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Replication of a Quasi-Experimental Design for Power-Distribution System Reliability Diagnostics in Tanzania

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ABSTRACT

Background: Power-distribution reliability in sub-Saharan contexts is often assessed using theoretical models, with limited validation through structured field experiments. The original quasi-experimental study proposed a novel framework for on-site diagnostics, yet its methodological robustness and practical applicability required independent verification.

Purpose and objectives: This study aimed to replicate a quasi-experimental design for evaluating the reliability of medium-voltage distribution equipment. The objectives were to assess the reproducibility of the diagnostic protocol, verify the statistical model for failure prediction, and evaluate the method's operational feasibility in a real-world setting.

Keywords: *Power-distribution reliability, Quasi-experimental design, Sub-Saharan Africa, System diagnostics, Replication study, Tanzania*

Article Highlights

- Matched-pairs quasi-experiment replicated across rural and peri-urban feeders.
- Hazard ratio of 0.65 confirms significant reliability improvement from diagnostics.
- Variation in Weibull shape parameter β indicates context-specific failure modes.
- Framework proves methodologically sound for field-based system evaluation.

Core Reliability Metric

Modelled using a Weibull survival function: $R(t) = \exp[-(t/\eta)^{\beta}]$, with inference based on 95% bootstrapped confidence intervals.

This replication validates a practical diagnostic framework while highlighting the need for localised parameter calibration.