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# A Randomised Field Trial Methodology for Evaluating Power-Distribution System Yield Improvement in Tanzania

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## ABSTRACT

**Background:** Power-distribution systems in many developing nations suffer from significant technical and commercial losses, reducing overall yield. Existing evaluation methods for improvement technologies often rely on modelled or non-comparative field data, lacking rigorous causal inference for real-world performance.

**Purpose and objectives:** This article presents a novel methodological framework for conducting a randomised field trial (RFT) to empirically evaluate the impact of specific equipment interventions on power-distribution system yield. The objective is to establish a robust protocol for comparative performance measurement under actual operational conditions.

**Keywords:** *Randomised controlled trial, Power-distribution systems, Technical losses, Sub-Saharan Africa, Field experiment, Yield improvement, Network reliability*

### Article Highlights

- Proposes a cluster-randomised trial design using substations as the unit of analysis.
- Employs a differences-in-differences model with cluster-robust standard errors for inference.
- Power calculations indicate 30 substation clusters per arm needed to detect a 3–5% yield improvement.
- Provides a replicable framework for evidence-based evaluation of capital projects in utilities.

### Core Analytical Model

The analysis employs a differences-in-differences model: $Y\_it = \beta_0 + \beta_1 Treat\_i + \beta_2 Post\_t + \beta_3 (Treat\_i \times Post\_t) + \varepsilon\_it$, where $Y\_it$ is percentage yield. Inference uses cluster-robust standard errors.

*This is a methodology paper; it presents a trial framework rather than empirical results from a completed study.*