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Bayesian Hierarchical Model for Measuring Adoption Rates in Smallholder Farms Systems of Ghana: A Methodological Evaluation

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Abstract

Adoption rates of modern agricultural technologies in smallholder farms systems are crucial for sustainable food production in Ghana. However, accurate measurement of these adoption rates is challenging due to the complexity and variability inherent in such systems. A Bayesian hierarchical model was developed to account for heterogeneity across different regions and farming practices. The model incorporates uncertainty through credible intervals around estimated adoption rates, providing a nuanced understanding of technology uptake. The Bayesian hierarchical model revealed significant regional variations in adoption rates, with certain highland areas showing higher adoption compared to plains areas (direction: higher adoption in highlands). The developed Bayesian hierarchical model offers a more precise and interpretable framework for measuring adoption rates in Ghana's smallholder farms systems. Further research should validate these findings across diverse farming contexts, enhancing the reliability of adoption rate measurements in agricultural development strategies. Bayesian Hierarchical Model, Adoption Rates, Smallholder Farms, Agricultural Technology The empirical specification follows $Y = \vec{\beta}_{0+\beta} \, p \, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Geographic Terms: Ghana*

Methodological Terms:
Bayesian statistics
Hierarchical modelling
Measurement theory
Smallholder systems
Agricultural adoption rates

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