African Horticulture Studies (Agri/Plant Science)

Methodological Evaluation of Regional Monitoring Networks in South Africa: A Multilevel Regression Analysis of System Reliability

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Abstract

South Africa's agricultural sector relies on regional monitoring networks to track crop health, pest infestations, and water management practices across diverse landscapes. These networks aim to provide timely data for decision-making but face challenges in maintaining consistent quality. We employed a multilevel regression model to analyse data from multiple regions over two seasons. The model accounts for both fixed effects (regional characteristics) and random effects (seasonal variability). System reliability varied significantly across regions, with urban areas generally outperforming rural ones due to better infrastructure and funding. The multilevel regression analysis revealed that regional governance and technological access are the most critical determinants of system reliability. This insight can guide policy adjustments for future monitoring network implementations. Enhanced investment in rural regions, improved technology transfer programmes, and strengthened regulatory frameworks are recommended to improve overall system performance. multilevel regression, regional monitoring networks, system reliability, South Africa, agriculture The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *African Geographic Regions, Monitoring Networks, Multilevel Analysis, System Reliability, Regression Techniques, Data Quality Assurance, Spatial Distributions*

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