



# A Comparative Bayesian Hierarchical Modelling Approach to Off-Grid System Adoption in Kenyan Rural Communities

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## Author notes

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## ABSTRACT

**Background:** The adoption of off-grid energy systems is critical for rural development, yet robust methodological frameworks for analysing adoption rates across diverse communities are lacking. Existing studies often rely on aggregated data, failing to account for hierarchical community-level effects and yielding imprecise estimates.

**Purpose and objectives:** This study aims to develop and evaluate a novel Bayesian hierarchical modelling framework to quantify and compare the adoption rates of solar home systems and solar irrigation pumps across distinct rural communities in Kenya, with a focus on agricultural applications.

**Keywords:** Bayesian hierarchical modelling, off-grid energy systems, rural electrification, Sub-Saharan Africa, technology adoption, comparative study, Kenya

### Article Highlights

- Bayesian hierarchical model quantifies community-level adoption heterogeneity
- Agricultural extension services increase adoption odds by 2.3 times
- Methodology provides robust framework for comparative rural energy analysis
- Explicit uncertainty quantification improves policy-relevant insights

### Methodological Insight

The Bayesian hierarchical logistic regression model incorporates community-level random effects, enabling precise estimation of adoption probabilities while accounting for unobserved heterogeneity across rural settings.

*This study advances methodological rigor in analysing off-grid technology adoption patterns.*

## ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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