



Methodological Evaluation of Smallholder Farm Systems in Ghana Using Bayesian Hierarchical Models for Reliability Assessment

Kofi Opoku Anyantawah¹, Amma Gyamfi Owusu-Agyeman², Abena Kwesi Amoako^{1,3}, Eshetu Essielu^{1,3}

¹ University of Professional Studies, Accra (UPSA)

² Department of Agricultural Economics, University of Professional Studies, Accra (UPSA)

³ University of Ghana, Legon

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Correspondence: kanyantawah@aol.com

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Author notes

Kofi Opoku Anyantawah is affiliated with University of Professional Studies, Accra (UPSA) and focuses on Agriculture research in Africa.

Amma Gyamfi Owusu-Agyeman is affiliated with Department of Agricultural Economics, University of Professional Studies, Accra (UPSA) and focuses on Agriculture research in Africa.

Abena Kwesi Amoako is affiliated with University of Ghana, Legon and focuses on Agriculture research in Africa.

Eshetu Essielu is affiliated with University of Ghana, Legon and focuses on Agriculture research in Africa.

Abstract

Smallholder farm systems in Ghana are characterized by variability and complexity, necessitating robust methods for their evaluation. A systematic literature review was employed, with a focus on identifying studies that utilised Bayesian hierarchical models to evaluate farm system performance. Data from these studies were analysed quantitatively and qualitatively to identify commonalities and areas for improvement. Bayesian hierarchical models demonstrated significant variability in their application across different regions of Ghana, suggesting the need for localized model adaptations. The findings underscored the importance of context-specific approaches when applying Bayesian hierarchical models to smallholder farming systems. Researchers and policymakers should prioritise methodological rigor in future studies by adopting flexible modelling techniques that can accommodate varying farm conditions. The empirical specification follows $Y = \beta_{0+\beta}^{-1} p X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *African agriculture, Bayesian statistics, hierarchical modelling, smallholder farming, system reliability, empirical methods, econometric analysis*

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