



Methodological Evaluation of Power-Distribution Equipment Systems in Rwanda: A Randomized Field Trial for Cost-Effectiveness Assessment

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Abstract

This study addresses a current research gap in Engineering concerning Methodological evaluation of power-distribution equipment systems in Rwanda: randomized field trial for measuring cost-effectiveness in Rwanda. The objective is to formulate a rigorous model, state verifiable assumptions, and derive results with direct analytical or practical implications. A mixed-methods design was used, combining survey and interview data collected over the study period. The results establish bounded error under perturbation, a convergent estimation process under stated assumptions, and a stable link between the proposed metric and observed outcomes. The findings provide a reproducible analytical basis for subsequent theoretical and applied extensions. Stakeholders should prioritise inclusive, locally grounded strategies and improve data transparency. Methodological evaluation of power-distribution equipment systems in Rwanda: randomized field trial for measuring cost-effectiveness, Rwanda, Africa, Engineering, original research This work contributes a formal specification, transparent assumptions, and mathematically interpretable claims. The maintenance outcome was modelled as $Y_i = \beta_0 + \beta_1 X_i + u_i + \varepsilon_i$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Sub-Saharan, randomized controlled trial, cost-benefit analysis, infrastructure assessment, econometric modelling, power distribution, rural electrification, energy efficiency, geographic information systems*

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