



Bayesian Hierarchical Model for Cost-Effectiveness Analysis in Ethiopian Smallholder Farm Systems,

Seresignew Asfaw^{1,2}, Mekdes Gebre^{3,4}, Yared Mengistu^{1,5}, Alemayehu Debella^{1,6}

¹ Addis Ababa University

² Department of Interdisciplinary Studies, Gondar University

³ Department of Interdisciplinary Studies, Hawassa University

⁴ Department of Advanced Studies, Gondar University

⁵ Gondar University

⁶ Department of Research, Gondar University

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Correspondence: sasfaw@yahoo.com

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Author notes

Seresignew Asfaw is affiliated with Addis Ababa University and focuses on Environmental Science research in Africa.

Mekdes Gebre is affiliated with Department of Interdisciplinary Studies, Hawassa University and focuses on Environmental Science research in Africa.

Yared Mengistu is affiliated with Gondar University and focuses on Environmental Science research in Africa.

Alemayehu Debella is affiliated with Department of Research, Gondar University and focuses on Environmental Science research in Africa.

Abstract

Bayesian hierarchical models are increasingly used in cost-effectiveness analysis to evaluate interventions in agricultural settings, particularly for smallholder farming systems where data can be limited and heterogeneous. The study employs a Bayesian hierarchical linear regression model, which allows for capturing spatial variability and heterogeneity among farms while accounting for measurement error and non-linear relationships between variables. Uncertainty in parameter estimates is quantified through credible intervals. A key finding is the significant improvement in crop yields observed when using precision agriculture techniques compared to traditional farming methods, with a 15% increase in yield across surveyed plots ($n=200$). The Bayesian hierarchical model successfully identifies cost-effective interventions and highlights the importance of context-specific approaches for smallholder farmers. Future research should consider expanding the model to include additional variables such as climate variability and market access, which could further enhance its predictive power and applicability in diverse Ethiopian farm settings. Bayesian hierarchical models, cost-effectiveness analysis, precision agriculture, smallholder farming systems, Ethiopia

Keywords: Ethiopia, Smallholder Farming, Bayesian Hierarchical Models, Cost-Effectiveness Analysis, Monte Carlo Simulations, Spatial Statistics, Decision Trees

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