

A Tool for Estimating Best Management Practices Effects in Arkansas

1. Introduction

Increased nutrient and sediment losses from expanding agricultural practices and urban development in Arkansas are an important environmental concern. Already, fifteen percent of Arkansas streams do not support at least one of their designated uses (ADEQ, 2002); with rapid urban development and the state's heavy focus on agriculture, many are implementing best management practices (BMPs) to lessen the effects of this development to existing water bodies. However, there are still many questions pertaining to the effectiveness of BMPs. Various studies exist that have determined the effectiveness of BMPs at various scales and for a variety of site conditions. These data can only be dependably used for the site from which they were obtained if considered individually. Collectively, these data comprise quantitative effectiveness over a wide range of conditions and can thus be used to provide reliable estimates of BMP effectiveness. This study develops a tool for estimating BMP effectiveness, based on accumulation and analyses of data reported in previous studies, with a focus on site conditions and management interventions in Arkansas. This study incorporates data from a variety of regions in Southeastern US, which have site conditions and management similar to those in Arkansas. Developed in Microsoft® Access ©, this tool will be made accessible to local and state agencies and will aid rural and urban planners in developing management solutions for nutrients and sediment control. The tool describes the BMPs individually and gives site-specific estimates of their long-term effectiveness in sediment and nutrient control.

2. Project Objectives

- ▶ Quantitatively assess BMP effectiveness by compiling existing quantitative BMP effectiveness data in the literature
- ▶ Develop a user-friendly tool to estimate BMP effectiveness based on site conditions

3. Methods

The BMP Tool for Arkansas was built from the structure of the existing BMP tool by Gitau et al. (2005).

▶ Data Collection

An extensive literature review retrieved particulate, dissolved, and total phosphorus (PP, DP, and TP), nitrate, ammonium, and total nitrogen (NO₃-N, NH₄-N, and TN), and total sediment reduction effectiveness of various BMPs reported in the Southeastern US and the other states adjacent to Arkansas. Associated site and study conditions were included for each reference, as well as a full citation.

▶ Data Organization

The BMP effectiveness data gathered from the literature was stored in a Microsoft Access database. Data was queried by Hydrologic Soil Group, slope range, and combinations of the two to determine a mean, range, and standard deviation for individual BMP effectiveness based on soil and slope conditions. Data was arranged into BMP groups.

▶ Tool Development

A BMP Effectiveness tool was developed based on the literature database to allow user evaluation of BMP's based on their specified soils and slopes. The tool permits users to search the BMP data in several different manners and the data can be compiled based upon pollutant reduction effectiveness, BMP group, site conditions (soil or slope), or reference citation. This is all available to the user through the BMP Tool's main interface. The user can also customize the BMP Tool using the BMP database. The BMP Tool was written in Structured Query Language (SQL), executed during runtime, so that any updates are reflected in the results.

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4. Capabilities of the BMP Tool

- ▶ Obtain BMP Effectiveness Estimates
 - Specific to hydrologic soil group and slope
- ▶ View Summary Data
 - Compiled results for specific sediment or nutrient reduction by BMP
- ▶ Update the Database
 - Add, edit, or remove references or effectiveness data to fit the user's needs
- ▶ Retrieve other pre-analyzed information
 - Standardized forms/reports to view other information included in the tool
 - Customized forms/reports to view specific or user defined information in the tool

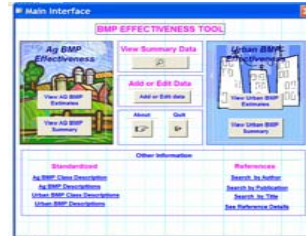


Fig 1A: Main interface of the BMP Tool.

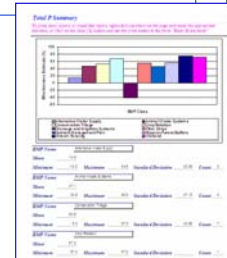


Fig 1B: Total P reduction viewed by BMP classes



Fig 1C: Interface to add effectiveness data



Fig 1D: Searchable compilation of effectiveness data with direct links to its appropriate citation



Fig 1E: Searchable compilation of citations



Fig 1G: Tool lookup interface

Fig 1F (Above): Summary of general effectiveness

Fig 1I (Right): BMP effectiveness based on Hydrologic Soil Group



Fig 1H: Tool output

5. Example Application

Site environmental reviews show that a farm in North Eastern Arkansas (HSG-B, 3-8% slope) is contributing to sediment pollution. BMPs must be implemented on this farm to prevent further losses.



Which BMP should be implemented and how effective is it likely to be in reducing P pollution?

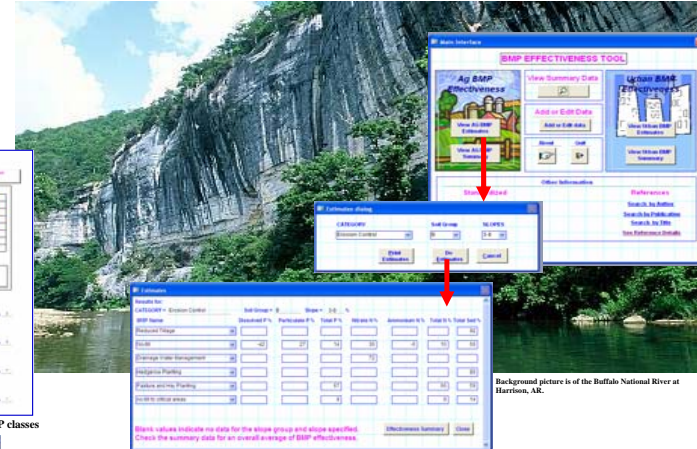


Fig 2A (Above): Using the BMP Tool for the Example Application.

Using the assessment tool (Figure 2A), estimates of effectiveness are obtained for six erosion control BMPs. In this case, the BMP tool shows that Reduced Tillage has the greatest reduction in total sediment losses (92%). Figure 2B graphically shows all results, estimates for other BMPs can be obtained in the same manner.

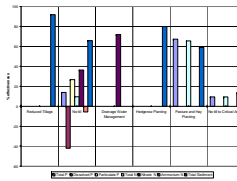


Fig 2B (Right): Graphical results from the BMP Tool.

The BMP Tool is meant to be an aid in BMP selection; not all BMPs may be acceptable for all applications or areas.

7. Conclusions

- ▶ Functional, user-friendly BMP Effectiveness Database
- ▶ Tool computes statistical mean, range, and standard deviation
- ▶ BMP Tool makes BMP effectiveness data searchable by soil and slope
- ▶ BMP Tool can be linked as an add-in to other applications like the SWAT model

8. References

- Arkansas Department of Environmental Quality (ADEQ). 2002. Integrated water quality monitoring and assessment report 2002. Little Rock, AR.
- Gitau, M. W., W. J. Gburek, and A. R. Jarrett. 2005. A tool for estimating best management practice effectiveness for phosphorus pollution control. J. Soil and Water Conservation, 60: 1 – 10.