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Simulating Heterogeneous Farmers under Different Policy Schemes: Integrating Economic Experiment and Agent-Based Modeling

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Non-point source (NPS) water pollution from agricultural runoff is a leading cause of water body impairments in the United States; however, NPS pollution is difficult to identify and regulate because of hidden actions and asymmetric information. Past economic research showed that ambient based policies could induce groups to reduce pollution to socially optimal levels. However, most of the work was based on economic experiments that are limited in scale and the ability to draw conclusions outside lab settings. In this paper, we develop an agent-based model (ABM) that scales up findings from an economic experiment on technology diffusion and management of NPS water pollution in an actual watershed. The economic experiment features both farm size and location heterogeneity and participant decision space is extended to both production and technology decisions to better reflect the reality. Data from geographic information systems (GIS) and the Census of Agriculture initialize ABM setup. The farm agents operate constellations of farmland parcels that are generated based on a distance matrix calculated from parcel level coordinates and are fitted using size probability density functions to the Ag Census data. Cluster analysis and mixed effects multinomial logit models are used to generate agent types and provide foundation for assumptions and parameters used in the ABM. Experiment data calibrate agent decision rules that determine production and adoption deviations from target level. This integrated model enables us to explore the effects of several different policy interventions on technology diffusion and agricultural production and, hence, on agricultural non-point source pollution.