Nutrient Management Planning:
Virginia and the Chesapeake Bay Watershed

What is nutrient management planning?

Nutrient management planning is the practice of deliberately balancing the levels and management of key nutrients – usually of Nitrogen and Phosphorus – required for desired crop yield with the capacity of various soils to prevent additional nutrients from migrating offsite and adversely effecting the environment. Nutrient management plans are physical documents that are site-specific – that is, limited in scope to a clearly defined plot of land.

Nutrient management plans seek to optimize nutrient rates, timing of application and placement to efficiently produce crops and reduce negative impacts on water quality. Generally speaking, a nutrient management plan consists first of data that farmers have gathered regarding either the nutrient content of their soil as well as crop uptake levels, or the amount of nutrients their crops are expected to remove from the land. The ideal balance of these measures is known as an agronomic rate (see inset). The second essential part of a functional nutrient management plan is action. A farmer is able to optimize crop yields without undue impact on water quality if there is a plan for how much Nitrogen and Phosphorus can be spread on land without over-saturating it. When a plot of land becomes over-saturated with a given nutrient, that nutrient is more prone to leach out of the soil and pollute run-off to surface waters or migration to groundwater. Nutrient loss from animal waste also contributes to nonpoint source Nitrogen and Phosphorus pollution (see inset). Lastly, documentation is vital to an acceptable nutrient management plan. A farmer should work with nutrient management planners to determine the maximum amount of a given nutrient his farm can efficiently utilize without overwhelming the nutrient-carrying capacity of the soil.

What is an agronomic rate?

An agronomic rate is simply the rate of nutrient application a given crop can be expected to absorb from the fertilized soil in which it is planted.

Excess Nitrogen and Phosphorus are of primary concern to farmers and regulators. Virginia's Department of Conservation and Recreation (DCR) is responsible for regulating the state's Nutrient Management Program. Nutrient management planners oversee nutrient application for both agriculture (primarily rural) and turf and landscape (primarily urban). Currently, about 51% of agricultural lands are under nutrient management plans.[1] Under the proposed Chesapeake Bay Total Maximum Daily Load, 95% of cropland could be required to achieve implementation of nutrient management plans by 2025.[2]

What is nonpoint source pollution?

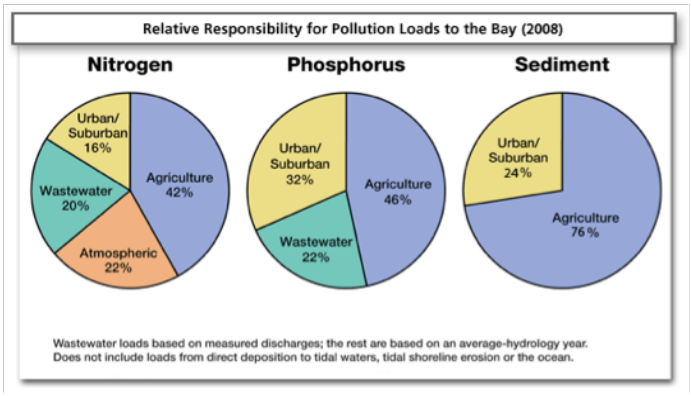
Unlike the more easily traceable point source pollution that comes from industrial hubs such as manufacturing plants and sewage treatment facilities, nonpoint source pollution originates in virtually countless homes, businesses and agricultural operations. It compounds as runoff that can enter bodies of water critical to fisheries, irrigation systems and drinking water systems. Although the impact of this kind of pollution on individual ecosystems is hard to quantify, its effect on drinking water and wildlife is demonstrably negative.

What are the origins of Phosphorus and Nitrogen?

These nutrients originate partially from modern fertilizers, which span a wide range of commercial, synthetic, and manure-based options. Crop needs and economics each play a major role in helping a farmer determine which type of fertilizer to purchase. Also, livestock manure and poultry litter in particular are widely used to fertilize crops across Virginia because they are inexpensive, abundant, and rich in both Nitrogen and Phosphorus.

