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# A Quasi-Experimental Evaluation of Process-Control Systems for Agricultural Yield Optimisation in Senegal

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## ABSTRACT

**Background:** Agricultural productivity in sub-Saharan Africa is constrained by inefficient resource management and variable climatic conditions. While automated process-control systems (PCS) offer potential for optimisation, rigorous empirical evaluations of their impact on yield in real-world farming contexts are scarce.

**Purpose and objectives:** This study aimed to quantify the causal effect of a sensor-based irrigation and nutrient delivery PCS on crop yield, compared to traditional manual farming practices. The primary objective was to estimate the average treatment effect on the treated (ATT) for yield improvement.

**Keywords:** *Quasi-experimental design, Process-control systems, Yield optimisation, Sub-Saharan Africa, Precision agriculture, Agricultural engineering, Senegal*

### Article Highlights

- Quantifies a 22.4% yield increase from process-control system adoption.
- Employs propensity score matching to establish a robust causal counterfactual.
- Demonstrates pronounced efficacy in managing water stress periods.
- Provides evidence to inform subsidy and financing policy for smallholders.

### Methodological Note

The study uses a quasi-experimental design with propensity score matching to estimate the Average Treatment Effect on the Treated (ATT), moving beyond correlation to stronger causal inference.

*This article provides causal evidence for precision agriculture impacts in a sub-Saharan African context.*

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