

Nutrient Cycles and Flows

We used the term *cycle* earlier when discussing the flow of nutrients from soil to plant to animal to soil, as well as global carbon and nitrogen cycles ([chapter 2](#)). Some farmers minimize their use of nutrient supplements and try to rely more on natural soil nutrient cycles—as contrasted with purchased commercial fertilizers—to provide fertility to plants. But is it really possible to depend forever on the natural cycling of all the nutrients to meet a crop's needs? Let's first consider what a nutrient cycle is and how it differs from the other ways that nutrients move from one place to another.

When nutrients move from one place to another, that is a *flow*. There are many different types of nutrient flows that can occur. When you buy fertilizers or animal feeds, nutrients are “flowing” onto the farm. When you sell sweet corn, apples, alfalfa hay, meat, or milk, nutrients are “flowing” off the farm. Flows that involve products entering or leaving the farm gate are managed intentionally, whether or not you are thinking about nutrients. Other flows are unplanned—for example, when nitrate is lost from the soil by leaching to groundwater or when runoff waters take nutrients along with eroded topsoil to a nearby stream.

Increasingly . . . emphasis is being laid on the direction of natural forces, on the conservation of inherent richness, on the acquirement of plant food supplies from the air and subsoil.

—J.L. HILLS, C.H. JONES, AND C. CUTLER, 1908

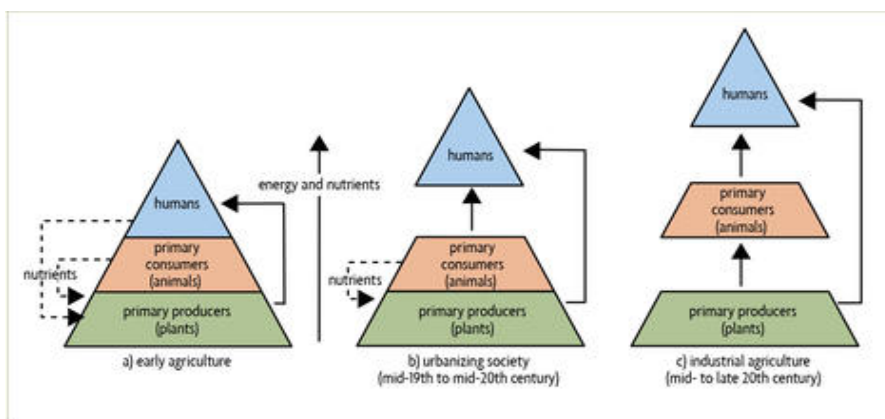


Figure 7.1. The patterns of nutrient flows change over time. From Magdoff, Lanyon, and Liebhardt (1997).

When crops are harvested and brought to the barn to feed animals, that is a nutrient flow, as is the return of animal manure to the land. Together these two flows are a true cycle, because nutrients return to the fields from which they came. In forests and natural grassland, the cycling of nutrients is very efficient. In the early stages of agriculture, when almost all people lived near their fields, nutrient cycling was also efficient (figure 7.1a). However, in many types of agriculture, especially modern, “industrial-style” farming, there is little real cycling of nutrients, because there is no easy way to return nutrients shipped off the farm. In addition, nutrients in crop residues don't cycle very efficiently when the soil is without living plants for long periods, and nutrient runoff and leaching losses are much larger than from natural systems.

The first major break in the cycling of nutrients occurred as cities developed and nutrients began to routinely travel with farm products to feed the growing urban populations. It is rare for nutrients to travel many miles away from cities and return to the soils on which the crops and animals were originally raised (figure 7.1b, c). Thus, nutrients have accumulated in urban sewage and polluted waterways around the world. Even with the building of many new sewage treatment plants in the 1970s and 1980s, effluent containing nutrients still flows into waterways, and sewage sludges are not always handled in an environmentally sound manner.

The trend toward farm specialization, mostly driven by economic forces, has resulted in the second break in nutrient cycling by separating animals from the land that grows their feed. With specialized animal facilities (figure 7.1c), nutrients accumulate in manure while crop farmers purchase large quantities of fertilizers to keep their fields from becoming nutrient deficient.

