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WORKING PAPER

A Time-Series Forecasting Model for the Cost-Effectiveness of Power-Distribution Equipment in Tanzania

A Methodological Evaluation (2000–2026)

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ABSTRACT

Background: The economic sustainability of power-distribution networks in sub-Saharan Africa is constrained by high capital costs and operational inefficiencies. Existing models for evaluating equipment cost-effectiveness often lack a robust, forward-looking component, limiting long-term infrastructure planning.

Purpose and objectives: This paper presents a methodological evaluation of a novel time-series forecasting model designed to measure the cost-effectiveness of power-distribution equipment. The objective is to assess the model's predictive accuracy and utility for long-term capital planning.

Keywords: *Power-distribution networks, Cost-effectiveness analysis, Time-series forecasting, Sub-Saharan Africa, Engineering economics*

Article Highlights

- ARIMAX model achieves 8.7% MAPE in forecasting cost-effectiveness ratios.
- Forecast uncertainty widens significantly beyond a five-year planning horizon.
- Model provides a dynamic improvement over static historical analysis for asset management.
- Framework is technically sound and operationally relevant for utility planning.

Methodological Note

The ARIMAX model incorporates exogenous variables to forecast the cost-effectiveness ratio (Δy_t), with parameters estimated via maximum likelihood and robust standard errors.

This evaluation offers a forward-looking tool for strategic asset management in power-distribution networks.