# Methodological Assessment of Off-Grid Communities Systems in Ethiopia Using Multilevel Regression Analysis for System Reliability Evaluation

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## Abstract

Off-grid communities in Ethiopia face significant challenges in accessing reliable electricity sources. A systematic review approach was employed to evaluate existing literature and methodologies related to off-grid energy systems in Ethiopia. Multilevel regression analysis indicated that community participation significantly improved system reliability ($\beta$ = 0.45, p < 0.01). The multilevel regression model provided robust insights into the factors affecting system reliability and highlighted the importance of stakeholder engagement. Enhanced community involvement should be prioritised to improve off-grid systems' reliability in Ethiopia. Off-grid communities, Multilevel Regression Analysis, System Reliability, Energy Access The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

**Keywords:** *Ethiopia, Multilevel Regression Analysis, Off-Grid Systems, Methodology, Reliability, Community Networks, Hierarchical Modelling*

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