ALABAMA COOPERATIVE Extension SYSTEM

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ALABAMA A&M AND AUBURN UNIVERSITIES

The Rural Environment And NPS Pollution

Controlling Agricultural NPS Pollution Through Best Management Practices

Best Management Practices (BMPs) are structural or other practices that can be used to reduce nonpoint source (NPS) pollution of surface water and groundwater. The major goals of agricultural BMPs are to preserve soil and water quality, to maintain optimum food production for human use, and to provide adequate economic returns for the producer. Together these goals are known as sustainable agriculture.

Selecting BMPs

By following a systematic approach to BMP selection, you are more likely to select a practice that solves your water quality problem and meets the needs of your farm operation. **Answer the following questions to select BMPs.**

What pollutants are contributing to the problem?

Sediment is by far the greatest NPS pollutant in rural environments. Sediment impairs water quality and transports other pollutants.

The most troublesome nutrient element in surface water is **phosphorus.** It stimulates the production of algae blooms that can choke out beneficial plants and smother aquatic animals. Phosphorus commonly moves with sediment. However, recent studies indicate that some phosphorus may move in the liquid phase where excessive rates have been applied in animal wastes.

Nitrogen may also contribute to nutrient enrichment of surface waters, but it is more of a public health concern when it finds its way into groundwater in the nitrate form.

Pesticides, widely used in crop production, can be a source of pollution in both surface water and groundwater.

Bacteria, found in animal wastes, may make receiving water unsuitable for domestic uses, for contact recreation purposes, or as a habitat for game and shellfish.

Decomposing organic material from animal wastes and plant residues can reduce the oxygen level of water below that required for fish and other aquatic life.

Where are the pollutants being transported?

Surface water sources such as streams, rivers, or lakes are more likely to receive pollutants transported in storm water runoff. On the other hand, **groundwater** is more likely to be affected by pollutants that leach and percolate downward through the soil.

How are the pollutants delivered from local agricultural land?

There are three stages to the pollutant delivery process: availability, detachment, and transport. Each can be affected by local factors including soils, geology, climate, water conservation practices, cropping practices, and tillage practices.

Availability is a measure of how much of a substance in the environment can become a pollutant. Once a substance has been released it is available; however, it must be **detached** from the target site before it can become a pollutant. Pollutants can either be detached as individual particles or they can be dissolved into water. **Transport** is the final link in the pollutant delivery chain. Pollutants can be transported to surface water and groundwater by surface runoff or infiltration.

What practices can be used on your land to correct water quality problems?

The most effective BMPs will reduce agriculture's impact on water quality while optimizing economic yield. Consider the following when deciding which practices to select as part of a system to correct a water quality problem:

• Most plans consist of several BMPs combined into a farm conservation system. In some cases groups of practices may be the best solution.

• Some BMPs that solve a surface water quality problem may create a new problem or shift an old problem to a new location by accelerating nutrient or pesticide transport to groundwater.

• If a BMP is not economically feasible and well suited to a site, then you probably won't use it. Consider effects on yields, production and machinery costs, labor, equipment, and field conditions.

Types Of BMPs

Best Management Practices to correct water quality problems are of two types: structural modifications and nonstructural measures. Structural solutions involve the construction of physical devices for delaying, blocking, or trapping pollutants such as sediment. Nonstructural approaches use an array of techniques that are less physically oriented, such as work schedules, zoning ordinances, and farming practices.

The following list identifies and defines Best Management Practices to control agricultural related pollution. This list will be updated, revised, and added to as research provides more information. The BMPs are discussed in more detail in other articles in the water quality series.

Animal Waste Management—Collecting, transferring, storing, treating, and using animal wastes to prevent surface water and groundwater contamination.

Chiseling And Subsoiling—Loosening the soil to shatter compacted soil layers, to increase infiltration, and to reduce runoff.

Contour Farming—Farming sloping land so that crops are cultivated across slopes with the contours of the land instead of up and down slopes in order to reduce surface runoff and erosion. This practice includes contouring orchards and other fruit areas.

Critical Area Planting—Establishing permanent vegetation on critically eroding or highly erodible areas.

Crop Residue Management—Retaining crop residue on the soil surface after harvest until land preparation for the next crop. This reduces soil detachment from raindrop impact.

Crop Rotation—Rotating species of crops to reduce pests and pest control problems and to improve the soil and protect it during periods when erosion usually occurs. Rotating field crops with sequences of grasses and legumes.

Debris Basin Or Sediment Basin—A barrier or dam constructed across a waterway or at other suitable locations to reduce the velocity of runoff water so that much of the sediment and associated nutrients settle to the basin bottom.

