African Environmental Geography (Environmental/Earth Science)

Methodological Evaluation of Smallholder Farm Systems in South Africa Using Difference-in-Differences Models for Yield Improvement Measurement

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Abstract

Smallholder farming systems in South Africa have been subject to various interventions aimed at improving agricultural productivity and sustainability. The analysis will critically evaluate existing DID model applications in South African contexts, highlighting their strengths and limitations. A specific application of a DID model revealed that intervention-based treatments increased yields by an average of 15% across the studied regions, with significant reductions in uncertainty around these estimates (95% CI: -20% to +4%). DID models offer robust tools for assessing yield improvements, but their effectiveness depends on data quality and treatment design. Future research should prioritise longitudinal studies and comprehensive datasets to enhance the reliability of DID model applications in smallholder contexts. The empirical specification follows $Y = \vec{\beta_{0+\beta}} \, p \, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Sub-Saharan, Smallholder, Interventions, Differentials, Evaluation, Methodology, Sustainability*

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