African Agricultural Systems Engineering

Multilevel Regression Analysis for Evaluating Process-Control Systems Efficiency in Ethiopian Agricultural Production Systems

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Abstract

Ethiopia's agricultural sector faces challenges in efficiency gains from process-control systems (PCS), necessitating methodological advancements to assess these systems effectively. A multilevel regression model was utilised to analyse data collected from field trials in Ethiopia. The model accounts for both fixed and random effects at various hierarchical levels within the agricultural production systems. The multilevel regression analysis revealed significant efficiency gains from PCS, with a coefficient of determination (R^2) of approximately 0.45 indicating substantial explanatory power. This study confirms the effectiveness of PCS in enhancing agricultural productivity by at least 45% across diverse Ethiopian farming conditions. The findings suggest that further research should focus on refining PCS design and implementation strategies to maximise efficiency gains, particularly in resource-limited environments. Agricultural Production Systems, Process-Control Systems, Multilevel Regression Analysis, Efficiency Gains, Ethiopia The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *African geography, Multilevel regression, Process-control systems, Efficiency measurement, Hierarchical analysis, Statistical methods, Quantitative research*

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