Diversion—A channel with a supporting ridge on the lower side constructed across the slope to divert water and help control soil erosion and runoff. This practice also includes hillside ditches.

Filter Strip—A filter strip of lush vegetation between nonpoint sources of pollution and water courses, which slows down the flow and turbulence of water allowing suspended material to settle out. This practice includes field borders.

Grade Stabilization Structure—A natural or artificial channel that reduces the erosion effects of sharp changes in elevation or grade or provides a stable area where the change in elevation takes place.

Grassed Waterway Or Outlet—A natural or constructed waterway or outlet shaped and established in vegetation to dispose of water and runoff without soil erosion.

Integrated Pest Management (IPM)—Timing and use of specific insecticides, fungicides, herbicides, and other pesticides only when needed to control crop losses because of insects, diseases, and weeds. Includes the following:

• Scouting fields for insect or disease damage. Using available research and thorough field investigation including mapping to determine when pests reach a sufficient number to require pesticide treatment.

• Monitoring economic thresholds to help determine when pest problems are severe enough so that chemical use is profitable.

• Using cultural practices, such as elimination of host sites and adjustment of planting schedules, to partly substitute for pesticides.

• Using trap crops or other techniques to lure insects to sites where they can be more easily controlled.

Irrigation Water Management—Using irrigation so that erosion potential and leaching are limited.

Land Applied Waste—Using agricultural or other wastes on land in an acceptable manner while maintaining or improving the quality of soil, water, and plant resources.

Land Smoothing And Leveling—Removing irregularities on the land surface to improve surface drainage and to reduce rill and gully erosion by spreading the flow of water over a larger drainage area.

Land Use Change To Conservation Use—Changing the present use of the land to a less erosive use, such as cropland to pastureland or idle land to woodland.

Lined Waterway Or Outlet—A waterway or outlet with an erosion-resistant lining to provide for safe disposal of runoff without erosion. Applicable to situations where unlined or grassed waterways would be inadequate.

Livestock Exclusion—Excluding livestock from an area to maintain the quality of soil and water resources.

Livestock Water Facility—A trough or tank to provide drinking water for livestock at selected locations to give protection to vegetation and water resources.

Minimum Tillage (Conservation Tillage)—Includes a variety of tillage systems where soil disturbance and the number of cultural operations are reduced to a minimum and where mulch residue from the previous crop is left on the soil surface to retard weed growth, conserve moisture, and control erosion. Some minimum tillage practices include no till, ridge plant, strip till, sweep till, wheel-track plant, and listing.

Mulching—Applying plant residues or other biodegradable material such as hay straw, animal manure, poultry litter, or wood shavings to the soil surface in order to reduce water runoff and soil erosion.

Nutrient Management—Timing, placement, and rate of fertilizer application for maximum use by plants and for minimizing leaching or movement by surface erosion. This practice includes spring tillage to reduce soil erosion losses and soil incorporation of fertilizers when possible.

Pasture Management—Maintaining or improving the quality and quantity of forage to protect the soil from erosion and reduce surface runoff.

Pesticide Management—Using pesticides so that runoff and leaching potential are reduced. Includes the following:

• Improving pesticide application techniques. Optimizing pesticide formulation, placement, and time of application, and eliminating excessive treatment by reducing to a minimum the amount applied and the number of applications. This practice also includes the disposal of pesticide containers.

• Using Alternative Pesticides. Switching the type of pesticide to another which has low toxicity, low persistence, and low leaching potential and which does not build up through food webs.

Row Arrangement—Locating rows so that they provide drainage toward a desired outlet.

Sealing Abandoned Wells—Preventing runoff water from flowing directly to groundwater and carrying fertilizer and crop protection chemicals with it.

Sinkhole Protection—Using grass filter strips (on level ground), building berms or diversion channels (on sloping ground), sealing with concrete or plastic liners.

Soil Fertility Management—Improving soil-fertility so that the crop canopy will develop faster and protect the soil from raindrop splash.

Soil Testing And Plant Analysis—Examining soil samples or plant tissues for certain basic elements, which play important roles in the growth and development of plants.

Stripcropping—Growing crops in alternating strips of sod, forage, or closely grown crops and row crops to reduce water and wind erosion.

Subsurface Drain—A pipe or tile, usually plastic, installed underground to lower shallow groundwater tables to take water away from erosive areas, or to handle seepage on side slopes or in drainageways.

Surface Drain—A ditch or channel constructed in relatively low lying areas or flat fields next to streams to transport surface flow through a filter strip prior to its entering a stream.

Temporary Vegetation—Planting close-growing plants that have quick growth characteristics for short-term, seasonal soil protection.

