African Limnology (Earth/Environmental Science)

Time-Series Forecasting Model Evaluation in Ghanaian Smallholder Farm Systems: An Assessment of Yield Improvement Dynamics

Oparekpor Asare[1], **Logandji Amonoo**[2,3]

[1] Department of Advanced Studies, University of Professional Studies, Accra (UPSA)

[2] University of Professional Studies, Accra (UPSA)

[3] Water Research Institute (WRI)

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Correspondence: oasare@aol.com

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Author notes

Oparekpor Asare is affiliated with Department of Advanced Studies, University of Professional Studies, Accra (UPSA) and focuses on Environmental Science research in Africa.

Logandji Amonoo is affiliated with University of Professional Studies, Accra (UPSA) and focuses on Environmental Science research in Africa.

Abstract

Smallholder farms in Ghana face challenges in yield stability and forecasting due to environmental variability and market uncertainties. The study employed an Auto-Regressive Integrated Moving Average (ARIMA) model to forecast yield outcomes from multiple smallholder farms. Data were collected over a period of three years, capturing variations in rainfall, soil quality, and farm management practices. An ARIMA(1,1,0) model showed the best performance with an R^2 value of 0.78 for predicting yield improvements across different farms, indicating a significant proportion (78%) of variance explained by the model. The ARIMA model provided robust predictions for yield improvement in Ghanaian smallholder farm systems, enhancing decision-making processes and resource allocation strategies. Farmers should adopt the recommended predictive models to anticipate future yields more accurately, thereby improving their economic resilience. Further research is needed to validate these findings across broader geographical regions. The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Sub-Saharan, Smallholder, Forecasting, ARIMA, Variability, Sustainability, Ecosystem*

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