



Methodological Evaluation of Regional Monitoring Networks in Rwanda: A Randomized Field Trial for Cost-Efficiency Assessment

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Abstract

Regional monitoring networks are crucial for assessing soil quality in Rwanda's diverse ecosystems. However, their cost-effectiveness is often debated due to varying operational costs and environmental impacts. A randomized field trial was conducted across three regions with differing soil types. Soil samples were collected at regular intervals to assess nutrient levels and microbial activity, using standard analytical methods. Data analysis employed linear regression models to estimate cost-effectiveness metrics. Randomized sampling revealed a significant difference ($p < 0.05$) in nutrient uptake efficiency between treatment groups, indicating that certain regions benefit more from monitoring networks than others. The randomized field trial demonstrated the variability of regional soil quality and cost-effectiveness across different environmental conditions in Rwanda. Future studies should focus on scaling up effective network designs based on this study's findings to optimise resource allocation for sustainable agricultural practices. The empirical specification follows $Y = \beta_{0+\beta} p X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: Rwanda, Geospatial Analysis, Randomized Controlled Trials, Precision Agriculture, Soil Quality Assessment, Data Analytics, Experimental Design

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