African Security Studies (Interdisciplinary - Social/Political focus)

# Methodological Evaluation of Off-Grid Communities Systems in Nigeria Using Multilevel Regression Analysis for System Reliability Measurement

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## Abstract

Off-grid communities in Nigeria face significant challenges in accessing reliable energy sources, leading to poor system reliability and limited development opportunities. The review employed rigorous methodologies including comprehensive database searches, inclusion criteria based on study quality and relevance, and critical appraisal of selected studies using predefined criteria. A key finding is the predominance of qualitative over quantitative approaches in off-grid systems research, despite multilevel regression analysis being a robust method for measuring system reliability. The review underscores the need to incorporate more rigorous quantitative methodologies, particularly multilevel regression analysis, into future studies on off-grid communities' energy systems. Researchers should prioritise the application of multilevel regression models in their studies, alongside critical appraisal techniques to enhance methodological rigor and reliability. off-grid communities, Nigeria, system reliability, multilevel regression analysis, qualitative research Model estimation used $\hat{\{}\theta\}=argmin\{\theta\}sumiell(yi,f\theta(\xi))+\lambda lVert\theta rVert2^{2}$, with performance evaluated using out-of-sample error.

**Keywords:** *Sub-Saharan, multilevel modelling, off-grid, communities, reliability, analysis, development*