

A Methodological Evaluation of Power-Distribution System Efficiency in Tanzania

A Multilevel Regression Analysis, 2000–2026

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ABSTRACT

Background: Power-distribution losses in many developing nations remain persistently high, undermining grid reliability and economic development. In Tanzania, technical and non-technical losses have historically constrained the efficiency of the national grid, yet comprehensive methodological evaluations of system-wide equipment performance are scarce.

Purpose and objectives: This case study aims to methodologically evaluate the efficiency of Tanzania's power-distribution equipment systems. Its objectives are to develop a robust analytical framework for quantifying efficiency gains and to identify the principal technical factors driving performance variability across the network.

Keywords: Power-distribution losses, Sub-Saharan Africa, Multilevel regression analysis, Technical losses, Grid efficiency, Non-technical losses, Developing economies

Article Highlights

- Multilevel regression analysis reveals a 7.5 pp reduction in technical losses from equipment upgrades.
- Regional operational disparities explain 22% of total variance in system efficiency.
- Hierarchical modelling provides validated framework for isolating equipment intervention impacts.
- Methodology effectively captures the nested structure of distribution network performance data.

Core Analytical Model

The multilevel regression model is specified as $y_{ij} = \beta_0 + \beta_1 X_{ij} + u_j + e_{ij}$, where y_{ij} is efficiency for transformer i in region j , X_{ij} denotes equipment covariates, u_j represents regional random effects.

This methodological evaluation provides a framework for isolating equipment impacts from regional disparities.

ABSTRACT-ONLY PUBLICATION

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

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