Time-Series Forecasting Models in Off-Grid Community Systems: A Meta-Analysis of Yield Improvement in Senegal

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Abstract

The study focuses on evaluating the effectiveness of time-series forecasting models in enhancing yield performance within off-grid community systems in Senegal. A comprehensive meta-analysis approach was utilised, integrating datasets from at least five different field trials conducted between and . Time-series forecasting models such as ARIMA (Autoregressive Integrated Moving Average) were employed to model the yield data. Robust standard errors were used for inference. A significant proportion, estimated at 45%, of the analysed systems showed a positive improvement in yield over time, with some communities seeing increases of up to 20%. The meta-analysis reveals that ARIMA models provide a reliable framework for forecasting yield improvements in off-grid solar water pumping systems. However, model performance varied significantly across different settings and contexts within Senegal. Further detailed analyses are recommended to explore the specific conditions under which these models perform optimally, with potential implications for policy formulation aimed at enhancing sustainability and efficiency of such systems. The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Sub-Saharan, Time-Series, ARIMA, Box-Jenkins, Forecasting, Sensitivity, Evaluation*

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