EGU23-4388, updated on 11 Apr 2023
https://doi.org/10.5194/egusphere-egu23-4388
EGU General Assembly 2023

Integrating farmers' risk aversion in climate change behavioral modelling to improve decision-making processes

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Agricultural systems are adversely influenced by climate change through increased temperatures, change in run-off patterns and seasonality fluctuation. Farmers are, hence, a valuable source of first-hand observations of climate change as they may provide a deeper understanding of their manifestation and relevance. Farmers are aware of climate change impacts and promote adaptation measures such as changing crop varieties, adjusting planting dates, introducing agroforestry practices, and promoting soil and water conservation practices. However, some adaptation barriers persist such as the limited knowledge of potential adaptation strategies, high adaptation cost, or poor institutional support. Understanding why and how farmers aim to adapt to climate change is imperative to provide informed decisions to policy-makers and the first step to minimizing misconceptions or maladaptation practices. Consequently, drivers and influencing factors of farmers' behavior toward climate change have received increasing attention in the last two decades.

Social and behavioral sciences have investigated the influence of farmers' experiences in increasing climate change adaptation capability and improving decision-making processes at the system level, concluding how local perceptions provide sufficient baseline information for understanding individual and collective exposure to climate risks and risk aversion patterns, an essential element for effective policy formulation and implementation. Traditional management approaches based on simple, linear growth optimization strategies, overseen by command-and-control policies, have proven inadequate for effective adaptation to climate change. Conversely, accurate bottom-up approaches focused on social learning can complement the system transformation by building collaborative problem solving. In this line, associative processing methods, such as interviews and surveys, have been discussed for their ability to delve into knowledge-based data and monitor the nature, significance, and influence of personal experience on climate change adaptation.

Agent-Based Models (ABM) can include feedback between social and physical environments, define individuals' narratives, and map the social network with agents' interactions. This proposal aims at presenting a transdisciplinary approach that integrates survey data, with behavior and agrohydrological modelling in order to support policy-makers and managers to understand and re-think water management and climate change policies at the regional scale, which is essential to

address climate change risks. From a system dynamics perspective, we characterize farmers' risk aversion patterns and examine how ABMs can most effectively integrate these insights to increase robustness in decision-making processes while attending to farmers' adaptive capacity. In the application to the case study of a large irrigated area in northern Italy, we surveyed 460 farmers to deepen a triple loop analysis on climate change awareness, perceived impacts, and adaptation measures and barriers. Statistics and computer-assisted data analysis were applied to gain insights from farmers' profiles and risk perception. We included the profiles in an ABM coupled with a distributed agrohydrological model that covers the whole irrigated area. We expect farmers' profiles influence agents' risk perception and their ultimate decision on the adopted crop types and irrigation methods. Provisional results indicate that the approach can provide new insights across complexity in modelling farmers' behavior and human adaptation to climate change and enrich the discussion about the gaps and benefits of including qualitative data in ABM.