



Methodological Evaluation of Off-Grid Communities Systems in Ghana Using Quasi-Experimental Design to Assess System Reliability

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Abstract

Off-grid communities in Ghana face challenges in accessing reliable energy sources, necessitating robust system designs to ensure continuous power supply. A mixed-methods approach combining quantitative data analysis with qualitative interviews was employed. The quasi-experimental design involved comparing pre- and post-system implementation data to assess changes in energy availability, reliability, and user satisfaction. The analysis revealed a significant increase ($p < 0.05$) of 20% in system uptime after the deployment of solar-powered systems compared to baseline conditions. This study contributes new insights into understanding factors influencing off-grid community energy reliability, particularly in Ghanaian contexts. Further research should explore long-term sustainability and cost-effectiveness of these systems for wider implementation. Model estimation used $\hat{\theta} = \underset{\theta}{\operatorname{argmin}} \{ \theta \} \operatorname{sumiell} (y_i, f\theta(\xi)) + \lambda l \operatorname{Vert} \theta r \operatorname{Vert} 2^2$, with performance evaluated using out-of-sample error.

Keywords: *Sub-Saharan, Quasi-experimental, Randomization, Sampling, Evaluation, Sustainability, Technology Transfer*

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