



Bayesian Hierarchical Model for Risk Reduction in Off-Grid Communities Systems in Kenya: An Evaluation

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Abstract

Off-grid communities in Kenya face significant challenges related to energy security, particularly solar-powered systems for lighting and power. A Bayesian hierarchical model was developed and applied to assess risk factors associated with system performance and reliability across multiple communities. Uncertainty quantification is provided through robust standard errors. The model revealed that solar panel efficiency had a significant positive correlation ($p < 0.05$) with the frequency of maintenance required, indicating that higher efficiency panels require more frequent repairs due to their increased exposure to environmental stresses. Bayesian hierarchical models offer a robust framework for understanding and managing risks in off-grid community systems, providing actionable insights into system design and maintenance strategies. Policy makers should encourage the adoption of high-efficiency solar panels while also implementing targeted maintenance programmes to mitigate potential failures. The empirical specification follows $Y = \beta_{0+\beta}^T X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: Kenya, Off-grid, Bayesian, Hierarchical, Risk, Evaluation, Methodology

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