African Physical Geography (Pure - Earth Science)

Methodological Evaluation of Off-Grid Communities Systems in South Africa Using Time-Series Forecasting Models for Risk Reduction Assessment

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Abstract

Off-grid communities in South Africa face challenges related to energy security, particularly in rural areas where access to conventional grid electricity is limited. The study employed ARIMA (AutoRegressive Integrated Moving Average) model for time series analysis, accounting for uncertainty through robust standard errors. A significant proportion of households in tested communities experienced improved energy stability with the implementation of forecasting models, reducing power outage frequency by 20% over a year. ARIMA models effectively forecasted future energy demands and disruptions, aiding in proactive risk management for off-grid systems. Communities should consider adopting ARIMA-based forecasting to enhance their resilience against energy supply uncertainties. The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Sub-Saharan, ruralization, renewable energy, ARIMA, forecasting, sustainability, resilience*

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