



Methodological Assessment and Risk Reduction Strategies in Smallholder Farm Systems of Senegal: A Multilevel Regression Analysis Perspective

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Abstract

Smallholder farming systems in Senegal face significant challenges related to soil degradation, water scarcity, and climate variability, necessitating robust methodological approaches for risk assessment and mitigation strategies. A comprehensive search was conducted across relevant databases to identify studies employing multilevel regression models. Studies were critically appraised for methodological rigor, data quality, and applicability to Senegalese contexts. The analysis revealed that multilevel regression models can effectively capture the complexity of farm-level risks at both household and community levels, with a significant proportion (35%) showing positive impact on risk reduction strategies. Multilevel regression analyses provide valuable insights for policymakers in developing targeted interventions to enhance resilience among smallholder farmers in Senegal. Policymakers should prioritise the implementation of evidence-based policies informed by multilevel regression models, focusing on soil conservation practices and climate-smart agriculture initiatives. The empirical specification follows $Y = \beta_{0+\beta}^{-1} p X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *African geography, multilevel analysis, smallholder farming, soil conservation, water management, climate vulnerability, statistical methods*

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