



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

Kabuga Muhizi<sup>1</sup>, Ingabire Ndayishimiye<sup>2</sup>, Uwilingiyimana Ngirabatware<sup>1,2</sup>, Byarushane Ruzindana<sup>3,4</sup>

<sup>1</sup> African Leadership University (ALU), Kigali

<sup>2</sup> Rwanda Environment Management Authority (REMA)

<sup>3</sup> Department of Crop Sciences, Rwanda Environment Management Authority (REMA)

<sup>4</sup> University of Rwanda

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**Correspondence:** [kmuhizi@outlook.com](mailto:kmuhizi@outlook.com)

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## Author notes

*Kabuga Muhizi is affiliated with African Leadership University (ALU), Kigali and focuses on Agriculture research in Africa.*

*Ingabire Ndayishimiye is affiliated with Rwanda Environment Management Authority (REMA) and focuses on Agriculture research in Africa.*

*Uwilingiyimana Ngirabatware is affiliated with African Leadership University (ALU), Kigali and focuses on Agriculture research in Africa.*

*Byarushane Ruzindana is affiliated with Department of Crop Sciences, Rwanda Environment Management Authority (REMA) and focuses on Agriculture research in Africa.*

## 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  $Y = \beta_{0+\beta} p X + \text{varepsilon}$ , and inference is reported with uncertainty-aware statistical criteria.

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

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