Whole Farm Nutrient Balance

Nutrients are transported along multiple pathways and in a variety of forms on a livestock operation. Our tendency is to focus on a small part of the total picture, such as the nutrients in manure and their losses into the environment. However, an understanding of the big picture is necessary to identifying the underlying cause of nutrient concentration concerns as well as the solutions.

A picture of the flow of nutrients is presented in Figure 2-3. Nutrients arrive on a livestock operation as purchased products (fertilizer, animal feed, and purchased animals), nitrogen (N) fixed by legume crops, and nitrates in rain and irrigation water. These "Inputs" are the origin of all nutrients required for crop and livestock production as well as those nutrients that escape into the environment.

Within the boundaries of the farm, there is a "Recycling" of nutrients between the livestock and crop components. Manure nutrients are recycled, at least in part, for crop production. Feed crop nutrients are in turn recycled as animal feed for livestock or poultry production.

Nutrients exit a livestock operation preferably as "Managed Outputs" including animals and crops sold and possibly other products moved off farm (e.g., manure sold or given to a neighboring crop producer). Some nutrients exit the farm as losses to the environment (nitrates in groundwater, ammonia volatilized into the atmosphere, and N and phosphorus into surface water). Nutrients (especially phosphorus) also accumulate in large quantities in the soil. Although not a direct loss to the environment, a growing accumulation of nutrients in the soil adds to the risk of future environmental losses.

The "Imbalance" is the difference between the Inputs and the Managed Outputs. This Imbalance accounts for both the direct environmental loss and the accumulation of nutrients in the soil. Livestock operations with a significant imbalance are concentrating nutrients, resulting in increased risk to water quality (Lanyon and Beegle 1993 and Klausner 1995). In contrast, livestock operations that have achieved a balance represent a potentially sustainable production system.

The balance between nutrient inputs and managed outputs defines the quantity of nutrients lost to the environment or added to soil storage.

An analogy can be drawn between the whole farm nutrient balance for a

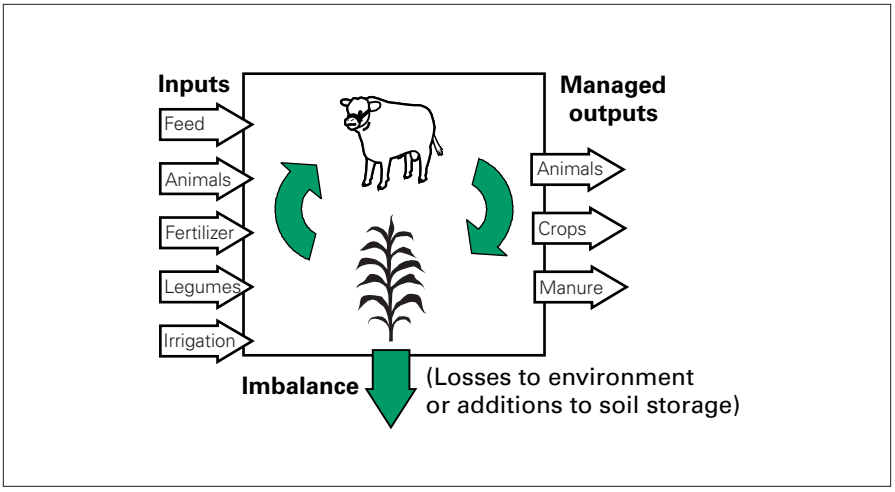
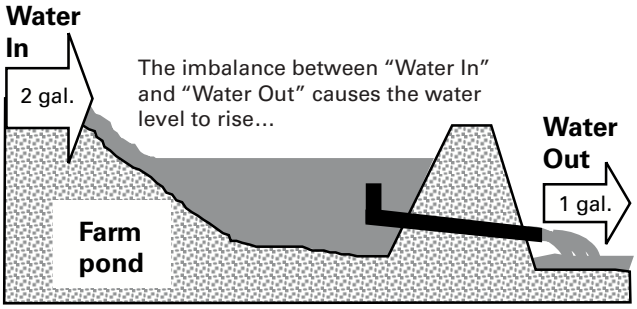
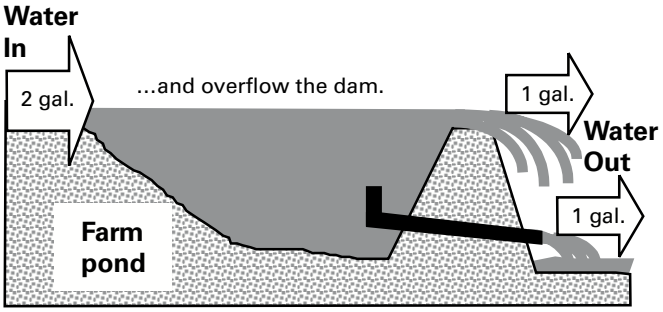


