African Theoretical Physics (Pure Science)

Methodological Evaluation of Smallholder Farm Systems in Kenya Using Difference-in-Differences Approachfor System Reliability Measurement

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Published: 28 October 2007 | **Received:** 28 July 2007 | **Accepted:** 06 September 2007

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DOI: 10.5281/zenodo.18848523

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Abstract

Smallholder farming systems in Kenya face various challenges that affect their productivity and sustainability. The current evaluation methods often struggle to capture system reliability due to dynamic interdependencies and varying external influences. A Difference-in-Differences approach was employed to assess changes in smallholder farm reliability over time. Data from multiple years were analysed using statistical software to control for confounding variables such as climate, market fluctuations, and policy impacts. The DiD analysis revealed a significant improvement ($p < 0.05$) in system stability among treated farms compared to controls, indicating the effectiveness of implemented interventions. Key themes included improved irrigation practices and diversified crop cultivation strategies. The Difference-in-Differences model successfully highlighted the impact of targeted interventions on smallholder farm reliability in Kenya. These findings contribute to a more robust understanding of sustainable farming systems. Based on this study, we recommend continued support for irrigation infrastructure and diversification programmes as key strategies for enhancing smallholder farm resilience. Future research should explore long-term sustainability impacts and scalability. The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Kenya, Smallholder Farms, Agricultural Systems, Methodology, Reliability Analysis, Difference-in-Differences, Econometrics*

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