Bayesian Hierarchical Model for Measuring Cost-Efficiency in Off-Grid Communities in Ghana

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Abstract

The study examines off-grid communities in Ghana, focusing on their energy systems' cost-effectiveness. Bayesian hierarchical models were employed to analyse the cost-effectiveness of various off-grid energy systems within communities, accounting for both heterogeneity across communities and internal variability within each system. A key finding is that decentralized solar photovoltaic (PV) configurations generally outperformed other hybrid systems in terms of cost-effectiveness, with a median benefit-cost ratio above 1.5. The Bayesian hierarchical model provided nuanced insights into the relative performance of different off-grid energy configurations, contributing to more informed policy decisions. Further research should explore scalability and long-term sustainability implications of identified cost-effective configurations. Bayesian Hierarchical Model, Off-Grid Communities, Cost-Efficiency, Energy Systems, Ghana The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Geographic, Sub-Saharan, Hierarchical, Bayesian, Econometrics, Sustainability, Development*

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