Figure 2-3. A whole farm nutrient balance considers all nutrient inputs and managed outputs. The difference or imbalance drives a farm's nutrient-related water quality risks.

livestock operation and water flow in a farm pond. The farm pond is the equivalent of a livestock and cropping operation (whole farm). The "Water In" and "Water Out" (of the pipe) are, respectively, comparable to nutrient Inputs and Managed Outputs. If the flow of water into the pond exceeds the outflow, the pond level rises. Similarly, if the nutrients entering a livestock operation exceed the nutrients leaving as managed products, the nutrients concentrate within the farm (e.g., rising soil P levels).

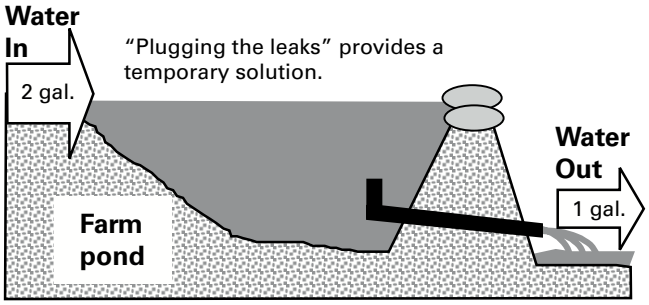


If that imbalance is sustained, water eventually flows over the top of the dam with potentially catastrophic results. Similarly with nutrients, the imbalance is eventually corrected by losses to the environment (e.g., nitrates leaching to groundwater or P exiting with runoff and erosion) of similar magnitude as the imbalance. A sustained nutrient imbalance drives the nutrient-related contamination of water.

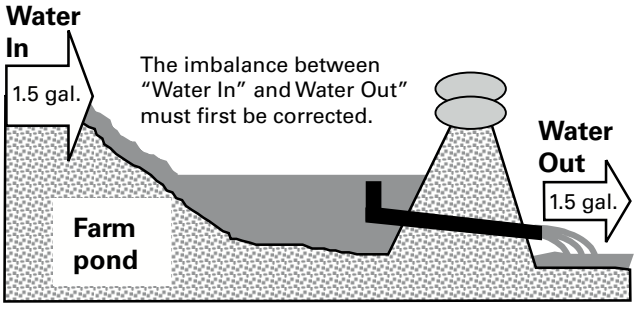


Sandbags provide a temporary solution to this problem. If the water imbalance is not corrected, however, the water level eventually exceeds what the sandbags can hold back. Many current best management practices (BMPs) for manure handling focus on plugging leaks without correcting the origin of the imbalance. BMPs such as grass filter strips, no applications on frozen soil, or soil erosion control do not correct the imbalance and provide only short-term benefits.

A sustained... whole farm nutrient imbalance...has undesirable environmental consequences.



The imbalance of water flows must first be corrected to save the dam and the property downstream. To achieve a relative balance, the quantity of water entering the pond needs to be reduced and/or the water exiting the outlet pipe must be increased. Similarly, any nutrient management planning process must first achieve a whole farm nutrient balance. The nutrients arriving on farm must roughly balance those exiting the farm in managed products. After a balance is achieved, then BMPs designed to plug the leaks will provide additional long-term benefits.



For the purpose of this discussion, nutrient imbalance will be expressed as a ratio of inputs to managed outputs. A ratio of 3:1 suggests that for every three pounds of nutrient entering a farm, one pound leaves as a managed product and the remaining two pounds are lost to the environment or added to soil storage reserves.