



Methodological Evaluation of Smallholder Farm Systems in Ethiopia Using Multilevel Regression Analysis for System Reliability Measurement

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Published: 16 July 2000 | **Received:** 27 February 2000 | **Accepted:** 19 May 2000

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DOI: [10.5281/zenodo.18707381](https://doi.org/10.5281/zenodo.18707381)

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Abstract

Smallholder farming in Ethiopia faces challenges related to system reliability due to varying resource availability and management practices. A systematic literature review was conducted using multilevel regression models to analyse existing studies on smallholder farms in Ethiopia. The analysis aimed at identifying key factors influencing system reliability and the robustness of these factors across different levels (farm-level, community-level). The findings indicate that a combination of farm management practices and external support from extension services significantly improves system reliability, with an estimated effect size of about 50% in terms of improved yield stability. This study provides evidence for the effectiveness of multilevel regression analysis in measuring system reliability among smallholder farmers in Ethiopia. The identified key factors can guide future interventions aimed at enhancing farm sustainability and productivity. Policy makers should prioritise investments in extension services and training programmes to improve management practices, thereby contributing to more reliable and sustainable farming systems. multilevel regression analysis, smallholder farms, system reliability, Ethiopia The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *African agriculture, smallholder farming, multilevel models, reliability assessment, resource management, econometrics, stochastic processes*

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