

AFRICAN CIVIL ENGINEERING JOURNAL

ISSN: XXXX-XXXX | Peer-Reviewed | Open Access

Comparative Methodological Evaluation of Process-Control Systems for Agricultural Yield Optimisation in Rwanda

A Multilevel Regression Analysis (2000–2026)

DOI: [10.5281/zenodo.18973382](https://doi.org/10.5281/zenodo.18973382) | Received: 23 April 2007 | Accepted: 22 July 2007 | Published: 19 September 2007

Samuel Niyonzima¹|Valérie Mukamana^{2,3}|Jean de Dieu Uwimana⁴

¹ Rwanda Environment Management Authority (REMA)

² University of Rwanda

³ Department of Civil Engineering, Rwanda Environment Management Authority (REMA)

⁴ Department of Civil Engineering, University of Rwanda

Correspondence: sniyonzima@gmail.com

DOI: [10.5281/zenodo.18973382](https://doi.org/10.5281/zenodo.18973382)

Received: 23 April 2007 | Accepted: 22 July 2007

ABSTRACT

Background: Agricultural productivity in Rwanda is constrained by variable environmental conditions and resource limitations. The adoption of engineering-led process-control systems for irrigation and nutrient delivery has been proposed as a key intervention, yet a rigorous methodological evaluation of their comparative efficacy is lacking.

Purpose and objectives: This study conducts a comparative methodological evaluation of three dominant process-control systems—centralised, distributed, and hybrid adaptive control—to determine their statistical reliability in measuring and optimising crop yield improvements.

Keywords: *Process-control systems, Agricultural yield optimisation, Multilevel regression analysis, Sub-Saharan Africa, Precision agriculture, Irrigation engineering, Comparative methodology*

Article Highlights

- Hybrid adaptive control showed a 17.3% mean yield increase over centralised systems.
- Multilevel regression successfully accounted for unobserved zonal heterogeneity.
- Distributed system performance was highly variable and often statistically insignificant.
- Findings support prioritising hybrid architectures for heterogeneous conditions.

Core Methodology

Longitudinal multilevel regression analysis, nesting farm-level data within regional agro-ecological zones, with inference based on robust standard errors.

This study provides a novel framework for the methodological evaluation of agricultural control systems.

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

REQUEST FULL PAPER

 **Email:** info@parj.africa

Request your copy of the full paper today!

SUBMIT YOUR RESEARCH

**Are you a researcher in Africa? We
welcome your submissions!**

Join our community of African scholars and share
your groundbreaking work.

 **Submit at:** app.parj.africa



Scan to visit app.parj.africa

Open Access Scholarship from PARJ

Empowering African Research | Advancing Global
Knowledge