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Impact Evaluation of Renewable Energy Microgrids on Rural Livelihoods in Northern Ethiopia's Tigray Region: A Comparative Study

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Abstract

Renewable energy microgrids have been implemented in various rural communities to provide electricity access and support sustainable livelihoods. A comparative analysis was conducted using data from 50 randomly selected households across four villages equipped with different types of renewable energy microgrids. Data on income generation, energy consumption patterns, and community engagement were collected through structured interviews and field observations. The study found that the implementation of solar-powered microgrids significantly increased household incomes by an average of 15% in comparison to households not using such systems ($p < 0.05$), with a confidence interval for the difference being [8%, 23%]. Renewable energy microgrids have demonstrably enhanced rural livelihoods, particularly through increased income generation and improved energy efficiency. Further studies should explore long-term impacts and scalability of renewable energy solutions in Tigray and other similar contexts. Model estimation used $\hat{\{}\theta\}=argmin\{\theta\}sumiell(yi,f\theta(\xi))+\lambda lVert\theta rVert2^{2}$, with performance evaluated using out-of-sample error.

Keywords: *African Geography, Renewable Energy, Microgrids, Impact Assessment, Sustainable Development, Case Studies, Rural Economics*

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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