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Methodological Evaluation of Off-Grid Communities Systems in Rwanda Using Quasi-Experimental Design for Cost-Effectiveness Measurement

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Abstract

Rwanda has seen an increasing adoption of off-grid energy solutions to support agricultural productivity, yet there is limited empirical evidence on their cost-effectiveness. A mixed-method approach combining surveys with field observations was employed. A t-test was used to compare yield differences between communities using different off-grid energy solutions. There is an observed trend towards higher crop yields (30%) among communities utilising solar-powered irrigation systems compared to those not adopting such technologies. The quasi-experimental design successfully identified cost-effective agricultural innovations in Rwanda, with a focus on solar-powered irrigation. Further research should be conducted to validate these findings and explore other off-grid energy solutions' impacts on agriculture. Quasi-experimental design, off-grid communities, cost-effectiveness, agricultural productivity, Rwanda The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *African agriculture, GIS, mixed-methods, off-grid systems, quasi-experimental design, sustainability, technology adoption*