



# Deploying Sustainable Energy Solutions Among Northern Ethiopian Villagers: A Community Feedback and Performance Metrics Investigation

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## Abstract

The deployment of sustainable energy solutions in rural areas is crucial for reducing reliance on traditional fossil fuels and mitigating environmental impacts. In northern Ethiopia, where access to electricity remains limited, there is a need to assess how villagers respond to and utilise new energy technologies. A mixed-methods approach was employed, combining surveys with qualitative interviews. A total of 150 villagers were surveyed using a structured questionnaire designed based on pre-existing energy usage models from similar studies in Africa. Interviews were conducted with 20 randomly selected participants to gather detailed insights into their experiences and concerns. Surveys revealed that 65% of respondents found the solar power kits reliable, while 40% reported increased electricity use since the deployment. However, issues such as initial setup costs and limited battery capacity were highlighted as significant barriers to full utilization. The findings suggest a promising uptake of sustainable energy solutions among Northern Ethiopian villagers but indicate room for improvement in addressing financial constraints and technological limitations. Future interventions should incorporate more affordable financing options and provide technical support to enhance the performance metrics of the solar power kits. Additionally, ongoing community engagement is essential to ensure sustained acceptance and use. sustainable energy deployment, northern Ethiopia, village feedback, performance metrics Model estimation used  $\hat{\theta} = \underset{\theta}{\operatorname{argmin}} \{ \sum_i \ell(y_i, f(\theta; \xi)) + \lambda \|\theta\|_2^2 \}$ , with performance evaluated using out-of-sample error.

**Keywords:** *Sustainable Development, Renewable Energy, Community Engagement, Performance Measurement, Geographic Information Systems, Participatory Action Research, Rural Electrification*

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