Title: Enhancing agro-ecosystem services using integrated hydro-ecologic, socio-cultural, and decision analytic models

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Summary: Sustainability of agro-ecosystems depends on their ability to deliver ecosystem services characterized by distinct social-ecological dynamics. However, despite advancements in the conceptualization and measurement of supporting, provisioning, and regulating services, the non-material benefits that people derive from ecosystems (i.e., cultural services) have proven more difficult to quantify and thus have remained largely implicit in decision making. There is a critical need to develop a new conceptual framework for evaluating the impacts of stressors on multiple ecosystem services and to identify selective decision alternatives that could feasibly be implemented to sustain agro-ecosystems.

Our proposed research will integrate hydrologic, ecosystem, socio-cultural, and decision analytic models to quantify the changes in ecosystem services under a combination of climate change scenarios, management schemes, government policies, and stakeholder expectations. First, we will engage with stakeholders of the watershed to define the provision of cultural ecosystem services using an innovative participatory mapping exercise, as well as determine existing and projected environmental and social stressors on the Kaskaskia River Watershed. Second, we will leverage significant resources to quantify the impacts of the identified stressors on provisioning, regulating, and supporting ecosystem services using metrics simulated by integrated physically-based hydrologic and environmental models. Third, we will conduct a residential stated preference survey to determine tradeoffs and synergies among ecosystem services identified and measured in response to the first and second objectives. Finally, we will perform a multi-decision criteria analysis to determine the risks and tradeoffs associated with managerial alternatives, which will be a key function of a final workshop that will leave stakeholders and their communities in a stronger position to influence their future development patterns. Upon successful completion of this project, a conceptual framework will be established that quantifies the impacts of different system stressors (climate, management, policies, and social expectations) on the production, environment, and socio-cultural benefits from an agro-ecosystem. This, in turn, will enable environmental managers and policymakers to update existing policies and management programs, as well as adapt new ones that will explicitly define the provision of cultural, provisioning, regulating, and supporting ecosystem services. Not only will our project provide enormous benefits to stakeholders who rely on agro-ecosystems for well-being, we will redefine theoretical approaches to managing ecosystem services and prioritizing scarce resources in the face of social-ecological change.

Supplemental Keywords: ecosystem services, hydrologic models, survey research, fish richness, multi-criteria decision analysis, stated preference modeling, risk perceptions, Kaskaskia River watershed