Managing phosphorous runoff in a heterogeneous landscape: Welfare Implications of Spatially Targeted Policies

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Abstract:

Nutrient and pesticide runoff from agricultural lands affect water quality through eutrophication and harmful algal blooms, causing serious concerns for the society. Complex tradeoffs between agricultural decisions and water quality that emerge due to the intertemporal nature of phosphorus accumulation from heterogeneous landscapes need to be addressed by incorporating both spatial and temporal nature of the problem. In this paper, we develop a spatial-dynamic model of agricultural decisions in a simulated watershed to examine welfare gains for targeted policies in heterogeneous landscapes. We find the socially optimal fertilizer input for every combination of spatially heterogeneous features for a representative farm and derive the optimal tax to correct private farmers' behaviors to achieve the socially optimal outcome. Results show that the welfare gains from spatially targeted policies increase with higher levels of heterogeneity. In the case where policy implementation costs are proportional to the level of heterogeneity of policies, we show that there is an optimal level for implementing spatially targeted policy. Finding the optimal level for targeted agricultural management policy based on heterogeneous physical features provides policy insight that can help design cost-effective long-term optimal agricultural policies in spatially heterogeneous landscapes.

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