CHESAPEAKE BAY FOUNDATION
Saving a National Treasure

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Animal Manure: A Concern for Pennsylvania Waters and the Chesapeake Bay

Pennsylvania's leadership in livestock and poultry production helps to feed an ever-growing population. However, a by-product of the livestock industry is manure, which can be both a waste product and a resource, depending on how it is utilized. Most manure is spread on farm fields to fertilize crops and to help the farmer dispose of this by-product. Once manure is applied to the land, any nutrients not taken up by crops may volatilize into the air, leach into ground water, or run off the surface of farm fields when it rains. If not properly managed, these nutrients lose the ability to act as a fertilizer for crops and, as a result, become pollutants.[1]

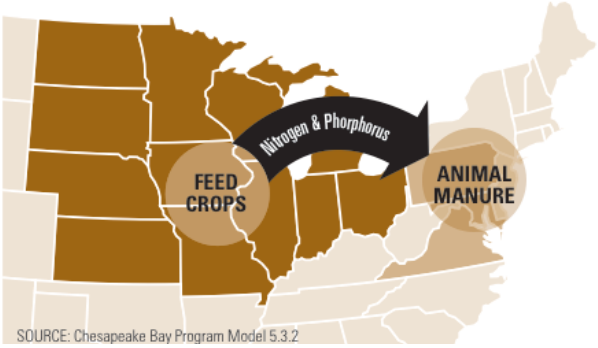
The leading source of nitrogen, phosphorus, and sediment pollution to the Chesapeake Bay from Pennsylvania is agricultural activities. Agricultural pollution, primarily sediment, impairs 5,802 miles of Pennsylvania's streams.[2] According to the U.S. Environmental Protection Agency (EPA), manure contributes to the nitrogen and phosphorus pollution entering Pennsylvania streams that flow to the Chesapeake Bay. No sediment pollution is from manure. While reducing the effects of manure pollution will help restore many of Pennsylvania's waters to a healthier condition and make significant progress toward cleaning the Chesapeake Bay, **reducing manure pollution is only a part of solving local or regional water quality issues.**

Manure pollution is not only about excess nutrients, however. Depending on the type of animal, its management, and other factors, manure also contains varying amounts of other pollutants, such as antibiotics, hormones, heavy metals, bacteria, and viruses. Manure over-application, application too close to streams or water wellheads, application when the ground is frozen, or spills due to inadequate management, can lead to fish kills, contaminated well water, and other negative impacts. While pollution impacts from manure are most often seen in Pennsylvania waters where animal agriculture dominates, the overall nutrient pollution from Pennsylvania to the Chesapeake Bay is important to consider.

We need widespread adoption of management practices to address the myriad of impacts on our atmosphere, ground water, local streams and rivers, and ultimately the Chesapeake Bay. Manure management challenges intensify as cropland available for manure application is lost to urban and suburban development, so land use must also be a component of our long-term strategy.

Pennsylvania Manure Production and Nutrients

Pennsylvania's approximately 191,800,000 poultry, 1,100,000 hogs, 1,600,000 cattle, 119,900 horses,[3] and other livestock are vital to the agricultural economy of the Commonwealth, but produce large volumes of manure.



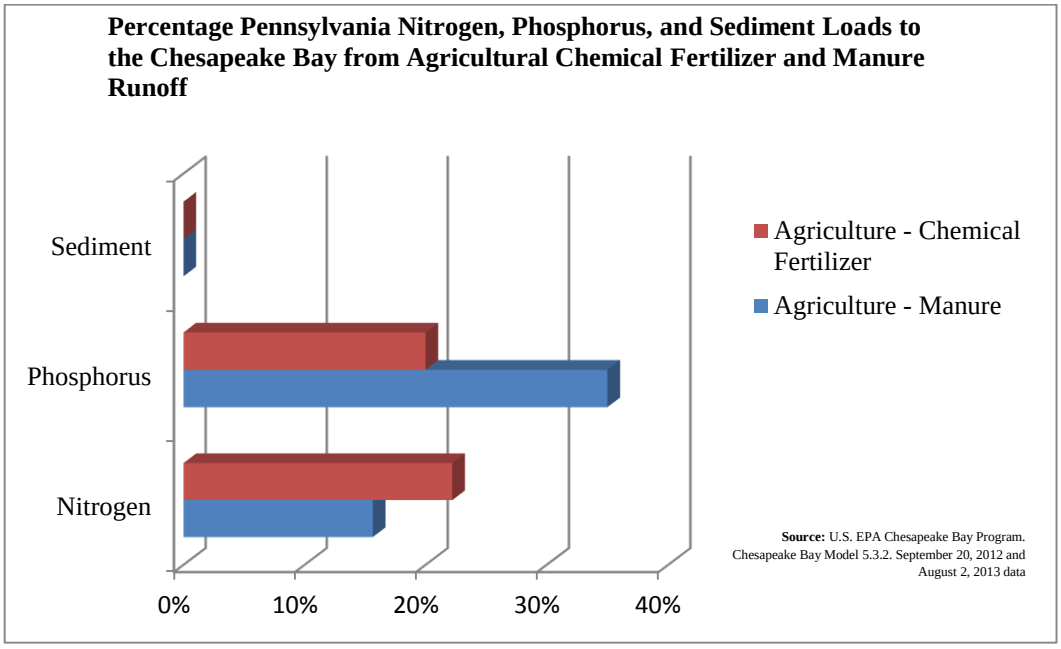
Manure concentrations do not occur where crops are using the nutrients. (Graphic by Chesapeake Bay Commission).

