



# Methodological Assessment of Off-Grid Community Systems in Nigeria: A Randomized Field Trial on System Reliability

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## Abstract

Off-grid community systems in Nigeria are increasingly used for energy provision, particularly solar-powered solutions. These systems aim to improve access to electricity and reduce reliance on grid infrastructure. A systematic review was conducted, including empirical studies from Nigeria that utilised randomized field trial designs to measure system reliability. Methodological rigor and statistical models were evaluated for robustness. In the reviewed studies, the average system failure rate across all tested systems was found to be between 5% and 10%, with variation depending on geographical location and system design. The methodological approaches varied significantly in terms of study design, data collection methods, and statistical models used. Overall, there is room for improvement in standardising methodologies to enhance comparability across studies. Standardised field trial designs should be implemented with detailed documentation of methodology, including statistical models and uncertainty intervals, to facilitate future research and policy development. Off-grid systems, reliability, randomized trials, methodological assessment, Nigeria The empirical specification follows  $Y = \beta_{0+\beta} p X + \text{varepsilon}$ , and inference is reported with uncertainty-aware statistical criteria.

**Keywords:** *Sub-Saharan, geospatial, reliability assessment, randomized trials, sustainability metrics, energy access, community infrastructure*

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