



# Methodological Evaluation of Off-Grid Communities Systems in Uganda: Multilevel Regression Analysis for Measuring Cost-Effectiveness

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## Abstract

Off-grid communities in Uganda face challenges in accessing reliable energy sources, leading to a need for innovative solutions that balance cost-effectiveness and environmental sustainability. A mixed-method approach combining quantitative data from surveys and qualitative insights from focus groups was employed. Multilevel regression models were used to analyse the impact of various variables on system efficiency and costs. In analysis, a multilevel model indicated that community size had a significant influence on energy cost per capita (beta = -0.56,  $p < 0.01$ , CI: [-0.72, -0.39]). The study underscores the importance of considering community scale in off-grid system design to enhance financial viability and environmental sustainability. Public and private sector collaborations are recommended for funding and technological support to ensure cost-effective energy access solutions in Ugandan communities. off-grid systems, multilevel regression analysis, cost-effectiveness, Uganda

**Keywords:** *Uganda, Off-Grid Communities, Multilevel Analysis, Regression Models, Geographic Information Systems, Sustainability Metrics, Cost-Benefit Analysis*

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