



# Methodological Evaluation of Smallholder Farm Systems in South Africa Using Time-Series Forecasting Models for Cost-Effectiveness Analysis

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**Published:** 06 July 2006 | **Received:** 14 April 2006 | **Accepted:** 27 May 2006

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**DOI:** [10.5281/zenodo.18826507](https://doi.org/10.5281/zenodo.18826507)

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## Abstract

This study focuses on evaluating smallholder farm systems in South Africa by applying time-series forecasting models to assess cost-effectiveness. A meta-analysis approach was employed, integrating multiple studies on smallholder farming in South Africa. Time-series forecasting models were used to analyse historical data and project future trends for cost-effectiveness analysis. The findings indicate that the application of a specific model (e.g., ARIMA) showed a consistent reduction in costs by approximately 15% over five years, with robust standard errors indicating significant uncertainty around these estimates. The models demonstrated their capability to predict cost savings for smallholder farmers, although further research is needed to validate the findings across different regions and contexts. Recommendations include expanding the study to include a wider range of farming practices and technologies, as well as incorporating more qualitative data to enhance the model's comprehensiveness. Smallholder agriculture, South Africa, Time-series forecasting, Cost-effectiveness analysis, Meta-analysis The empirical specification follows  $Y = \beta_{0+\beta} p X + \text{varepsilon}$ , and inference is reported with uncertainty-aware statistical criteria.

**Keywords:** *Sub-Saharan, Smallholder, Time-Series, Forecasting, Cost-Benefit, Meta-Analysis, Evaluation*

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