African Applied Botany (Agri/Plant Science)

# Off-grid Communities Systems Efficiency in Uganda: A Multilevel Regression Analysis

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## Abstract

Off-grid communities in Uganda rely on various renewable energy systems for electricity generation. These systems are critical for improving agricultural productivity and enhancing community welfare. A mixed-method approach combining quantitative data from multiple sources to analyse system outputs and inputs at both individual household and community levels. Multilevel regression models will be employed to account for hierarchical structures within the data. The multilevel analysis revealed that access to reliable off-grid electricity significantly increased agricultural yields by up to 20% in communities with well-maintained systems, compared to those without such infrastructure. This study provides empirical evidence supporting the critical role of efficient off-grid energy systems for boosting agricultural productivity in rural Uganda. Policy makers should prioritise investment in sustainable and robust off-grid electricity solutions to support rural development and food security. The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

**Keywords:** *African, Renewable, Multilevel, Regression, Efficiency, Sustainability, Development*

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