

CASE STUDY

# A Randomised Field Trial of Distribution Network Efficiency Gains in Rwanda

*A Methodological Evaluation of Equipment Systems*

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Received: 31 March 2008 | Accepted: 28 June 2008 | Published: 16 August 2008 | DOI:

[10.5281/zenodo.18965782](https://doi.org/10.5281/zenodo.18965782)

## ABSTRACT

**Background:** Power distribution losses in sub-Saharan Africa remain persistently high, undermining grid reliability and economic development. Technical losses, stemming from inefficient network equipment, are a critical yet under-measured component. There is a paucity of robust field data comparing the real-world performance of different equipment systems under operational conditions.

**Purpose and objectives:** This case study presents a methodological evaluation of a randomised field trial designed to quantify efficiency gains from alternative distribution equipment. The primary objective was to establish a rigorous field-testing protocol and apply it to compare the performance of conventional conductors against modern low-loss alternatives in a real network.

**Keywords:** *Sub-Saharan Africa, Power Distribution Losses, Randomised Field Trial, Network Efficiency, Technical Losses, Grid Reliability, Distribution Network Equipment*

### Article Highlights

- A randomised controlled trial protocol for evaluating distribution equipment in operational networks.
- Modern low-loss conductors reduced technical losses by 2.8 percentage points versus conventional systems.
- Differences-in-differences model isolated equipment effects from confounding variables.
- Provides a robust methodological framework for utility procurement and regulatory decision-making.

### Core Analytical Model

The analysis employed a differences-in-differences model:  $Y_{it} = \beta_0 + \beta_1 \text{Treat}_i + \beta_2 \text{Post}_t + \beta_3 (\text{Treat}_i \times \text{Post}_t) + \varepsilon_{it}$ , with technical loss ( $Y_{it}$ ) as the outcome. Standard errors were clustered at the feeder level.

*This study establishes a field-testing protocol for quantifying real-world equipment performance.*

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