Effects of Conservation Practices on Phosphorus Loss Reduction from an Indiana Agricultural Watershed

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Excessive applications of fertilizers and manures on agricultural lands have greatly contributed to off-site losses of nutrients, and in particular are at least partially responsible for phosphorus (P) concentrations leading to harmful algal blooms and eutrophication problems in Lake Erie (Richards et al., 2002) and other water bodies. However, techniques that can reduce total and soluble phosphorus losses from croplands and drainage channels (also known as best management practices, BMPs) may be difficult to implement, due to high costs for implementation, the desire to maximize land area under active production, and the available labor's timing (Bosch et al., 2014). In addition, the effectiveness of BMPs can be expensive and difficult to evaluate through field experiments or watershed monitoring.

Computer models are efficient and flexible tools for evaluating the status of the nutrient loss problem and effectiveness of BMPs. The overall goal of this study was to evaluate the effectiveness of BMPs in reducing phosphorus losses at the field and small watershed scales. The three objectives here were: 1) understand the pathways of phosphorus loss from fields to the watershed outlets; 2) represent different BMPs currently existing in the study area and validate their simulated effectiveness; and 3) evaluate the effectiveness of other BMPs that could potentially be implemented to reduce phosphorus losses. In this study we utilized the Agricultural Policy Environmental eXtender (APEX) model. The USDA-ARS National Soil Erosion Research Laboratory (NSERL) is actively monitoring over a dozen field and watershed catchments in the St. Joseph River Basin in northeastern Indiana. We selected the Matson Ditch catchment within the St. Joseph River Basin as our study area (Figure 1). An APEX model was setup for the Matson Ditch with detailed input data including observed daily weather information, known conservation practices, and actual field management practices. The model was calibrated and validated with detailed flow and water quality data. The NSERL data was critical for achieving a properly calibrated and validated APEX model. The validation of the model also included the proper simulation of BMP effectiveness and phosphorus losses through tile drainage. The model was then used to understand the mechanisms and pathways of phosphorus loss from the catchment. Lastly, APEX was used in scenario trials. Scenarios included the optimal placement of single and bundled BMPs, which could help reduce the loss of phosphorus from the catchment.

The results of this study increased understanding of phosphorus loss in a typical Midwestern U.S. catchment. The analysis also provided insights on the upscaling of BMP effectiveness from field to small watershed scale, and offered suggestions for optimal placement of BMPs, using the best available information. The evaluation of the APEX model at a study site where more information was available increased confidence in the model results.

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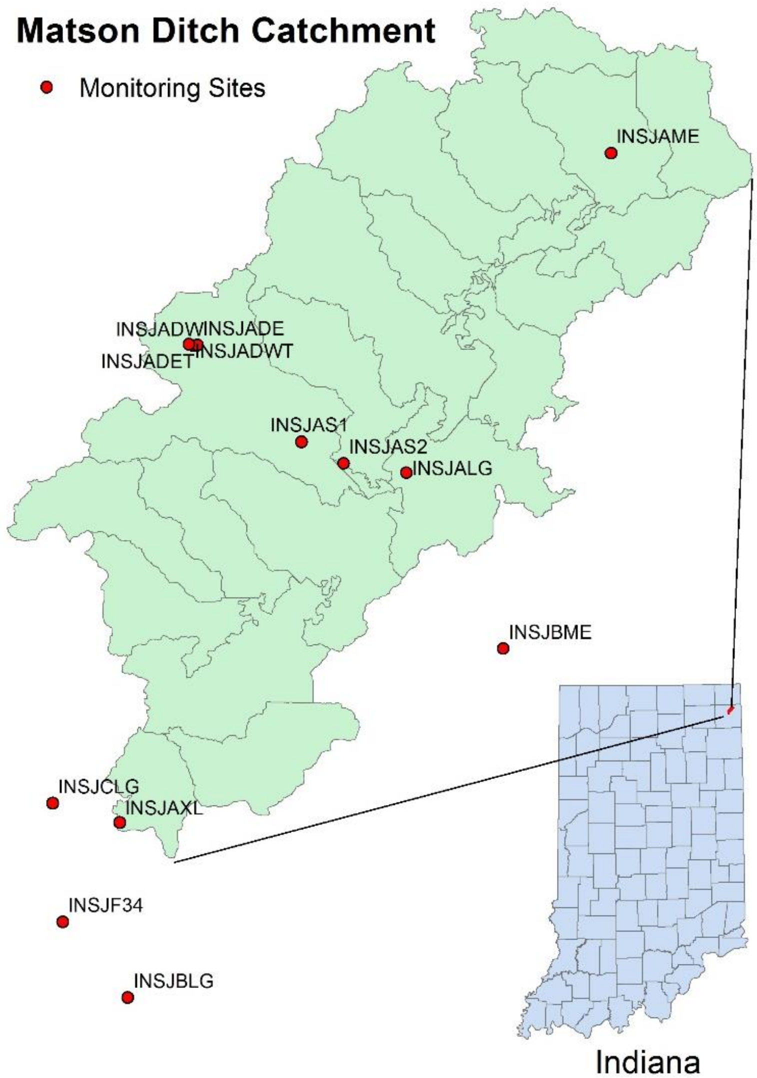

Figure 1. Monitoring sites of the USDA-ARS National Soil Erosion Research Laboratory. Field observations and data from these monitoring sites includes effects of existing land management and conservation practices on runoff, sediment losses, pesticide losses, and nutrient (N and P) losses.

References

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