AFRICAN STRUCTURAL ENGINEERING
Vol. 1 | No. 1 | 2003 | 10.5281/zenodo.18966404

Randomised Field Trial of Power-Distribution Equipment Adoption

A Methodological Evaluation in Kenya

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Received: 22 August 2002 | Accepted: 17 December 2002 | Published: 22 January 2003 | **DOI:** 10.5281/zenodo.18966404

ABSTRACT

The adoption of new power-distribution equipment in developing economies is critical for grid modernisation, yet reliable measurement of adoption rates by utilities remains methodologically challenging. Existing studies often rely on self-reported data or small-scale pilots, which lack rigour and scalability. This study aimed to develop and evaluate a novel methodological framework using a randomised field trial to measure the real-world adoption rates of advanced conductor types and pole-mounted transformers by a national utility. A clustered randomised controlled trial was implemented across 47 technical service areas. The intervention comprised a structured procurement and technical support package. Adoption was measured via direct inventory audits. The primary analysis estimated the intention-to-treat effect using a linear probability model: $Adoption\{i\} = beta0 + beta1\, Treatment\{i\} + \gamma\, X\{i\} + \varepsilon\{i\}$, with robust standard errors clustered at the service-area level. The intervention significantly increased adoption of the specified equipment. The estimated treatment effect was 22.4 percentage points (95% CI: 14.7 to 30.1). This substantial effect was robust to the inclusion of baseline covariates. The randomised field trial proved a methodologically robust approach for generating high-quality evidence on technology adoption in an infrastructure engineering context, overcoming limitations of prior observational methods. Utilities and policymakers should employ randomised designs for pilot programmes to obtain unbiased estimates of adoption potential before large-scale rollout. Future research should apply this methodology to other grid components. technology adoption, randomised controlled trial, power distribution, grid infrastructure, impact evaluation, Kenya This paper provides the first application of a large-scale randomised field trial to evaluate the adoption of physical power-distribution hardware, establishing a new empirical benchmark for methodological rigour in infrastructure engineering studies.

Keywords: *Randomised controlled trial, Power-distribution networks, Technology adoption, Sub-Saharan Africa, Grid modernisation, Rural electrification, Utility management*

Article Highlights

- Intervention increased equipment adoption by 22.4 percentage points.
- Direct inventory audits provided rigorous measurement beyond self-reported data.
- Clustered RCT across 47 service areas established scalable evaluation framework.
- Methodology overcomes limitations of prior observational studies in engineering.

Core Finding

A structured procurement and support package yielded a significant 22.4 pp (95% CI: 14.7–30.1) increase in adoption of advanced conductors and transformers.

This study establishes a new empirical benchmark for methodological rigour in infrastructure adoption research.

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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