

Phosphorus and Water Quality In Kansas

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

A report in 1994 by the Kansas Department of Health and Environment indicated that 24 percent of stream miles and 89 percent of lakes in Kansas were impaired by excessive levels of nutrients.

Phosphorus is the nutrient that is most often responsible for the impairment of surface water. Phosphorus is essential for crop plant growth, and economic yield increases to phosphorus fertilizer occur where there are soil deficiencies. In some cases, however, phosphorus can move into surface waters and cause impairments of normal uses. Phosphorus is primarily a surface water quality problem, rather than a groundwater problem. In most soils, nearly all the phosphorus exists in organic and inorganic compounds of very low solubility. As a result, phosphorus generally does not leach downward far enough to reach groundwater.

Concerns About Phosphorus in Water

Excess phosphorus in water is not considered to be a human health concern, according to the Kansas Department of Health and Environment (KDHE).

Excess phosphorus, however, is a concern for aquatic ecosystems. Under most natural conditions, phosphorus is the limiting factor in the growth of aquatic plants.

When large amounts of phosphorus enter lakes and streams, it enhances the growth of algae and other aquatic weeds, leading to excessive aquatic plant growth, often referred to as algae blooms. This unwanted burden of aquatic plant growth is termed "eutrophication." Water clogged with overabundant aquatic plant growth can

lead to a number of undesirable consequences. The water can become undesirable for recreational activities. In addition, when these aquatic plants die and decompose, they consume oxygen in the water and severe fish kills may occur. Decaying algae and plants may cause undesirable odor and taste in drinking water.

Improving water quality in a lake impaired by excessive phosphorus is difficult and takes considerable time. Therefore, it is best to take preventive steps to limit phosphorus movement into surface waters.

Sources of Phosphorus

Phosphorus comes from both point and nonpoint sources. Point sources include municipal waste treatment plants, industrial operations, and large, confined livestock operations. These sources generally are regulated by federal and state laws requiring them to have environmental controls.

Phosphorus also comes from nonpoint sources. Nonpoint sources of phosphorus include soil erosion and water runoff from cropland, lawns and gardens; private waste treatment systems; urban areas; small livestock confinement operations; and livestock grazing operations. It is believed that much of the excess phosphorus in surface water comes from agriculture, with both crop production and livestock operations contributing.

Phosphorus in the Environment

In the environment, phosphorus exists either in the particulate or dissolved form.

1. Particulate phosphorus includes phosphorus that exists in one of three forms: (a) associated with soil particles; (b) in mineral form as aluminum, iron, or calcium compounds; or (c) incorporated in organic matter. This form of phosphorus can move into surface waters attached to soil and organic matter particles through soil erosion. Particulate phosphorus is largely unavailable to aquatic organisms. But if particulate phosphorus levels are high in surface waters, such as in areas where significant erosion problems occur, this form of phosphorus can play a role in eutrophication.
2. Dissolved phosphorus includes phosphorus compounds dissolved in water. A small amount of dissolved phosphorus exists naturally in all soils. Runoff water also can contain dissolved phosphorus, either from the top layer of the soil or from recently applied fertilizer or manure still on the soil surface. Dissolved phosphorus can be quickly utilized by aquatic organisms and even low levels can cause eutrophication.

In Kansas, about 75 to 90 percent of phosphorus movement into surface water occurs is particulate phosphorus with soil erosion. About 10 to 25 percent is dissolved phosphorus in water runoff. Therefore, generally, preventing soil erosion is very important in limiting phosphorus movement from cropland, rangelands, and pastures.

Factors that affect the level of nonpoint source phosphorus pollution from cropland include soil phosphorus content and the rate and method of phosphorus applied as either fertilizer or manure. Generally, the higher the soil test phosphorus level, the greater the potential phosphorus runoff to surface waters.

Dissolved phosphorus becomes more important where: (a) soil test levels are high, (b) higher fertilization rates are applied, (c) phosphorus fertilizer is not incorporated or is surface applied on frozen soils during a time of year when runoff is likely, or (d) livestock waste is spread on pastures or cropland and not incorporated.

Livestock waste washed from livestock confinement areas, pastures, or other feeding areas also can be a significant source of phosphorus entering surface waters.

Failing septic systems disposing of toilet and wash water from indoor plumbing can contribute phosphorus locally. Failing septic systems can be generally categorized in the following manner: (1) septic systems that discharge directly into a stream or ditch from the tank without any lateral field or lagoon; or (2) septic systems that discharge domestic wastewater to the soil surface due to a failing lateral field or lagoon. In failing systems, human waste and wastewater comes to the soil surface where it can then be transported by water runoff to surface water.

In urban areas, construction sites where soil is disturbed may lead to soil erosion and phosphorus losses to surface water. In addition, phosphorus runoff losses can occur from lawns, gardens, and turfgrass areas through soil erosion or surface water runoff containing dissolved phosphorus. Fertilizer applied to lawns, gardens, and turf can be lost in runoff waters, particularly if fertilizer is spilled on driveways, sidewalks, or roadways.

Eutrophication

Lakes and ponds naturally support a healthy population of aquatic life. But if nutrient levels, especially phosphorus, become too high, the following undesirable changes can occur:

- Increased algae growth
- Reduced water clarity
- Unpleasant odor and taste
- Increased filtration costs
- Reduced oxygen in the water
- Changes in fish populations, or fish kills
- Toxins from bluegreen algae

Controlling Phosphorus Runoff

Point source phosphorus pollutant sources are largely controlled through federal and state regulations and permits.

Nonpoint source phosphorus pollutant sources are generally controlled through the voluntary actions of citizens. Technical assistance and cost share are available from local and state agencies to assist in implementing pollution control practices.

Cropland. In cropland, phosphorus losses can be controlled by implementing a series of best management practices



Particulate phosphorus can move into surface water through soil erosion.

(BMPs). These BMPs for phosphorus fall into two categories:

(1) Phosphorus use practices. Producers can help reduce the potential for phosphorus runoff by applying phosphorus fertilizer only when needed and by using application timing and placement methods that minimize rate and incorporate the phosphorus below the soil surface. Manure also should be incorporated. Producers can use buffer areas, where no phosphorus is applied, around water resources.

(2) Erosion control. Most phosphorus under field conditions is strongly attached to soil particles. In this form, it will not dissolve and move off-site in runoff water, but it can move off-site with soil particles as soil erosion occurs. BMPs that reduce soil erosion play a major role in reducing the potential for phosphorus movement. Vegetative filter strips also can reduce erosion losses.

Livestock Production. With confined livestock operations, facilities need to be located away from surface water drainage ways. Waste collection, storage, and handling operations need to be properly designed. In addition, a nutrient management plan for land application of animal wastes needs to be developed and implemented. Improved grazing management systems may reduce soil erosion in pastures and rangelands. In addition, developing alternative water sources and improving riparian areas along streams also may reduce phosphorus runoff into streams. *Domestic Sources.* Repairing or replacing failing septic systems will substantially reduce phosphorus runoff losses associated with septic systems. Controlling erosion from construction sites also can help reduce phosphorus losses.

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