Nitrogen is usually the most limiting nutrient in crop production systems and is added to the soil environment in the greatest amount of any of the plant nutrients. Increases in nitrogen content of the soil and plant uptake generally lead to higher nitrogen and protein content of the plant as well as yield. Nitrogen in the soil system can present an environmental risk to the atmosphere, ground water, and surface water. Significant amounts of surface applied ammonium (NH4+) can be lost to the atmosphere as ammonia gas (NH3) through volatilization. These additions of nitrogen to the atmosphere can contribute to the greenhouse effect and acid rain. Excess movement of nitrogen, primarily from runoff and erosion or leaching, into ground water and surface water can lead to degradation of water quality. Conservation buffer practices may help reduce runoff or leaching losses by filtering out nutrient-rich sediments, enhancing infiltration (which can reduce soluble losses from runoff), and taking up nitrogen and other nutrients before they reach water bodies.

Phosphorus is also an essential nutrient for plant growth and occurs in the soil as inorganic orthophosphate and organic compounds. Although the total amount of phosphorus in the soil is large, the quantity of plant available phosphorus in the soil solution is very small, ranging from 0.25 to 3.00 pounds per acre. Phosphorus applied to the land surface either as manure or commercial fertilizer is primarily lost through the process of surface runoff and erosion. Approximately 80 to 90 percent of the phosphorus load is carried in the sediment. The remaining 10 to 20 percent is carried in runoff. Generally, phosphorus lost in runoff amounts to less than 5 percent of that applied to agricultural land. From a crop production standpoint, this amount is considered to be insignificant. From a water quality standpoint, this small amount can lead to significant reduction in surface water quality.

Potassium (K+) is utilized in relatively large quantities by plants. The nutrient plays an important role in plant hardiness and disease tolerance. If a soil is high in potassium, forage crops will take up potassium at the expense of magnesium, causing an imbalance in the plant. Cattle grazing this forage will not get enough magnesium, which can lead to the ailment grass tetany. Potassium is also showing up as an imbalance in cattle rations when forages grown on high soil K fields are fed to dairy cattle. Again the imbalance of K to other nutrients, namely calcium and magnesium, is the problem. There are no known deleterious effects of K in fresh or saline waters except to increase the salt content and electric conductivity.

Figure 21

Excess Nutrients and Impact on the Environment

Nutrients are essential for life, but excessive levels can become a burden on the environment and often create an imbalance in the ecosystem (Figure 21). These impacts can vary depending on properties of the nutrient, the concentration, and the characteristics of the nutrient cycle.