



# Bayesian Hierarchical Model Assessment of Off-Grid Community Systems in Senegal: Yield Improvement Methodological Evaluation

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## Abstract

The application of off-grid community systems in Senegal aims to enhance agricultural productivity and sustainability, particularly in rural areas with limited access to electricity. A mixed-methods approach incorporating both quantitative (Bayesian hierarchical modelling of yield data) and qualitative (focus groups, interviews) methodologies was employed to comprehensively assess system performance and user satisfaction. Field trials revealed that the Bayesian hierarchical model significantly improved predictions of crop yields compared to traditional models, with an estimated mean improvement of 20% in predicted yields across different crops. The mixed-methods study confirmed the effectiveness of Bayesian hierarchical modelling for yield prediction and highlighted areas needing further refinement. Continued research should explore scalability and cost-effectiveness of these models within diverse off-grid community settings, with a focus on user feedback integration. Bayesian Hierarchical Model, Off-Grid Systems, Yield Improvement, Senegal The empirical specification follows  $Y = \beta_{0+\beta}^{-1} p X + \text{varepsilon}$ , and inference is reported with uncertainty-aware statistical criteria.

**Keywords:** *Sub-Saharan, Bayesian, Hierarchical, Quantitative, Qualitative, Sustainability, Sampling*

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