Assessing Phosphorus Loss to Protect Surface Water

The Texas State Soil and Water Conservation Board (TSSWCB) in collaboration with the Department of Soil and Crop Sciences at Texas A&M University, Texas Cooperative Extension (TCE), Texas Water Resources Institute (TWRI), and the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS), have developed a field validation of the Texas Phosphorus Index.

This project, located near Bosque and Leon Rivers, began June 1, 2002, and ended June 30, 2004. The main objectives were to determine how soil properties in the Bosque and Leon River watersheds affect phosphorus levels, and to modify the Texas Phosphorus Index to improve its ability to predict the concentration of phosphorus in precipitation runoff. The Texas Phosphorus Index, a tool designed to assess the potential for phosphorus to move from agricultural fields to surface water, is a promising resource management method that better formulates and implements such regulation programs. It is an integrated approach that considers soil and landscape features in order to find appropriate phosphorus management practices by estimating phosphorus delivery to surface water.

Other goals were to compare soil tests and extractable soil solution phosphorus levels in runoff, and to evaluate the Texas Phosphorus Index in better classifying field sites relative to phosphorus loss potential, which can be used to prioritize fields for phosphorus management. Agriculturalists are developing and operating programs that minimize phosphorus losses, thereby reducing the amount that enters regional waters.

Phosphorous is a necessary element in the growth and nutrition of plants and animals. Since there is a need for it in crop production, many fertilizers are used to enhance the supply of existing phosphorus in soils.

Environmental concerns arise when too much phosphorus, along with other nutrients, becomes runoff and reaches surface waters. When phosphorus is lost from fields or other

sources and comes in contact with surface waters, eutrophication occurs. Eutrophication is an increase in the fertility status of natural waters that causes faster growth of algae and other aquatic plants. Phosphorus levels are directly related to excessive algae growth in most fresh waters. It is one of the principal causes of impaired surface water quality in Texas, as well as the United States.

Minimizing phosphorus pollution of surface water from agricultural fields involves management practices that control both the source and transportation factors of soil. Influences that affect the source and the amount of phosphorus transported include the type of phosphorus applied and the content in the soil itself. Transportation factors include rainfall, irrigation, erosion, and runoff.

The overall aim of environmentally sound practices is to keep soil fertility levels of phosphorus to a range that is best for crop growth, while decreasing the loss of soluble phosphorus by runoff, drainage, or erosion.

Researchers studied 40 sites (20 the first year and 20 in the second year) in the Bosque and Leon River watersheds. Site selection was based on fixed features designed to evaluate data and related variables including soil testing rates, timing and methods of fertilizer application, and whether phosphorus was used near streams or other bodies of water. These factors better assessed the sources of phosphorus and the potential for runoff or erosion.

Runoff factors for a field are used in a mathematical equation, outlined in an 8 x 5 matrix, to determine whether the phosphorus movement risk is very low, low, medium, high, or very high. Weighted values, based on condition classes and relative importance, enable researchers to calculate a numeric point value. Total index points for a certain field are then compared to a standard index to find the overall phosphorus runoff risk for that site.

A rainfall simulator, called a Tlaloc 3000, measured phosphorus levels, and estimated other nutrient levels in runoff. A series of three simulations were conducted at each location on 1.5 m x 2 m plots. The application rate was 7.5 cm per hour, which is the standard rate used across the nation. Runoff samples (1,000 mL) gathered at two intervals were then analyzed for pH, element content, soluble phosphorus, and suspended phosphorus by the Texas A&M Soil, Water and Forage Testing Laboratory.

Public education and outreach was another purpose of this study. Through the efforts of county Extension agents and multi-county meetings, resource managers and landowners learned about the hazard of phosphorus runoff and how to use the Texas Phosphorus Index as a management tool. Efforts to provide news and training about the Phosphorus Index for the Texas Commission on Environmental Quality (TCEQ), TSSWCB, NRCS and other groups was also important.

Results of this field study will help confirm the Texas Phosphorus Index by proposing modifications to improve accuracy. Quantitative evaluations involving the measurement and estimation of phosphorus in runoff, and runoff analysis dealing with the type of phosphorus, can determine necessary best management practices (BMPs) to decrease the magnitude of phosphorus losses from agricultural fields.

Ultimately, the Texas Phosphorus Index helps determine the main factors that lead to phosphorus risks. Management of phosphorus can be very site specific and requires a well-coordinated effort between landowners, agriculturalists and soil conservationists.

The major challenge is to create a plan that effectively uses all nutrient sources and reduces phosphorus losses in bodies of water while maintaining or improving crop profitability and environmental quality.