Methodological Evaluation of Process-Control Systems for Agricultural Yield Improvement in Tanzania

A Difference-in-Differences Data Framework

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ABSTRACT

Background: Agricultural productivity in sub-Saharan Africa remains constrained by inefficiencies in cultivation and resource management. Process-control systems, integrating sensor networks and automated actuators, present a potential engineering solution, but rigorous methodological frameworks for evaluating their causal impact on crop yield are lacking.

Purpose and objectives: This Data Descriptor presents a structured dataset and methodological framework designed to quantify the causal effect of adopting agricultural process-control systems on maize yield. The primary objective is to provide a replicable difference-in-differences (DiD) data architecture for impact evaluation in engineering applications.

Keywords: *Agricultural engineering, Process control, Sub-Saharan Africa, Difference-in-differences, Sensor networks, Yield improvement, Tanzania*

Article Highlights

• Presents a structured panel dataset for evaluating process-control systems on smallholder farms.
• Employs a difference-in-differences model with two-way fixed effects to estimate causal impact.
• Dataset designed to detect a minimum 15% yield improvement with 80% statistical power.
• Includes diagnostic variables to test the critical parallel trends assumption.

Methodological Core

The causal impact is estimated via: $Y\_it = \beta_0 + \beta_1(Treat\_i \times Post\_t) + \alpha\_i + \gamma\_t + \varepsilon\_it$, with standard errors clustered at farm level.

This paper presents a methodological framework and dataset structure, not empirical results.

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