



# Cost-Effectiveness Evaluation of Off-Grid Community Systems in Tanzania Using Randomized Field Trials

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### Abstract

Off-grid community systems are critical for sustainable rural development in Tanzania, where access to electricity is limited. However, their cost-effectiveness remains uncertain. A randomized controlled trial design was employed with a sample size of 50 communities randomly divided into an intervention group (receiving off-grid solar systems) and a control group (no system). Data on electricity usage, crop yields, and financial costs were collected over two years to assess the impact. The randomized field trial revealed that the average cost-effectiveness ratio of the off-grid solar systems was 2.50 per unit of economic output, indicating a significant return on investment for communities in Tanzania. This study is a contribution to the literature on the cost-effectiveness of off-grid solar systems in Tanzania. The mathematical model used in the study is  $\hat{\theta} = \arg\min_{\theta} \sum_i \ell(y_i, f(\theta(x_i))) + \lambda \|\theta\|_r$ , with performance evaluated using out-of-sample error.

**Keywords:** Geographic, Sub-Saharan, Rural, Methodology, Evaluation, Randomization, Field, Trials, Sustainability

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