Other sources of these nutrients can also be traced to various human activities, including industrial and household waste and natural sources, like wildlife and algae blooms. Nitrogen and Phosphorus pollution can also originate in the atmosphere.

Agriculture, wastewater treatment plants, and development account for the majority of Nitrogen and Phosphorus pollution. Agriculture alone results in 42% of the Nitrogen and 46% of the Phosphorus that enters the Chesapeake Bay, as of 2008.[3]



Source: Chesapeake Bay Program[3]

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Has nutrient management planning helped?

Since 1985, nitrogen and phosphorus loadings have been reduced by 24% and 37% respectively despite an increase in population of approximately 2 million people in Virginia.[4]

How does nutrient management planning affect farmland?

Historically, nutrient management plans in the Chesapeake Bay watershed have been based on acceptable levels of Nitrogen that can be applied to fertilize various types of soils. But because Phosphorus levels have consequently risen unchecked, some soils across the region have begun to approach unsafe levels. Since 2001 the DCR has required all plans to be Nitrogen and Phosphorus-based. The amount of Nitrogen and Phosphorus allowed to be applied to a given plot of land varies drastically across the state depending on the types of crops being cultivated, the types of soil in which they are planted and the base levels of Nitrogen and Phosphorus already in that soil.

According to the DCR, Phosphorus-based plans frequently require more acreage than Nitrogen-based plans – sometimes up to three times as much land. This is because Phosphorus can tend to build up in farmed soils even more quickly than Nitrogen. If a plot of land is found to have reached a high level of Phosphorus, the farmers responsible for it may be encouraged to applying only as much Phosphorus to their land as their crops can remove, or occasionally none at all in the case of extremely high levels accumulated from years of over-application.

Case study

In the Journal of Soil and Water Conservation, L.S. VanDyke, J.W. Pease, D.J. Bosch and J.C. Baker detail four cases in which nutrient management plans were implemented on Virginia livestock farms: Southwest Dairy, Shenandoah Valley Dairy, Southwest Swine and Piedmont Poultry. In all four cases, Nitrogen and Phosphorus losses were reduced significantly, while net profits for each farm increased. According to the study, "average annual nitrogen losses decreased by 23 to 45%, phosphorus losses decreased on three farms by 23 to 66%, and net farm income increased by $395 to $4,593." Despite these findings, in 1999, the study determined that nutrient management planning alone would not be enough to reach a regional goal of reducing Nitrogen pollution into the Chesapeake Bay by 40%. At the time the study was published, less than 10% of farms in the Virginia portion of the Chesapeake Bay watershed had nutrient management plans."[5]

What strategies can farmers use to address excess nutrients?

Since crops, litter, and manure can contain so much Nitrogen and Phosphorus, there are some alternative ways farmers can deter runoff pollution. The DCR recommends implementing 35' grass or forest buffers between cropland and surface waters and discourage livestock grazing near streams over time.[2] These buffers can serve as effective filters for runoff containing Nitrogen and Phosphorus, essentially increasing a farm's overall agronomic rate by reinforcing its capacity to absorb. Cover crops and the implementation of conservation tillage, which involves allowing about a third of a farm's surface area to be covered by vegetation year-round, have a similar effect.

Farmers with excess litter or manure often sell or give their surpluses to other farmers though, under current law, farmers purchasing these natural fertilizers are not yet required to use nutrient management plans. It may be possible to compost the litter, pelletize it, and use it to generate energy, incinerate it, or even gasify it. A farmer also may install storage systems for animal waste to prevent losses of manure to streams during storm events and to store it until the nutrients are needed for crop application. Surplus manure can be stored while a farmer is waiting to use or sell it by simply putting it under cover. Incentives and cost-share programs exist in order to reduce the financial burden on the farmer (see inset). Also, the farmer may employ feed management techniques that reduce the amount of nutrients that enter the farm.

