



Methodological Evaluation of Off-Grid Communities Systems in Ghana Using Difference-in-Differences for Cost-Effectiveness Measurement

Amma Gyamfi^{1,2}, Kofi Agyei^{3,4}

¹ Department of Agricultural Economics, Ashesi University

² Water Research Institute (WRI)

³ Ashesi University

⁴ Department of Crop Sciences, Water Research Institute (WRI)

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Correspondence: agyamfi@gmail.com

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Author notes

Amma Gyamfi is affiliated with Department of Agricultural Economics, Ashesi University and focuses on Agriculture research in Africa.

Kofi Agyei is affiliated with Ashesi University and focuses on Agriculture research in Africa.

Abstract

This study addresses a current research gap in Agriculture concerning Methodological evaluation of off-grid communities systems in Ghana: difference-in-differences model for measuring cost-effectiveness in Ghana. The objective is to formulate a rigorous model, state verifiable assumptions, and derive results with direct analytical or practical implications. A mixed-methods design was used, combining survey and interview data collected over the study period. The results establish bounded error under perturbation, a convergent estimation process under stated assumptions, and a stable link between the proposed metric and observed outcomes. The findings provide a reproducible analytical basis for subsequent theoretical and applied extensions. Stakeholders should prioritise inclusive, locally grounded strategies and improve data transparency. Methodological evaluation of off-grid communities systems in Ghana: difference-in-differences model for measuring cost-effectiveness, Ghana, Africa, Agriculture, original research This work contributes a formal specification, transparent assumptions, and mathematically interpretable claims. The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *African agriculture, off-grid systems, cost-effectiveness analysis, difference-in-differences, econometrics, rural development, sustainability assessment*

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