



Methodological Assessment of Off-Grid Communities Systems in Ethiopian Agriculture: Panel Data Estimation for Risk Reduction Analysis

Weldu Asfaw¹, Girmay Tadesse^{2,3}, Mekuria Abayneh^{1,2}

¹ Jimma University

² Ethiopian Public Health Institute (EPHI)

³ Department of Soil Science, Gondar University

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Correspondence: wafaw@yahoo.com

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Author notes

Weldu Asfaw is affiliated with Jimma University and focuses on Agriculture research in Africa.

Girmay Tadesse is affiliated with Ethiopian Public Health Institute (EPHI) and focuses on Agriculture research in Africa.

Mekuria Abayneh is affiliated with Jimma University and focuses on Agriculture research in Africa.

Abstract

Off-grid communities in Ethiopia face significant agricultural risks due to unpredictable weather patterns and limited access to energy sources. A mixed-method approach was employed, integrating quantitative analysis with qualitative insights. Panel data from 10 years of agricultural records were used for econometric modelling, employing a fixed-effects model to account for unobserved heterogeneity across communities. The panel data revealed that implementing renewable energy systems reduced crop failure by an average of 25% among off-grid communities, with significant variability in the effectiveness of different technologies (e.g., solar panels vs. wind turbines). This study provides empirical evidence supporting the efficacy of certain renewable energy solutions in mitigating agricultural risks for off-grid Ethiopian populations. Policy makers should prioritise investment in renewable energy infrastructure to enhance resilience and stability in Ethiopia's agriculture sector. The empirical specification follows $Y = \beta_{0+\beta}^{-1} p X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: Ethiopia, Off-grid Communities, Panel Data, Agricultural Risk, Methodology, Sustainability, Livelihoods, Climate Variability

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