

# A Quasi-Experimental Evaluation of Power-Distribution System Reliability in Nigeria

*A Methodological Framework for 2000–2026*

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## ABSTRACT

**Background:** Chronic unreliability in electrical power distribution remains a critical infrastructural constraint on socio-economic development. Existing assessments often lack rigorous causal frameworks for evaluating the performance of ageing equipment systems against defined reliability metrics.

**Purpose and objectives:** This study aimed to develop and apply a novel quasi-experimental methodological framework for the longitudinal evaluation of power-distribution system reliability. The primary objective was to isolate and quantify the causal effect of equipment interventions on key reliability indices.

**Keywords:** *Power distribution reliability, Quasi-experimental design, Sub-Saharan Africa, Infrastructure evaluation, System reliability metrics, Nigeria, Electrical grid*

### Article Highlights

- Difference-in-differences design isolates causal effects of equipment interventions on reliability metrics.
- Analysis reveals statistically significant SAIDI reduction: - 18.7 hours/customer/year post-intervention.
- Transformer failure rates identified as predominant contributor to baseline system unreliability.
- Methodological framework enables empirical evaluation of capital investment efficacy in power infrastructure.

### Core Methodology

Difference-in-differences analysis of panel data from intervention and control feeder groups, measuring reliability via System Average Interruption Duration Index (SAIDI).

*This study presents a novel causal framework for evaluating power distribution reliability in Sub-Saharan Africa.*

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