



# Off-grid Community System Reliability in Ghana: A Panel Data Evaluation

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### Abstract

Ghana's off-grid communities rely on renewable energy systems for electricity supply, with significant disparities in reliability across different regions. A mixed-method approach combining econometric modelling (Panel Data Estimation) and qualitative insights was employed. The study utilised secondary data from government records, community surveys, and expert interviews for a comprehensive evaluation of the off-grid systems in Ghana. The analysis revealed that system reliability varied by region, with northern communities experiencing higher failure rates compared to southern regions (45% vs. 20%). Panel data estimation indicated significant correlations between investment levels and system reliability, suggesting a need for targeted interventions in underperforming areas. Targeted investments in infrastructure upgrades are recommended for northern off-grid communities to improve their electricity supply reliability. off-grid systems, Ghana, renewable energy, panel data estimation, reliability analysis Model estimation used  $\hat{\theta} = \text{argmin} \{ \theta \} \text{sumiell} ( y_i, f\theta ( \xi ) ) + \lambda l \text{Vert} \theta r \text{Vert} 2^2$ , with performance evaluated using out-of-sample error.

**Keywords:** *Sub-Saharan, Africa, Polytomous, Multilevel, Random-effects, Panel, data, Regression*

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