Our agricultural economy has evolved with regional concentrations of livestock and crop production that are not in balance. Pennsylvania's livestock production depends on large grain shipments imported from the Midwest and other areas, because inadequate crops are produced here to meet their needs. After the feeds are consumed, the nutrients remain in the heavy, bulky manure, leaving Pennsylvania with a concentration of excess nutrients.[5, 6] The volume of manure produced by Pennsylvania's farm animals makes the proper storage and handling a challenge. The nutrients that are valuable for crop production become a liability when concentrated in areas far from the crop fields.

How Pennsylvania's Manure Can Pollute Rivers, Streams, and the Chesapeake Bay

Runoff and leaching into groundwater from agricultural activities in Pennsylvania contributes approximately 55 percent of the nitrogen pollution, 59 percent of the phosphorus pollution, and 64 percent of the sediment pollution to the Chesapeake Bay.[7] As the graph below illustrates, **of the total pollution loads from all sources, EPA calculates that roughly 16 percent of the nitrogen pollution and 35 percent of the phosphorus pollution from Pennsylvania are from manure runoff.**[8] Pollution from manure is not a source of sediment pollution at all; yet, siltation from sediment pollution is the leading cause of stream degradation in the Commonwealth, impairing over 8,900 miles of streams.[2]

Manure is not the leading source of nitrogen pollution from runoff; rather, chemical fertilizers running off agricultural lands are the leading source of nitrogen pollution entering into the Bay from Pennsylvania. **Manure runoff is the leading source of phosphorus pollution from agricultural operations**. The ratio of phosphorus to nitrogen in manure is generally higher than what many crops need, so manure applied to meet the crops' nitrogen requirements leads to over-application of phosphorus. When manure is applied according to the crops' phosphorus needs, additional commercial nitrogen fertilizer is usually necessary for optimum production.[1]



Nitrogen Pollution

Some of the applied nitrogen from manure and fertilizer can move through soil and into groundwater. In fact, an average of 48 percent of the nitrogen load entering the Bay from streams has been discharged from groundwater.[9] Because groundwater discharges to surface waters are often slow, this nitrogen can be decades old before it reaches a river or stream. According to the U.S. Geological Survey, numerous studies in the Chesapeake Bay watershed, including in Pennsylvania, have shown that agricultural land use has the greatest impact on nitrogen concentration in groundwater.[10]

Manure and fertilizer can lose nitrogen into the air in the form of ammonia. This atmospheric nitrogen, along with that from motor vehicles and equipment, typically falls relatively close to the sources of emission, whereas sources such as coal-fired electric plants create emissions that can travel thousands of miles.[11] In fact, roughly half of the atmospheric loads of nitrogen originate outside of the Bay watershed.[12] The emissions from livestock vary from animal to animal, and day to day, therefore, making it very difficult to estimate. This volatilization begins immediately after excretion. Further losses occur as manure is handled, stored, or applied as fertilizer.[13, 14] Differences in management, livestock digestive systems, diets, manure collection and storage systems, facility design, location, weather, and other factors greatly influence volatilization rates.[15]

However, ammonia volatilization, mostly from livestock waste, has risen in the overall Bay watershed, according to Chesapeake Bay Program estimates. The emissions from manure and their subsequent atmospheric deposition are in addition to the 16 percent of Pennsylvania's nitrogen load from manure that travels via runoff.

