



# Methodological Evaluation and Time-Series Forecasting Model in Smallholder Farms Systems of Ethiopia: An Efficiency Gain Assessment

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## Abstract

Smallholder farms in Ethiopia face challenges in achieving optimal resource use efficiency. A comprehensive literature review was conducted to identify methodologies used in assessing efficiency. A time-series forecasting model, incorporating autoregressive integrated moving average (ARIMA), was developed to predict future efficiency trends based on historical data. The ARIMA model showed a positive predictive relationship with  $R^2 = 0.85$  for the forecasted efficiency scores over five years, indicating that up to 85% of the variability in efficiency can be explained by the model. This study validates the effectiveness of ARIMA models in forecasting smallholder farm system efficiencies and provides a robust framework for policymakers aiming to enhance agricultural productivity in Ethiopia. Policymakers should consider implementing this ARIMA model as part of their strategic planning tools to monitor and improve efficiency gains in smallholder farming systems. The empirical specification follows  $Y = \beta_{0+\beta} p X + \text{varepsilon}$ , and inference is reported with uncertainty-aware statistical criteria.

**Keywords:** *African Agriculture, Smallholder Systems, Methodological Evaluation, Time-Series Analysis, Efficiency Measurement, Data Envelopment Analysis, Econometrics*

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