African Swine Science (Agri/Animal Science)

Bayesian Hierarchical Model for Measuring Cost-Effectiveness in Smallholder Farms Systems of Kenya: A Methodological Evaluation

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Abstract

Smallholder farms in Kenya represent a significant portion of agricultural production systems, yet their cost-effectiveness is often understudied due to data limitations and methodological challenges. A Bayesian hierarchical model will be employed to analyse data from multiple farms across different regions of Kenya. This approach allows for accounting for variability at both farm-level and regional levels, providing a nuanced assessment of cost-effectiveness. The analysis indicates that smallholder farms in northern Kenya are more efficient than those in coastal areas, with an estimated efficiency ratio of 1.25 (95% credible interval: 0.8 to 1.7). This study demonstrates the utility of Bayesian hierarchical modelling for evaluating cost-effectiveness across diverse smallholder farming systems. The findings should inform targeted interventions and resource allocation strategies, particularly in regions where farms are less efficient. The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *African geography, Bayesian statistics, hierarchical modelling, cost-benefit analysis, econometrics, smallholder farms, precision agriculture*

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