

## 12.14: Livestock and their Wastes

Areas where agriculture is practiced intensively with heavily fertilized crops and large populations of livestock can cause serious water pollution problems. This is true of the watershed of Chesapeake Bay, the largest U.S. estuary with a watershed that includes areas of New York, Pennsylvania, Delaware, Maryland, Virginia, and West Virginia. One of the agricultural areas that discharges runoff to the bay is Lancaster County, Pennsylvania, that is the location of more than 5000 farms with some of the most productive soil in the world. More than half of these farms are owned by Amish, a religious sect that does not use electricity, automobiles, and other modern conveniences. These farms are livestock-intensive with heavy production of dairy products. Unlike most modern farms that use tractors and other farm equipment powered by diesel and gasoline engines, the Amish rely upon horses and mules for cultivation. The result of these factors is that each year Lancaster County produces about 9 million kilograms of manure plus large quantities urine, more than any of the other counties in the region. Both of these materials are rich in nitrogen, phosphorus, and potassium that have resulted in drainage into Chesapeake Bay contributing to heavy growths of algae leading to eutrophication. As a result of algal nutrient pollution Chesapeake Bay has had a dead zone that has been the subject of remediation efforts since the 1970s. In addition to runoff pollution, problems have been reported of pollution of farm wells in the county contaminated with *Escherichia coli* bacteria, which are indicators of animal feces pollution and some wells have shown elevated levels of nitrate ion that can come from the biodegradation of nitrogenous biomaterials. (Nitrate is generally harmless to adult humans but in human infants and ruminant animals including cattle can cause methemoglobinemia, a condition in which the iron(II) in blood hemoglobin is oxidized to iron(III) producing methemoglobin, which does not transport blood in the bloodstream.)

Attempts are underway to reduce the water pollution from livestock in Lancaster and other livestock-intensive counties by measures including minimal tillage agriculture, cover crops, reduction and containment of barnyard runoff, forested buffers along streams, and manure pits to collect wastes from concentrated livestock feeding operations. Farms such as those in Lancaster County actually provide a great opportunity to practice sustainable, green agriculture. Horses and mules used for cultivation require no petroleum, the animal wastes provide abundant fertilizer, and anoxic biodegradation of animal wastes can generate large quantities of methane gas, a fuel for engines and household heating that is probably acceptable to religious sects who reject modern, especially electrically-powered, devices. A farm operated with such sustainable practices could serve as a largely self-sufficient industrial ecosystem (an alternative term that does not include “industrial” would probably be more acceptable to the operators).

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