

Impact of Nutrients on Ground and Surface Water

Nutrients need to be managed properly to meet crop requirements without negatively affecting human or animal health or the quality of water resources. Nutrients of concern with respect to water quality are nitrogen and phosphorous: specifically, nitrate-nitrogen in ground water and phosphorous in surface water. Excess nitrates in drinking water can cause adverse effects in human and animal health. Excess phosphorous in lakes and streams can lead to algal blooms and excessive growth of aquatic plants.

Nitrates in Ground Water

Health Risk

Nitrate is the most common contaminant of groundwater used for human consumption. Once in the stomach, nitrate (NO_3^-) is converted to nitrite (NO_2^-), and this form reduces the capacity of blood to carry oxygen to cells. This can result in “blue baby” disease in infants. Federal and State drinking water standards specify that water used for human consumption should not contain more than 10ppm of nitrate nitrogen (NO_3^- -N).

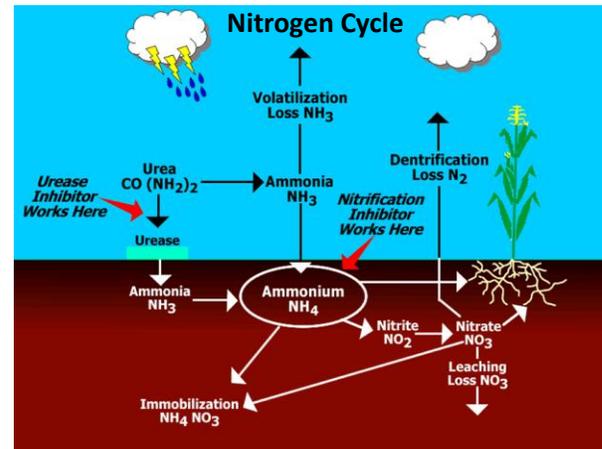
Nitrate Movement

Nitrate is a soluble, negatively charged ion. It is converted from nitrogen applications as manure or fertilizer. It is not attracted and held to soil particles so it moves in the soil with water. Nitrate movement is greatest when nitrogen inputs are higher than plant requirements and in soils where water movement to groundwater is high. These soils are typically sandy type soils or those soils where the distance to groundwater is shallow.

Since nitrogen exists in many different forms in the environment, the nitrogen cycle is complex. It's availability to plants is affected by several physical, chemical, and biological processes. When excess nitrogen is present in the soil, the potential risk to lose nitrogen in the form of nitrate is increased. When nitrogen is lost through the soil profile to groundwater, this process is called leaching.

Farmers have no control with how much nitrate they receive from rainfall or organic matter but they can

manage their inputs from fertilizer, legumes, and manure to prevent groundwater contamination.



Nitrogen application

A portion of the nitrogen applied but not used by the crop has the potential to contribute nitrate to groundwater through leaching. It is important, because of this leaching potential, farmers use nitrogen credits and apply nitrogen to meet the crop's needs and avoid applying extra nitrogen.

Manure application

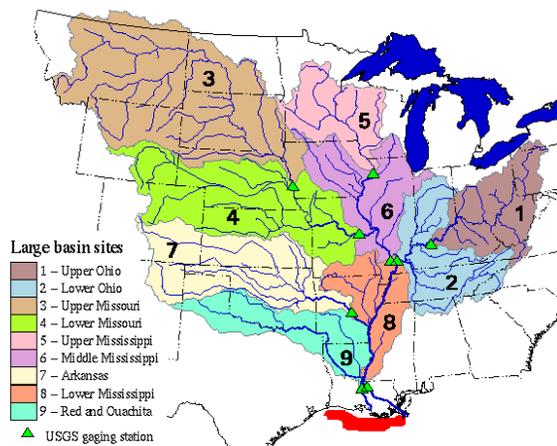
Manure contains substantial amounts of nitrogen but much of it is in the organic form and is not all available the first year of application. The amount of nitrogen available from manure depends on the type of manure, application rate and method, and consecutive years of application. Depending on crop need, eliminate or reduce fertilizer nitrogen application if using manure.

Manure application becomes an environmental concern during winter when the ground is frozen. During this period, soluble ammonium and nitrate nitrogen may be lost in substantial quantities in the runoff water. Winter runoff can also carry organic nitrogen from manure solids. The best way to prevent winter nitrogen loss is by avoiding winter application of manure on frozen soil, especially on sloping land.

When soils are frozen, do not apply manure to fields greater than 12% slope. If applying to frozen fields with 6%-12% slope, then conservation practices such as contour strips must be employed.

Hypoxia

A nitrogen threat to water quality has recently developed. This deals with nitrogen losses in surface water runoff and the impact of that nitrogen on salt water estuaries - specifically the Gulf of Mexico. It is suspected that nitrogen from the upper Midwest is being carried via the Mississippi River watershed to the Gulf of Mexico where it is causing the formation of a "dead" or hypoxic zone that is deplete of oxygen. This hypoxia zone is seasonal and has been up to 7,000 square miles in size. The result has been devastation of the commercial fishery industry in the gulf.



Phosphorous in Surface Water

Environmental Risk

Phosphorous is not a problem in groundwater because elevated concentrations do not pose a health threat and the concentration in water that moves through soil solution is very low. Phosphorous is a problem in runoff because it encourages the growth of algae and nuisance weeds in surface waters, especially lakes where water movement is minimal. Excess nutrients in surface water cause abnormally high production of algae and aquatic plants which reduces oxygen in the water killing fish and other desired aquatic organisms.

Rate of Application

Applying more phosphorous than crops need is unwise economically and environmentally. Soil tests can determine current soil phosphorous levels and how much is needed for the crop to be grown. The combination of soil tests and realistic yield goals are critical to ensuring proper phosphorous fertilization

and optimum yields while protecting the environment.

Phosphorous Credits in Manure

Phosphorous applied as manure should be credited against the fertilizer recommendation. If manure is applied on the basis of its nitrogen content and the needs of the crop, generally more phosphorous will be applied than what the crop can use. Once soil phosphorous exceeds the optimum, apply just enough manure to replace the phosphorous removed by the crop. To credit phosphorous accurately, the manure should be tested. Once tested, assume 55% of the phosphorous will be available the first year.

Manure Management

The best manure management practice to reduce risk of phosphorous moving to surface water is to avoid applications to frozen land. Losses of phosphorous in runoff depend on the amount and timing of winter precipitation, depth of snow, and the spring freeze-thaw pattern. Most phosphorous is lost in the eroded soil particles to it is adsorbed; very little is lost in runoff water. The exception would be when a winter rain or rapid spring thaw takes place while the soil remains frozen. If manure is applied to unfrozen soil or incorporated, there is practically no loss of phosphorous in the runoff water.

Erosion Control

Most of the phosphorous found in surface water is associated with organic matter and soil particles eroding from the land. Therefore, the best control option is erosion control. Adopting practices which reduce the risk of soil or organic matter particles from reaching surface waters is best. These practices include:

- Using soil-erosion control practices such as buffer strips to minimize soil loss and runoff
- Avoid applying manure to sloping, frozen soils
- Apply recommended rates to crop based on soil test
- Credit phosphorous contributions from manure and other organic wastes
- Incorporate or inject manure
- Control runoff from barnyards and feedlots
- Store manure in properly located and constructed facilities