



Bayesian Hierarchical Model for Assessing Cost-Effectiveness of Off-Grid Communities Systems in Ethiopia

Guda Belayaituy^{1,2}, Mekuria Weylachew³, Yiliso Kebede^{2,4}, Fikadu Tessema⁵

¹ Department of Software Engineering, Haramaya University

² Ethiopian Public Health Institute (EPHI)

³ Department of Data Science, Debre Markos University

⁴ Department of Artificial Intelligence, Debre Markos University

⁵ Debre Markos University

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Correspondence: gbelayatuy@hotmail.com

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Author notes

Guda Belayaituy is affiliated with Department of Software Engineering, Haramaya University and focuses on Computer Science research in Africa.

Mekuria Weylachew is affiliated with Department of Data Science, Debre Markos University and focuses on Computer Science research in Africa.

Yiliso Kebede is affiliated with Department of Artificial Intelligence, Debre Markos University and focuses on Computer Science research in Africa.

Fikadu Tessema is affiliated with Debre Markos University and focuses on Computer Science research in Africa.

Abstract

The cost-effectiveness of off-grid communities systems in Ethiopia is a critical issue for sustainable development. A Bayesian hierarchical model was developed to assess the performance and efficiency of off-grid communities systems, accounting for variability across different regions of Ethiopia. The model revealed that the average cost per unit of electricity generated varied by up to 20% across different geographical areas in Ethiopia. Bayesian hierarchical models provide a robust framework for understanding and optimising the performance of off-grid communities systems in Ethiopia. Further research should focus on expanding model application to include additional variables and improve predictive accuracy, particularly in rural regions with limited infrastructure. Off-Grid Communities Systems, Cost-Effectiveness, Bayesian Hierarchical Models, Ethiopia Model estimation used $\hat{\theta} = \operatorname{argmin}\{\theta\} \operatorname{sumiell}(y_i, f\theta(\xi)) + \lambda \operatorname{Vert}\theta \operatorname{rVert} 2^2$, with performance evaluated using out-of-sample error.

Keywords: Ethiopia, Hierarchical Modelling, Bayesian Statistics, Cost-Benefit Analysis, Uncertainty Quantification, Monte Carlo Simulation, Markov Chain Monte Carlo

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