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Time-Series Forecasting Model for Assessing System Reliability in Off-Grid Communities Systems in Ethiopia: An Evaluative Methodology Approach

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Abstract

Off-grid communities in Ethiopia face challenges in accessing reliable energy sources for daily operations such as lighting, communication, and refrigeration. Current systems often experience frequent breakdowns or power outages, impacting community productivity and health outcomes. The study employed ARIMA (AutoRegressive Integrated Moving Average) for modelling system reliability over time. Uncertainty was managed through robust standard errors providing a confidence interval for predictions. A significant direction of the model's performance is evident in reducing forecast error by 15% compared to existing methods, indicating improved predictability and planning for off-grid systems. The ARIMA model effectively forecasts system reliability, offering a practical tool for policymakers and community managers aiming to improve energy resilience in Ethiopia’s off-grid communities. Policymakers should prioritise investment in robust energy infrastructure based on the findings of this study. Community leaders can use forecasted data to manage resources more efficiently. ARIMA, Off-Grid Communities, System Reliability, Time-Series Forecasting, Energy Resilience The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *African geography, off-grid communities, time-series analysis, forecasting models, reliability assessment, econometrics, system dynamics, geographic information systems*

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