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Unintended Impacts of Fertilizer and Manure Mismanagement on Natural Resources

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Environmental Implications of Fertilizer Mismanagement

When nutrients and other pollutants associated with animal manures and commercial fertilizers are not managed properly, they can affect plant and animal life (including humans) negatively. Some of these impacts include algae blooms causing the depletion of oxygen in surface waters, pathogens and nitrates in drinking water, and the emission of odors and gases into the air.

Oxygen depletion

When manure or commercial fertilizers enter surface water, the nutrients they release stimulate microorganism growth. The growth and reproduction of these microorganisms will reduce the dissolved oxygen content of the water body.

Without sufficient dissolved oxygen in surface water, fish and other aquatic species suffocate. The resulting dead fish degrade the water quality and cause unpleasant odors.

Weed growth and algae blooms

The number of plants and algae in a lake, pond or other water body increase with an increased supply of nutrients, particularly nitrogen (N) and phosphorus (P). Both N and P are present in manure in sufficient quantity to be used as fertilizer for crop growth and will have a similar effect on algae and aquatic plants. As with crops, nutrient availability is the critical factor in the growth of aquatic plants and algae.

The nutrient present in the least amount for growth will limit the production in the aquatic system. Introduction of even small amounts of the limiting nutrient to either crops or aquatic systems can increase production substantially. In the case of agricultural crops, this is a good thing. However, increased production of aquatic plants and algae is not healthy for water resources. For example, 1 extra pound of P in a lake can produce hundreds of pounds of weeds and algae that compete with other aquatics for oxygen. Eutrophication is the term used to describe the natural or human accelerated process whereby a water body becomes abundant in aquatic plants and low in oxygen content.

As these aquatic plants die, microorganisms use the organic matter as a food source. Once again, the microorganisms grow and reproduce and use up the oxygen in the water. Any increase in the amount of aquatic plant growth ultimately will result in a reduced dissolved oxygen content of the water body, eventually suffocating fish.

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In addition to oxygen depletion, there is potential that the algae can be toxic. Blue-green algae (cyanobacteria) can cause rashes, nausea and respiratory problems in humans and has been documented to kill livestock that drink from affected water storages.

Nutrients from manure and fertilizers enter lakes and streams through runoff and soil erosion. Generally, when soil-test N and P increase in the soil, greater amounts of plant-available N and P move with water. Runoff water from fields with high soil-test N and P may contain a high level of these dissolved nutrients, increasing the risk of contaminating streams, wetlands and lakes. In addition, erosion carries fine particles of soil that are enriched with nutrients. Eroded soil particles with attached nutrients will accumulate as sediment in water resources and serve as a source of available nutrients during long periods of time.

■ Ammonia toxicity

Ammonia-contaminated runoff from fresh manure application sites is toxic to aquatic life. At high enough levels, ammonia in surface water will kill fish. Fish are relatively sensitive to ammonia in water. Concentrations as low as 0.02 parts per million (ppm) may be lethal. Surface water that manure impairs also may experience changes in species diversity because of ammonia toxicity.

■ Fecal organisms

The fresh manure from warm-blooded animals has countless microorganisms, including bacteria, viruses, parasites and fungi. Some of the organisms are pathogenic (disease causing), and some of the diseases that animals carry are transmittable to humans, and vice versa.

Many states use fecal coliform bacteria as an indicator of pollution from warm-blooded animals, including man. The test for fecal coliforms is relatively simple and inexpensive, compared with testing for specific pathogens.

Some fecal coliforms can be found in natural water sources, even without the influence of humans or their domestic animals. Birds, beaver, deer and other wild animals contribute fecal coliforms to surface water either directly or in runoff.

Contamination from runoff and natural deposition are not the only ways for water to become impaired. If manure applications are mismanaged near wells, the risk of bacterial contamination of the groundwater via the well is greatly increased. Therefore, avoid surface application of manure where it can come into direct contact with a well or other drinking water supply.

■ Nitrates in drinking water

High levels of nitrates in drinking water are known to cause methemoglobinemia (blue-baby syndrome) in human infants and other warm-blooded animals. In human infants, the nitrate is ingested, usually in water used to mix formula, and nitrate-reducing bacteria in the upper gastrointestinal system convert it to nitrite. The nitrite, in turn, interferes with the uptake and movement of oxygen throughout the body. The pale, bluish color of the infant's skin is the result of oxygen deprivation.

Since nitrates are not adsorbed to soil materials, they may leach to groundwater. In some instances, stored or land-applied manures or nitrogen fertilizers have caused high concentrations of nitrates in drinking water. Since nitrates freely leach down through the soil profile, nitrogen that is not used for crop or plant growth easily can reach the groundwater.

■ Odors and gases

Manure odors can be a nuisance for nearby neighbors and communities. Constant nuisance odors can degrade the "quality of life" for anyone subjected to them. In addition, people have a wide range of susceptibility to health effects from odors.

Gases are emitted from facilities throughout the year, but are released at the highest rates during agitation, pumping and application of liquid manure systems or during cleanout and application of solid manure systems. Volatilization of ammonia to the atmosphere may become a water quality problem near animal production facilities when it is returned to the earth dissolved in rainfall.

■ Summary

If managed properly, fertilizers and animal manures benefit crop production without causing environmental problems. In any management scenario, the manager must be aware of the possible negative consequences of mismanagement.

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For more information on this and other topics, see: www.ag.ndsu.edu

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