostics.

Keywords: *Time-series forecasting, Infrastructure efficiency, Water treatment systems, Sub-Saharan Africa, Policy evaluation, Engineering diagnostics, Operational data analysis*

Article Highlights

- SARIMA model forecasts significant efficiency decline in water treatment infrastructure.
- Analysis reveals fragmented operational data impedes systematic performance diagnostics.
- Findings advocate for predictive maintenance regimes informed by forecasting models.
- Provides a transferable framework for evidence-based infrastructure policy in SSA.

Methodological Contribution

Applies a seasonal ARIMA model to diagnose operational efficiency trends, moving beyond descriptive analysis to predictive policy diagnostics.

This analysis provides a robust evidence base for infrastructure investment and maintenance policy.

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

REQUEST FULL PAPER

 **Email:** info@parj.africa

Request your copy of the full paper today!

SUBMIT YOUR RESEARCH

**Are you a researcher in Africa? We
welcome your submissions!**

Join our community of African scholars and share
your groundbreaking work.

 **Submit at:** app.parj.africa



Scan to visit app.parj.africa

Open Access Scholarship from PARJ

Empowering African Research | Advancing Global
Knowledge