African Swine Veterinary Studies

Bayesian Hierarchical Model for Evaluating Cost-Effectiveness of Off-Grid Renewable Energy Systems in Rwandan Communities

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Abstract

Off-grid renewable energy systems are increasingly being promoted to rural communities in Rwanda for improving access to electricity and reducing reliance on diesel generators. However, the cost-effectiveness of these systems varies across different communities due to varying factors such as climate conditions, land availability, and socio-economic status. A Bayesian hierarchical model was employed to analyse data from multiple communities, accounting for the heterogeneity of off-grid renewable energy systems' costs and benefits. This approach allowed us to estimate the marginal likelihoods of system performance parameters while considering the uncertainty associated with these estimates. The analysis revealed that there is a significant variation in cost-effectiveness across different regions, with communities located in areas with more favorable climate conditions showing higher returns on investment compared to those in harsher environments. Specifically, communities in the central region demonstrated an average return of $150\ per\ kWh \frac{invested}{three}\ years . The\ Bayesian\ hierarchical\ model\ provided\ a\ robust\ framework\ for\ evaluating\ cost-Y = \vec{\beta_{0+\beta}}\ p\ X + varepsilon\ \$, \wedge\ inference\ is\ reported\ with\ uncertainty-aware\ statistical\ criteria .$

Keywords: *Rwanda, Renewable Energy, Bayesian Statistics, Hierarchical Modelling, Cost-Benefit Analysis, Off-Grid Systems, Methodology*

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