Phosphorus Challenges

Phosphorus that is unused by crops accumulates in the soil. Some becomes bound to sediment and lost during erosion, while some remains soluble and can be lost in runoff, especially when soil is saturated with phosphorus.[1] While areas of Pennsylvania with high concentrations of livestock production have high phosphorus saturation and pollution of nearby waters, Great Plains soils frequently require additional phosphorus,[16] often derived from phosphate rock, a non-renewable resource that is mined with significant environmental damages.[17]

Methodologies to capture excess phosphorus and cost-effectively relocate it to areas requiring it for crop production are essential, both to reduce impacts of excess phosphorus pollution here, and to also meet the increasing demands of global crop production. Some of these have been employed on a local scale to target manure application to where nutrients are needed, but they haven't been broadly employed to correct the phosphorus imbalances on a national or global scale.[18, 19, 20, 21, 22]

Managing Manure—A Better Way

Because manure is a rich source of nutrients, it is a valuable resource for farmers growing crops. In Pennsylvania, entire agricultural economies have established themselves around collecting, hauling, and distributing manure from areas that have too much to those that have too little. **Faced with a lack of manure, farmers could turn to chemical fertilizers, which tend to be more expensive, comparatively.**

Pennsylvania has a robust framework for assuring the proper collection, storage, and application of manure onto agricultural lands. There are approximately 825 Concentrated Animal Operations (CAOs) in Pennsylvania, defined as livestock and poultry operations with more than 2,000 pounds of live animal weight per acre of land available to apply manure. All CAOs must have an approved, implemented Nutrient Management Plan, satisfying the requirements of Act 38 of 2005. The Nutrient Management Plan must be prepared by a certified planner, and be approved by the County Conservation District or State Conservation Commission.[23]

The federal Clean Water Act requires Pennsylvania's about 370 Concentrated Animal Feeding Operations (CAFOs) with large livestock numbers to obtain a National Pollutant Discharge Elimination System permit from the Pennsylvania Department of Environmental Protection (DEP) and meet stringent requirements for permitting and inspections.[24] The permit requirements include documentation that Nutrient Management Plans are implemented and that manure storage facilities are maintained to prevent manure contamination of waters.[25]


Photo courtesy of USDA NRCS

Since 1977, Pennsylvania has required all farms that produce or use manure to prevent manure runoff to streams and other water bodies from land application, spillage, storage overflow or leakage, and barnyard runoff. Such farms (i.e. all other livestock or poultry farms besides CAFOs and CAOs) must develop a Manure Management Plan and keep it on site to guide and record management.[26] Fully implemented, a **Manure or Nutrient Management Plan improves crop utilization of manure nutrients and reduces the risk of water pollution.**

DEP published clarified and streamlined guidelines for manure management in 2011.[27] DEP is collaborating with Conservation Districts, The Pennsylvania State University, and others to ensure that all of the approximately 18,000

farmers with livestock in the Chesapeake Bay watershed are familiar with the requirements and are developing the necessary plans.

These **Manure Management Plans** must address manure application rates and timing, setbacks from streams and other water bodies, management of animal concentration areas (such as barnyards), pasture management, manure storage, and all other aspects of manure management. Areas with manure and sediment draining into local streams are not in compliance with the Manure Management requirements.[17]

Limited technical and financial resources are available to help farms in meeting these requirements, but the available assistance falls short of the needs of the diverse farms across Pennsylvania. The USDA Natural Resources Conservation Service offers resources for a variety of conservation practices, but demand far exceeds available funds, typically by a ratio of about three to one. Resource Enhancement and Protection (REAP) tax credits fund conservation practices, but the allocation is depleted by the end of each fiscal year.[28] DEP's Regional Watershed Assessment Program Initiative is assessing all approximately 140 farms in small watersheds and seeking voluntary compliance with regulations, with Environmental Stewardship Fund support.[29]

A Diversified Approach is Necessary

In order to properly manage manure and reduce its impact as a source of water pollution, a diversified effort of on-farm and off-farm pollution reduction practices will be the most effective and the most beneficial to the majority of our farmers. Pennsylvania's regulatory framework and Chesapeake Bay Clean Water Blueprint are firmly based on these accepted approaches. In fact, the Pennsylvania Department of Environmental Protection (DEP) stated in the Phase I WIP: "the expectation is that all 40,000 of the estimated farms in the watershed could be in baseline compliance in 7 years." [31]

Manure treatment technologies can and should play a role in treating the portion of the nutrient load associated with manure, but they currently do not count toward load reductions in the Bay model. Efforts are underway within the Chesapeake Bay Program to add technologies to the roughly 150 practices currently accepted. As noted above, chemical fertilizers are already the leading source of agriculturally-related nitrogen loads in Pennsylvania. **Since these technologies primarily deal with nitrogen, to some degree phosphorus, and not at all with the leading cause of stream pollution in the Commonwealth—sediment[2]—they cannot be considered the major solution to local water quality issues and the Bay.**

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