Tropentag, September 16-18, 2026, hybrid conference

"Towards multi-functional agro-ecosystems
promoting climate resilient futures"

Malagasy smallholder farmers' understanding of soil quality processes: Understanding perceptions and adoption intentions by evaluating mental models

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Abstract

Soil degradation poses a severe threat to smallholder livelihoods in Madagascar, yet farmers' perceptions of the processes affecting soil quality remain poorly understood. This study analyses the mental models of 1,007 smallholder farmers in south-eastern Madagascar, examining how environmental and socio-economic characteristics shape their understanding of soil quality. Additionally, we evaluate whether participating in a mental model elicitation task increases agronomic knowledge and technology adoption intentions.

Using a representative survey with randomised assignment, we find that Malagasy smallholders hold complex, nuanced mental models of soil health. Manure, rainfall, and heat are identified as the most frequent drivers, with manure perceived as the most beneficial factor for soil quality. Regression analysis reveals that education is the strongest predictor of mental model complexity, with complexity increasing progressively across education levels. Furthermore, sex, age, and local climatic conditions significantly shape both the complexity of these models and the occurrence of specific environmental drivers.

Experimental results indicate that the structured elicitation task itself serves as a cognitive intervention. Participation significantly increased agronomic knowledge test scores and was positively associated with intentions to adopt manure application. These findings underscore the complexity of farmers' systemic thinking and highlight the importance of taking into account the sociodemographic and ecological heterogeneity within local agricultural knowledge systems.

Ultimately, this research suggests that structured mental model elicitation holds significant potential as a tool for targeted agricultural extension, particularly for reinforcing practices that are already salient and positively perceived within a community's cognitive framework. Our results provide a roadmap for future policies.

Keywords: Agricultural production, Madagascar, mental models, smallholder farmers, soil quality, system thinking

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