Uncertain Futures: Using an ABM to Understand the Dynamics of Inequality Under Climate Change in Southern India

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Abstract. The impacts of climate change are increasingly being felt across the globe, exacerbating socio-economic inequalities, particularly in low-income and historically marginalized communities. These communities, which contribute least to greenhouse gas (GHG) emissions [1, 3], bear the brunt of climate change due to various factors such as limited income streams, insufficient assets, and lower levels of security. Recent research suggests that climate disasters have significant impacts on economic preferences and social behaviours, which can further intensify these inequalities [2]. However, mainstream modelling approaches often neglect these dynamics, leading to insufficient insights and ineffective policy designs.

Our research project simulates the agrarian economy of a district in Southern India, focusing on how social networks and differential economic preferences influence the systemic distribution of risks, benefits, and poverty traps in the face of intensifying climate shocks such as droughts. Moreover, we assess the effectiveness of governance measures aimed at promoting equitable outcomes and resilience among different income groups.

To explore the dynamics of the distributional impacts of farmers' adaptation to droughts, under various behavioural assumptions and social networks, we design an agent-based model. Our main agents are money lenders and farmers who manage their land and decide which crops to invest in. Besides the conventional farmers' decisions on crop diversification and agricultural investments, our model accounts for non-agricultural investments and inter-neighbour lending or borrowing.

We employ a detailed empirical data set encompassing income distributions, investment behaviours, and crop growth characteristics from the region. In addition, we ground agent's behavioural rules in a number of theoretical foundations of decision making under risk. Key state variables include landholding, financial capital, education level, borrowing/lending behaviour, number of earning members, and risk awareness. A preliminary version of the proposed algorithm is presented in Figure 1 below. The modelling considers decisions on crop

diversification, agricultural investments, non-agricultural investments, and inter-neighbour lending or borrowing.

We propose three hypotheses: (1) differential risk aversion exacerbates inequality and reduces the likelihood of escaping poverty, (2) post-disaster network-based economic preferences worsen inequality and decrease the probability of avoiding poverty, and (3) climate and economic shocks amplify inequality and poverty incidences unless countered by adequate policy measures.

An integrative framework underpins our research approach, combining hazard-based and entitlement-livelihood perspectives to conceptualize 'vulnerability'. This framework considers vulnerability as an outcome of both natural and social factors, thereby acknowledging the multitude of stressors that adversely affect the livelihoods of farmers. This comprehensive understanding is crucial for deciphering the linkages between climate change and inequality among farmers.

Moreover, we account for the fundamentals of uncertainty in climate variability, which encompasses policy interventions, economic and market fluctuations, and access to assets such as insurance, technology, capital, and information. The farmers' perceptions towards these influential factors are also examined and evaluated, providing a nuanced understanding of the impact of climate change on the agrarian economy.

Keywords: Climate Change, Inequality, Southern India, Agrarian Economy, Social Networks, Agent-based Modelling, Economic Preferences, Risk Distribution, Poverty Traps, Climate Shocks, Drought.

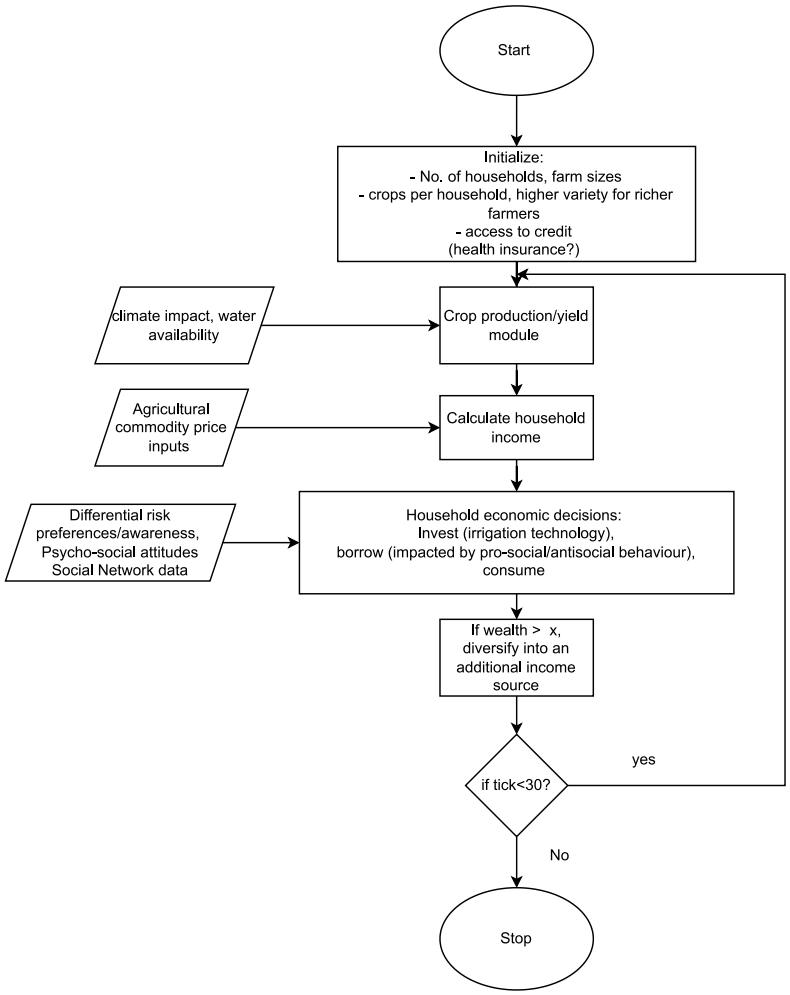

Fig. 1. A flowchart representing key inputs and processes for the proposed agent-based model.

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