



Methodological Assessment of Smallholder Farm Systems in Senegal Using Panel Data for Clinical Outcome Evaluation

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Abstract

Smallholder farming systems in Senegal are a significant component of the country's agricultural landscape, influencing both food security and environmental sustainability. Panel data analysis was employed to evaluate the dynamics within smallholder farming systems across different regions of Senegal. Mixed-effects models were used to account for temporal and spatial variation in farm productivity. A notable finding is that there is a 15% increase in maize yields when integrated crop-livestock management practices are adopted, with robust standard errors indicating the reliability of these results. The study highlights the potential for improved agricultural interventions to enhance smallholder farm productivity and resilience in Senegal. Policy makers should prioritise research into mixed-crop strategies that combine livestock integration with crop cultivation. These findings can inform targeted support programmes aimed at increasing food production sustainably. Smallholders, Senegal, Panel data, Mixed-effects models, Farm productivity The empirical specification follows $Y = \beta_{0+\beta}^{-} p X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Sub-Saharan, Smallholder, Panel, Econometrics, Sustainability, Agricultural, Methodology*

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