African Sedimentology and Stratigraphy (Earth Science)

Methodological Framework for Evaluating System Reliability in Smallholder Farms Systems Using Multilevel Regression Analysis in Kenya's Agricultural Ecosystems

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Abstract

Smallholder farms in Kenya's agricultural ecosystems are characterized by diverse production systems that vary significantly across different regions and seasons. Understanding these variations is crucial for developing sustainable management practices. The methodology employs multilevel regression analysis, incorporating both fixed and random effects models. The model specification will be guided by the hierarchical structure of data at different spatial scales (farm-level vs. regional-level variables). This theoretical framework provides a structured methodological basis for evaluating system reliability in smallholder farms across Kenya's diverse agricultural ecosystems using multilevel regression analysis. Future research should validate these findings through empirical studies and explore the implications of varying productivity levels on broader regional sustainability goals. The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Kenya, Multilevel Analysis, Smallholder Farms, Agricultural Ecosystems, Regression Models, Geographic Information Systems, Sustainability Studies*

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