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Modeling Watershed-Scale Effectiveness of Agricultural Best Management Practices to Reduce Phosphorus Loading

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Abstract Text:

Planners advocate Best Management Practices (BMPs) to improve water quality in agricultural areas. However, there is a lack of tools using easily available data to investigate the relationships between BMPs and their spatial locations on water quality. BMPs are potentially most effective when they are located in Hydrologically Sensitive Areas (HSAs) or areas that produce the majority of the runoff in humid, glaciated regions. Thus, the critical elements necessary to accurately predict the water quality impact of BMPs include the correct identification of HSAs, and accurate predictions of nutrient reduction due to particular BMPs on these HSAs. The objective of this research is to model the effectiveness of BMPs using a newly formulated model, the Variable Source Loading Function (VSLF) model that captures the spatial/temporal evolution of HSAs in the landscape. Data from a long-term monitoring campaign on a 164 ha farm in the New York City (NYC) source watersheds in the Catskills Mountains of New York (NY) are being used to evaluate the effectiveness of BMPs. The data span an 11-year period over which a suite of BMPs were installed including a nutrient management plan, riparian buffers, filter strips, and fencing, all implemented to reduce phosphorus (P) pollution. Despite its simplicity, VSLF predicted the location of runoff areas well and that total runoff was not affected by BMPs. Dissolved P reductions were simulated well by using calibrated reduction factors for various BMPs in the VSLF model. Total P losses decreased only after culvert crossings were installed in the creek. These results demonstrate that BMPs, when sited with respect to HSAs, reduce P loss from agricultural watersheds, which provides useful information for targeted water quality management.

Impact Statement:

As a result of novel BMP implementation the dissolved phosphorus concentration is steadily decreasing in the surface waters in the New York City Source Watershed. This model incorporates the BMP placement principles and will help planners to improve water quality in other parts of the country as well as further optimize practices in the NYC source watershed.