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A Randomised Field Trial Methodology for Cost-Effectiveness Evaluation of Power-Distribution Infrastructure in Nigeria

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ABSTRACT

Background: The persistent inefficiency of power-distribution infrastructure in Nigeria necessitates robust, evidence-based methods for evaluating the cost-effectiveness of new equipment and interventions. Current evaluation practices often rely on laboratory tests or non-randomised field deployments, which fail to account for real-world operational heterogeneity and confounding factors.

Purpose and objectives: This article presents a novel methodology for conducting a randomised field trial (RFT) specifically designed to evaluate the cost-effectiveness of power-distribution equipment, such as transformers and conductors, within the Nigerian grid. The objective is to provide a rigorous framework for comparing the lifecycle costs and performance of different technological systems under actual operating conditions.

Keywords: *Randomised controlled trial, Cost-effectiveness analysis, Power-distribution infrastructure, Sub-Saharan Africa, Engineering economics, Field experiment, Network reliability*

Article Highlights

- Proposes a novel randomised field trial (RFT) methodology for power-distribution infrastructure.
- Employs a primary composite metric: Total Owning Cost per Unit Reliability (TOCUR).
- Uses a linear mixed-effects model with robust, clustered standard errors for analysis.
- Designed to detect a minimum 15% difference in cost-effectiveness with 80% statistical power.

Core Analytical Model

$TOCUR_{ij} = \mu + \tau \cdot Treatment_i + \beta X_{ij} + u_j + \varepsilon_{ij}$, where u_j is a random intercept for region j.

This is a methodology paper presenting a trial protocol, not empirical results.