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Modeling and Optimization Approach to Managing Critical Pollution Areas within Watersheds

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Abstract:

Agricultural practices such as conventional tillage, nutrient and pesticide applications, as well as intense urban development are common sources/causes of surface water pollution. Watershed stakeholders are therefore interested in the most efficient and cost effective means of managing pollution while maintaining high agricultural yields and urban development. There are numerous best management practices (BMPs) for controlling off-site movement of sediment and agricultural chemicals; however the costs and effectiveness of these practices are typically highly site specific. Through watershed modeling and economic analysis, it is possible to identify critical pollution areas and optimize the allocation of BMPs to these areas. An approach is presented for the Trail Creek Watershed in northwest Indiana to help achieve target reduction in sedimentation levels, through the identification of most appropriate BMPs, critical areas for BMP placement, and the lowest possible cost to attain this goal. The process involves the watershed modeling of the fate and transport of sediments using Soil and Water Assessment Tool (SWAT), the evaluation of costs and benefits for different BMPs using an economic analysis tool, and the final optimization process using a genetic algorithm (GA). The GA incorporates pollutant loadings from SWAT output together with the BMP cost analysis to produce the best management scenario in terms of cost and pollution reduction effectiveness. It is expected that targeted reduction in sedimentation, by watershed planners and managers, can be achieved at significantly lower costs through BMP cost optimization and placement than more traditional approaches to placing BMPs.

Impact Statement:

The modeling results and optimization tools developed in this project will help farmers and other stakeholders optimize BMP selection for improving water quality and crop production in agricultural watersheds.

Category: Agricultural BMPs

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