Introduction

Is manure an environmental risk or benefit?

Phosphorus (P), an essential nutrient for crop and animal production, can accelerate freshwater eutrophication, now one of the most common water quality impairments in many developed countries. Recent outbreaks of harmful algal blooms (for example, *cyanobacteria and Pfiesteria*) have increased society's awareness of eutrophication and the need for solutions, the concentration of specialized farming systems has led to a P transfer from grain- to animal-producing areas. This transfer has created regional surpluses in P inputs as fertilizer and feed, built up soil P levels in excess of crop needs, and increased the loss of P from land to water. Recent research has shown that this loss of P in both surface and subsurface flow from watersheds originated from only a small area of a watershed during a few storms. These areas are where high soil P or P application as fertilizer or manure coincide with areas of high runoff or erosion potential. The overall goal of efforts to reduce P loss to water should be to balance P inputs and outputs at farm and watershed levels, while managing soil and P in ways that maintain productivity. Management strategies that minimize P loss to water may involve optimizing P-use efficiency, refining animal feed rations, using feed additives to increase animal absorption of P, moving manure from surplus to deficit areas, and applying conservation practices, such as reduced tillage, buffer strips, and cover crops, to critical areas of P export from a watershed. As issues related to P management are discussed in this lesson, producers are encouraged to evaluate their own P-related risk on current land application sites. This can be done with the aid of the Environmental Stewardship Assessment (P Index, Appendix A) and Regulatory Compliance Assessment (Appendix B)

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Phosphorus and Water Quality Impairment

Since the late 1960s, point sources of water pollution have been reduced due to their ease of identification. In some areas, however, the relative contribution of agricultural nonpoint sources to remaining water quality impairment has increased. Besides soil and pesticide loss from agriculture, most water quality concerns center on nonpoint transport of the nutrients P and nitrogen (N), which are essential inputs for optimum crop and animal production.

Recent assessments of water quality status have identified eutrophication as one of the main causes of water quality "impairment" in the United States (U.S. Environmental Protection Agency 1996, U.S. Geological Survey 1999). Eutrophication is the natural aging of lakes or streams brought on by nutrient enrichment. This process can be greatly accelerated by human activities that increase nutrient loading rates to water (Figure 34-1). While P and N contribute to eutrophication, P is the primary agent in freshwater eutrophication, because many algae are able to obtain N from the atmosphere (Carpenter et al. 1998, Schindler 1977). Thus, controlling eutrophication mainly requires reducing P inputs to surface waters.

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Eutrophication restricts water use for fisheries, recreation, industry, and drinking, due to the increased growth of undesirable algae and aquatic weeds and oxygen shortages caused by their death and decomposition (Table 34-1). Also, many drinking water supplies throughout the world experience periodic massive surface blooms of *cyanobacteria* (Kotak et al. 1993). These blooms