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Comparing System Dynamics and Agent Based Modeling Methods Through Their Application in a Single Case Study

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Abstract: Participatory modeling helps stakeholders to understand their problems and arrive at mutually acceptable solutions through what-if scenario analysis. Several papers comparing use of different participatory modeling methods in different contexts across the world are available in the literature. A novel contribution of our paper is simultaneous use of two such methods, system dynamics and agent based modeling, to address the same problem in a single case study and compare their results. We apply these two methods to model crop-water-market dynamics in a south Indian village over last fifty years. While building system dynamics model, causal loop diagram was drawn by identifying variables of interest and their causal relationships through focus group discussions with stakeholders. To facilitate this process, mental modeler software was used as a visualization tool. Stock and flow diagrams and associated equations were derived from the causal loop diagram with inputs from expert stakeholders. While building agent based model, agent behavior rules were identified through individual interviews with knowledgeable stakeholders. These stakeholders were selected using stratified sampling to capture diverse viewpoints. The rules were further refined during focus group discussions with larger number of stakeholders. Such focus group discussions also helped stakeholders understand the problems and their potential solutions better. By comparing results of these two models, we proposed a framework for their integration. This framework was used in focus groups to carry out what-if scenario analysis and arrive at mutually acceptable solutions. It needs to be tested and refined in other case study villages.

Keywords: Participatory Modeling, System Dynamics, Agent Based Modeling, Comparative Case Study, Agriculture.