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A conceptual framework for an agricultural agent-based model with a two-level social component: modeling farmer groups

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Abstract:

In the last decade, collective actions within smallholder groups and cooperatives have been promoted by various development programs and projects. However, to develop appropriate programs and policies aimed at supporting cooperation among farmers, an approach may be required able to reflect the dynamics of an agricultural system resulting from decision-making and interactions between elements at different levels and scales.

In this study, we are focusing on the groups of smallholders organizing for collective crop production and/or marketing. Our aim is to provide an approach and a tool to gain a deeper insight in how cooperative groups emerge and perform under different conditions and objective functions. An agent-based model will be built as a core of such a tool. The main difference from existing agricultural models is that we consider at least two levels of social agents and corresponding decision-making categories – individual and collective. The collective level refers to a dynamic cooperative group or network emerging as a higher level agent from the individual agents. Moreover, we are seeking for the trade-offs between simplicity and more realistic representation of social agent behavior, compared to purely rational economic optimization approach.

We start with a conceptual model to represent the system of interest. More specifically, in this model we: i) identify system components and interactions between them at different levels; ii) explore applicability of the heuristics-based approaches, such as Consumat (Jager, 2000), for individual decision-making and agent's transition to collective actions, when enriched with various socio-economic, spatial and environmental influencing factors; iii) explore ways to represent collective activities and decision-making in groups. The conceptual model, further combined with a land use/land cover and crop productivity framework, will be used as a prototype implementation to study emergence and performance of farmer groups in various settings. Our ultimate goal is to enrich the final tool with a functionality allowing to evaluate performance of a given agricultural system not only through socio-economic indicators, but putting emphasis on environmental aspects and land use optimization issues.

Keywords: agent-based modeling; agricultural modeling; farmer groups; farmer decision-making; multi-level agency