Pollutants of Concern and Their Delivery

The livestock and poultry industry is facing a growing scrutiny of its environmental stewardship. Emotion, lack of information, and thus, understanding by the general public contributes to this scrutiny. Problems also result from a few producers who have contributed to highly visible impacts on the environment due to misunderstanding, misinformation, or disregard for the environment and existing regulations. Animal production has the potential to negatively affect surface water quality (from pathogens, phosphorus, nitrogen, and organic matter); groundwater quality (from nitrate); soil quality (from soluble salts, copper, arsenic, and zinc); and air quality (from odors, dust, pests, and aerial pathogens). Manure and other byproducts of producing animals, if not properly managed, can exert a significant negative impact on the environment. This lesson will discuss the "tools" that can be used to control many of these pollutants while land applying manure.

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As issues related to best management practices (BMPs) are discussed in this lesson, producers are encouraged to evaluate their implementation of BMPs to better understand their own operation's strengths and weaknesses. This can be done with the aid of the post-application self-inspection checklist (Table 32-1), Environmental Stewardship Assessment (see Appendix A), and Regulatory Compliance Assessment (see Appendix B).

Sediment

Excessive sediment from eroding cropland, overgrazed pasture, construction sites, and other activities impacts water resources by reducing water resource storage; destroying fish and wildlife habitat; and negatively affecting property values, recreational uses (boating, fishing, swimming), commercial uses (drinking water supplies), and navigation (USEPA 1989; Clark et al. 1985).

Water erosion is the natural process of soil movement from higher to lower areas caused by downhill-flowing water. During a storm, precipitation rates may be greater than infiltration rates, resulting in overland flow of water or runoff, which creates the potential for water erosion. Agricultural activities, such as soil cultivation and the destruction of vegetative cover, accelerate soil erosion (Hickman et al. 1994).

Water erosion is a combination of three processes: (1) detachment, (2) transport, and (3) deposition. Soil is detached by the energy of raindrop impact or the force of flowing water. Soil transport occurs via flowing water, and soil deposition occurs when water velocity slows and suspended soil particles settle (Hickman et al. 1994). Most soil deposition occurs on land, although some soil reaches water resources, where it negatively affects water resource use.

Nutrients: nitrogen (N) and phosphorus (P)

Nutrients (N or P) can enter water resources through surface runoff, either dissolved in the water or attached to soil particles. Nitrogen and P can accelerate the eutrophication of water resources, resulting in algal blooms, reduced transparency, undesirable shifts in algal and fish populations, and even fish kills (Clark et al. 1985). Nonpoint source (NPS) N and P originate from agricultural activities, both row crop and animal operations, as well as urban storm water runoff. Phosphorus is delivered via overland flow into

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receiving water resources, usually attached to soil particles. Organic forms of N, attached to sediment or as part of organic matter, also enter surface waters through overland flow.

The majority of NPS N that enters surface waters is transported through subsurface flows. Surface runoff water commonly contains low N concentrations of compared to groundwater flows from fertilized fields (or lawns). Most N added to soils as commercial fertilizer or manure is converted to nitrate-N, a mobile form of N that readily moves with soil water. As rainwater enters the soil and flows downward through the rooting zone, growing plants absorb the N or it moves into the shallow groundwater. Nitrogen movement into the groundwater most often occurs during the winter when plants are not growing, but nitrate leaching can also occur in very wet periods during the spring or summer.

Once the nitrate-N moves below the water table and enters the saturated zone, it will flow with the groundwater. In upland areas, groundwater tends to move downward, driven by periodic rainfall that recharge the groundwater system. As the groundwater percolates downward, it frequently encounters discontinuous clay lenses or rock. These lenses, or aquitards, transmit water more slowly than the overlying sediments. Thus, once an aquitard is encountered, the major portion of the nitrate-N laden water will move laterally, discharging into a stream or ditch. However, some groundwater will flow into a semi-confined aquifer beneath the aquitard, either by transmission through the aquitard or by downward flow along the len's discontinuous boundaries. Nitrate has not been found in aquifers lying below these confining layers. Nitrate that is carried with the groundwater eventually discharges to a surface-water body. The amount of nitrate entering the surface water can be reduced if the groundwater flows through a riparian buffer or discharges into a controlled drainage system (discussed later). Nitrate in groundwater that passes through a riparian buffer may either be used by the riparian vegetation or converted to a gas by the bacteria found in the organic matter deposited in the area. Denitrification in riparian soils is an extremely important process for removing nitrate from groundwater flowing from fertilized fields.

High concentrations of nitrate in the groundwater are problematic. A 1990 USEPA national well water study found that 2.4% of rural private wells contained nitrate-N concentrations above 10 mg/l. The threshold for contaminated drinking water is 10 ppm nitrate-N. In infants, 10 ppm may cause Blue Baby Syndrome, or Methemoglobinemia, a condition in which nitrite binds with hemoglobin, reducing the flow of oxygen to tissues. Suffocation may occur.

Fecal contamination: bacteria and protozoa

Fecal coliform contamination, caused by animal waste runoff, septic systems, and point discharges of water from wastewater treatment plants, frequently impacts water resources adversely. When health advisory levels for fecal coliform concentrations are exceeded, water resources are closed for body contact sports as well as harvesting of filter feeders (mussels, oysters). Most NPSs of fecal contamination are caused by overland flow. Runoff from areas of fecal deposition move into surface waters or sometimes even into drinking water wells if the wells are not constructed properly.