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Evaluating BMP Scenarios under CEAP: Approaches to handling a multitude of runs and large datasets

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Abstract Text:

Mathematical models are increasingly being used to quantify Best Management Practice (BMP) effectiveness, as they offer the ability to study multiple BMP scenarios, and to analyze impacts of various management decisions on watershed response. Associated analyses can, however, be very computationally intensive due to the large number of runs needed to fully capture the variety of possible management and climatic scenarios. Further, large amounts of disk space are often required to store model outputs. There is, thus, the need to develop suitable and efficient techniques to handle such comprehensive BMP evaluations. This study develops computational techniques for analyzing various BMP scenarios for phosphorus pollution control and their effects on water quality, considering uncertainties in future weather patterns over a 25-year period. The study is part of an on-going CEAP effort, focused on the Lincoln Lake watershed in northwest Arkansas, where the overall goal is to quantify relationships between water quality, and selection, timing, and spatial distribution of BMPs. The study uses SWAT, a physically-based distributed-parameter watershed model, to simulate various BMP scenarios. A total of 172 BMP scenarios, incorporating grazing and pasture management, riparian and buffer zones, and poultry litter and commercial fertilizer application are analyzed. The study incorporates 1000 weather scenarios in each BMP application thus 172,000 model runs. At the rate of 8-10 minutes/run, 23,000-29,000 CPU hours, or 2.6-3.3 years would be needed to complete all runs on a standard desktop computer. Further, 67.5 Mb/run are needed to store output, translating to 10 Tb of computer space required. We first present our approach to handling the large numbers of runs needed to evaluate BMP performance under stochastic weather scenarios. We then present techniques used in handling the large datasets resulting from model outputs. Finally, we discuss applicability of these approaches to the CEAP effort, and some future directions.

Impact Statement:

This study provides information that aids watershed planners, state and federal agencies, and agricultural producers in the watershed in planning management interventions for watershed water quality protection. Further, the study develops the tools necessary for similar comprehensive evaluations, allowing pre-assessment of various BMP implementation schemes which, in turn, leads to improved, effectiveness-based water quality management.