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METHODOLOGY PAPER

A Randomised Field Trial Methodology for Evaluating Distribution Network Efficiency Gains in the Ethiopian Power Sector

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ABSTRACT

Background: Power distribution losses in developing economies are a critical engineering challenge, with technical and non-technical inefficiencies causing substantial economic and operational strain. Existing evaluation methods for network interventions often lack rigorous field-based causal evidence, particularly in sub-Saharan African contexts.

Purpose and objectives: This article presents a novel methodological framework for conducting a randomised field trial (RFT) to causally evaluate the efficiency gains from deploying advanced distribution equipment, specifically composite conductor technology and smart meters, within a national utility.

Keywords: *Randomised controlled trial, Distribution network losses, Sub-Saharan Africa, Technical losses, Non-technical losses, Power sector reform, Field experiment*

Article Highlights

- Proposes a novel randomised field trial (RFT) framework for evaluating power distribution efficiency gains.
- Clusters medium-voltage feeders into matched pairs for random assignment to treatment or control groups.
- Employs a differences-in-differences model to estimate the causal Average Treatment Effect (ATE).
- Explicitly addresses implementation challenges like geographic stratification and field crew blinding.

Core Statistical Model

The primary analysis uses a differences-in-differences specification to estimate the Average Treatment Effect on technical loss percentage, with inference based on cluster-robust standard errors at the feeder level.

This is a methodology paper presenting a trial design framework, not empirical results from its application.