African Forest Management (Forestry)

Methodological Evaluation of Smallholder Farm Systems in South Africa Using Multilevel Regression Analysis for Cost-Effectiveness Assessment

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Abstract

Smallholder farming systems in South Africa are characterized by significant variability in productivity and resource use efficiency. A multilevel regression model was employed to analyse data from 100 randomly selected smallholder farms across South Africa. The model accounts for both farm-level and district-level variations in productivity. The multilevel analysis revealed that access to irrigation significantly increased crop yield by an average of 25% compared to non-irrigated farms, with a confidence interval of ±4% Multilevel regression provides a robust framework for assessing cost-effectiveness in smallholder farming systems, highlighting the importance of resource management strategies. Farmers and policymakers should prioritise investment in irrigation infrastructure to enhance productivity and profitability. The empirical specification follows $Y = \vec{\beta_{0+\beta}} \, p \, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *African agriculture, smallholder farming, multilevel analysis, regression modelling, econometrics, resource allocation, cost-benefit assessment*

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