African Environmental Contamination (Environmental Science)

Bayesian Hierarchical Model for Evaluating Efficiency Gains in Smallholder Farm Systems in Ethiopia: A Methodological Approach

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Abstract

Smallholder farming systems in Ethiopia face challenges related to productivity and sustainability. A Bayesian hierarchical regression model was developed to analyse multiple smallholder farms' performance metrics. Uncertainty quantification was achieved through robust standard errors and confidence intervals. The model revealed an average efficiency gain of 15% across the sampled farms, with significant variability in gains by farm size and soil quality. A Bayesian hierarchical approach provided nuanced insights into smallholder farming efficiencies, enhancing the accuracy of performance evaluations. Farmers should be encouraged to adopt practices that align with model recommendations for optimal efficiency. Bayesian Hierarchical Model, Smallholder Farms, Efficiency Gains, Ethiopia The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Ethiopia, Smallholder Agriculture, Bayesian Hierarchical Models, Spatial Statistics, Monte Carlo Methods, Regression Analysis, Random Effects Models*

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