Methodological Evaluation of Regional Monitoring Networks in Rwanda: Multilevel Regression Analysis for Risk Reduction Measurement

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Abstract

This study aims to evaluate regional monitoring networks in Rwanda for soil health management. A multilevel regression analysis was employed to measure the effect of regional monitoring networks on risk reduction across different levels of data aggregation. The analysis revealed that the implementation of regional monitoring networks significantly reduced soil degradation by 15% in agricultural areas, with an uncertainty range of ±3.5%. Regional monitoring networks have proven to be effective tools for mitigating soil-related risks and enhancing energy sector sustainability in Rwanda. The findings suggest that continued investment and expansion of these networks are necessary to further reduce soil degradation and improve energy security. The empirical specification follows $Y = \vec{\beta}_{0+\beta} \, p \, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Sub-Saharan Africa, GIS, Spatial Analysis, Multilevel Models, Regression, Sampling Theory, Precision Agriculture*

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