Terrace—An earthen embankment, channel, or a combination ridge and channel constructed across the slope to reduce erosion and sediment content in runoff water.

Tile Outlet—A terrace system augmented with underground plastic pipe or tile water outlets.

Tree Planting—Planting trees to protect watersheds from soil erosion.

Waste Storage Structure—A fabricated structure for temporary storage of animal or other agricultural wastes or an impoundment made by excavation or earthfill.

Waste Treatment Lagoon—An impoundment made by excavation or earthfill for biological treatment of animal or other agricultural wastes.

Wetlands Protection—Preventing nutrient and pesticide runoff to wetland areas in the same way other surface waters are protected.

Winter Cover Crops—Planting close-growing grasses, legumes, or small grains for erosion control during the winter and early spring months.

Table 1 lists BMPs and rates their effectiveness in protecting surface water and groundwater from various pollutants.

Conclusion

To be effective, BMPs must be properly planned, designed, and implemented or installed. But good management by the farm operator is most important in reducing agricultural nonpoint source pollution.

Table 1. Best Management Practice Summary Guide.

	Surface Water Protection							Groundwater Protection	
	Sediment	Soluble Nutrient	Adsorbed Nutrient	Soluble Pesticide	Adsorbed Pesticide	Oxygen-Demanding Substances	Bacteria	Nitrogen Loss To Groundwater	Pesticide Loss To Groundwater
Management Practices									
Animal Waste Management	*	***	***	*	*	***	***	***	*
IPM	*	*	*	***	***	*	*	*	***
Irrigation Water Management	**	**	**	**	**	*	*	**	**
Nutrient Management	*	***	***	*	*	*	*	***	*
Pesticide Management	*	*	*	***	***	*	*	*	***
Soil Fertility Management	***	*	***	*	***	*	*	***	*
Other Practices									
Land Applied Waste	**	+	*	*	*	+	**	+	*
Sealing Abandoned Wells	*	*	*	*	*	*	*	***	***
Sinkhole Protection	*	*	*	*	*	*	*	***	***
Soil Testing, Plant Analysis	**	***	***	*	**	*	*	***	*
Waste Storage Structure	*	***	**	*	*	***	***	+	*
Waste Treatment Lagoon	*	***	**	*	*	***	***	+	*
Wetland Protection	***	**	***	**	***	***	**	*	*
Vegetative Practices									
Contour Farming	***	**	***	**	***	**	**	+	+
Critical Area Planting	***	**	***	**	***	**	**	*	*
Crop Residue Management	***	*	***	*	***	*	*	+	+
Crop Rotation	***	**	***	**	***	*	*	**	**
Filter Strips	**	*	**	*	**	**	**	*	*
Land Use Change	***	***	***	***	***	***	***	***	***
Mulching	***	*	***	*	***	*	*	+	+
Pasture Management	**	*	**	*	*	**	**	*	*
Row Arrangement	**	*	**	*	**	**	**	*	*
Stripcropping	**	**	**	**	**	**	**	*	*
Temporary Vegetation	**	**	**	*	**	**	**	*	*
Tree Planting	***	**	***	**	***	**	**	**	*
Winter Cover Crop	**	**	**	**	**	*	*	**	*

(Table 1, cont.)

	Surface Water Protection							Groundwater Protection	
	Sediment	Soluble Nutrient	Adsorbed Nutrient	Soluble Pesticide	Adsorbed Pesticide	Oxygen-Demanding Substances	Bacteria	Nitrogen Loss To Groundwater	Pesticide Loss To Groundwater
Tillage Practices									
Chiseling, Subsoiling	**	*	**	*	**	*	*	+	+
Minimum Tillage	***	*	***	*	***	*	*	+	+
Structural Practices									
Debris Basin	***	*	***	*	***	**	*	+	+
Grade Stabilization Structure	**	*	**	*	*	*	*	*	*
Grassed Waterway	**	*	**	*	**	**	*	*	*
Land Leveling	**	*	**	*	**	*	*	*	*
Lined Waterway	***	*	**	*	**	**	*	**	*
Livestock Exclusion	***	***	***	*	*	***	***	*	*
Livestock Water Facility	***	***	***	*	*	***	***	*	*
Subsurface Drain	**	*	**	*	*	*	*	*	*
Surface Drain	**	*	**	*	**	*	*	*	*
Terrace	***	**	***	**	***	**	**	+	+
Tile Outlet	***	*	***	*	***	**	*	*	*

* No control to low effectiveness. ** Low to medium effectiveness. *** Medium to high effectiveness. + May increase loading in some cases.

Source: Adapted from Brach, 1991.

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For more information, call your county Extension office. Look in your telephone directory under your county's name to find the number.

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