African Animal Welfare Studies (Agri/Animal Science)

Bayesian Hierarchical Modelling for Cost-Effectiveness Evaluation of Off-Grid Communities in Rwanda

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Abstract

Off-grid communities in Rwanda face challenges in accessing electricity, which impacts agricultural productivity and welfare. A Bayesian hierarchical model was developed to estimate the cost-effectiveness of off-grid community electricity projects in Rwanda, accounting for variability across different agricultural contexts and project sizes. Bayesian inference revealed that a specific solar energy system configuration led to an average annual increase of 12% in crop yields among participating farmers compared to those without access. The Bayesian hierarchical model provided robust uncertainty estimates, which were crucial for decision-making regarding the deployment and maintenance of off-grid renewable energy systems. Further research should focus on long-term economic impacts and sustainability factors to enhance the effectiveness of these projects in Rwandan agricultural settings. The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *African agriculture, Bayesian methods, hierarchical modelling, cost-effectiveness analysis, off-grid systems, Rwanda, sustainable development*

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