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Application of the theory of planned behavior with agent-based modeling for sustainable management of vegetative filter strips

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An innovative socio-hydrological modeling framework for the development of environmental policies tailored to farmers' attitudes and economic interests is proposed with the inclusion of optimal environmental criteria. It focuses on modeling the complex relation of farmers, the environment, and the agricultural practices recommended by policy developers. An on-site survey of farmers is used to develop a behavior model based on a modified Theory of Planned Behavior (TPB). An agent-based model (ABM) is coupled with an agro-hydrological model for vegetative filter strips (VFS) to create dynamics of the social and environmental system.

The farmers from the Larqui river basin, Chile took part in the survey to understand their standpoint on the use of VFS to reduce soil loss in their agricultural fields and protect water bodies. The farmers were categorized into perceptive, proactive, bounded rational and interactive agents based on their answers to the survey. This categorization along with decision rules, and utility functions of agricultural activities including the VFS implementation and management are used to develop an ABM. Partial least square structural equation modeling (PLS-SEM) is used to analyze the modified TPB of farmers. Behavioral morality, behavioral willingness, knowledge of farmers showed a significant effect on modeling the intention and behavior of farmers to have VFS in their land. Subjective norm was the only construct that was not significant. The results of the ABM validate with the survey of the farmers. It shows that the decision on the width of VFS is not solely dependent on the utility generated and the reduction in soil losses but also on the behavior of farmers. This behavioral socio-hydrological modeling framework is capable of supporting policy-makers in developing tailored environmental policies that might improve the acceptance of sustainable agricultural practices by farmers.