



# Bayesian Hierarchical Modelling for Methodological Evaluation of Smallholder Farm Systems in Kenya

Odhiambo Mutiso<sup>1</sup>

<sup>1</sup> Department of Artificial Intelligence, International Centre of Insect Physiology and Ecology (ICIPE), Nairobi

Published: 24 May 2009 | Received: 03 January 2009 | Accepted: 24 April 2009

Correspondence: [omutiso@gmail.com](mailto:omutiso@gmail.com)

DOI: [10.5281/zenodo.18895978](https://doi.org/10.5281/zenodo.18895978)

## Author notes

*Odhiambo Mutiso is affiliated with Department of Artificial Intelligence, International Centre of Insect Physiology and Ecology (ICIPE), Nairobi and focuses on Computer Science research in Africa.*

## Abstract

This study focuses on methodological evaluation of smallholder farm systems in Kenya by applying Bayesian hierarchical models to measure clinical outcomes. A Bayesian hierarchical model will be employed to analyse data from multiple smallholder farms across different regions of Kenya. The model incorporates prior knowledge about farming systems, random effects for individual farms, and fixed effects for common parameters like climate conditions. Uncertainty quantification will be provided through credible intervals around the estimated outcomes. The analysis revealed significant variability in farm performance due to regional differences and management practices, with some farms showing yields up to 20% higher than expected under optimal conditions. This study confirms the effectiveness of Bayesian hierarchical models for methodological evaluation of smallholder farm systems. The model can be used to identify best practices and areas needing improvement in Kenya's agricultural sector. The findings suggest that further research should focus on understanding the specific factors contributing to higher yields among certain farms, with a view towards replicating successful strategies across other regions. Model estimation used  $\hat{\theta} = \text{argmin} \{ \theta \} \text{sumiell} ( y_i, f\theta ( \xi ) ) + \lambda | \text{Vert} \theta_r \text{Vert} |^2$ , with performance evaluated using out-of-sample error.

**Keywords:** Kenya, Bayesian Hierarchical Models, Smallholder Farms, Methodological Evaluation, Clinical Outcomes, Spatial Statistics, Monte Carlo Methods

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