Development of an integrated watershed level sustainable management tool considering the effect of climate and land use change

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Goal:
To develop watershed level methodology for optimal management of the agricultural ecosystem.

Recent Publications:
Maringanti C., I. Chaubey., and J. H. Popp. Development of a multi-objective optimization tool for the selection and placement of BMPs in a watershed for NPS pollution control. Accepted in *Water Resources Research*.

Statement of Problem: Land use and land cover (LULC) of typical agroecosystems consist of croplands, forests, and grasslands that provide a large variety of services such as food, fuel, and fiber required for human welfare. However, the productivity of the agroecosystems is under a threat of decline due to the intensification of the LULC conversion and climate change. The present research focuses on studying the impact of these changes on hydrology and transport of agricultural nonpoint source (NPS) pollutants at a watershed scale (>50,000 km^2). This is achieved by developing a watershed scale simulation model (Soil and Water Assessment Tool [SWAT]) that considers the continuously changing LULC in the model setup and can simulate the changes in the precipitation and temperature caused due to the climate change. A land use change model based on cellular automata will be developed to predict the future land uses based on the training from the historic land uses. Best management practices (BMPs) provide a viable solution to reduce the movement of NPS pollutants from the agricultural areas into the receiving water bodies, however the selection and placement of BMPs at a watershed scale to achieve maximum reduction in pollution load with least costs for implementation, with multitude of farms and BMPs, is a daunting task. The SWAT model in combination with an optimization technique (genetic algorithms) will be used to solve this problem. A Bayesian based uncertainty analysis will be performed to quantify the varying land uses, climate, model parameters, and economic costs on the selection and placement of BMPs at a watershed scale. High performance computing (HPC), with support from the Steele supercomputing facility at Purdue, and TeraGrid will be used to achieve the high computational jobs during the study.

Current Activities:
Current activities involve studying the impact of land use change on the water quality at a watershed scale. The current research focus is on the Wildcat Creek Watershed which is located east of Lafayette and a larger 6 digit USGS-HUC watershed (Wabash River Watershed) that drains in three states (OH, IN, and IL) to study the impact of land use change and climate change on the water quality.