Tax Credit Program

Virginia has an innovative tax credit program for the purchase of more precise farm nutrient and pesticide application equipment. Recipients of the 25 percent tax credit must purchase equipment meeting state specifications and develop a nutrient management plan for their farm operations.

Why is nutrient management planning more focused on agriculture?

Nonpoint source pollution can be traced to urban areas and the DCR has recently added the turf and landscape category to its nutrient management planning program to address this issue. These plans are applicable to facilities like golf courses, athletic fields, community parks, and business parks.[6] Notably, however, this does not address the fact that a typical city block generates nine times more runoff than a woodland area of the same size. This is because impervious surfaces do not allow runoff to percolate into the ground, so water remains above the surface collecting gasoline, motor oil, heavy metals, trash, fertilizers, and

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pesticides. These pollutants accumulate and flow into storm sewer systems. When this runoff leaves the sewer system it empties into streams and rivers causing erosion, damaging vegetation, increasing sediment loads, raising water temperatures, and negatively impacting aquatic life.[7] Urban planners must work to encourage the implementation of structural controls such as green roofs, bioswales, retention basins, and permeable pavements.

Despite these urban challenges, agriculture is still the most significant contributor to nonpoint source pollution. In the 2000 National Water Quality Inventory, states reported that "agricultural nonpoint source pollution is the leading source of water quality impacts on surveyed rivers and lakes, the second largest source of impairments to wetlands, and a major contributor to contamination of monitored estuaries and ground water."[8] This is the result of a history of farming where farmers added more nutrients than were needed for optimum crop growth as "insurance" to maximize growth. Also, the costs of over-application have been externalized so there has not been a financial incentive to measure the amount of nutrients applied. Nutrient management plans help a farmer regulate the application of nutrients to benefit the longevity of the soil and surrounding ecosystem.

There are, however, numerous factors that need to be taken into account in evaluating the impact of nutrient management plans. This includes the pressure placed on farmers to implement creative methods to manage excess nutrients. As more solutions to the problems posed by nonpoint source nutrient pollution proliferate, nutrient management regulations will likely need to be modified to be kept current.

Conclusion

The health of Virginia's soil and water resources and the future of the Chesapeake Bay are dependent upon our ability to mitigate the negative effects of pollution. Nonpoint source pollution is difficult to address, but proper management of agricultural activity could greatly reduce the negative impact of excess nutrients on the environment. Nutrient management planning is a vital component of sustainable agriculture and the consistent application use of nutrient management plans is seen as a way to guide farmers toward greater efficiency of nutrient use.

Updated December 2010 by Melissa Keywood

Endnotes

[1] Sexton, Timothy. E-mail. October 2010. *Virginia Department of Conservation and Recreation.*

[2] "Chesapeake Bay TMDL Phase I Watershed Implementation Plan: Revision of the Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy." September 2010. *Virginia Department of Conservation and Recreation.* http://www.dcr.virginia.gov/soil_and_water/documents/vatmdlwipdrft.pdf (accessed November 2010).

[3] "Restoration and Protection Efforts: Reducing Pollution." April 2010. *Chesapeake Bay Program.* http://www.chesapeakebay.net/status_reducingpollution.aspx?menuitem=19691 (accessed November 2010).

[4] "The Virginia Watershed Implementation Plan for the Chesapeake Bay TMDL." September 2010. *Virginia Department of Conservation and Recreation.* http://www.dcr.virginia.gov/soil_and_water/documents/vatmdlsumqa100410.pdf (accessed November 2010).

[5] VanDyke, L.S., et al. "Nutrient management planning on four Virginia livestock farms: impacts on net income and nutrient loss." *Journal of Soil and Water Conservation.* 1999. 54(2): 499-505. http://www.jswconline.org/content/54/2/499.full.pdf

[6] "Soil and Water Conservation: Virginia's Nutrient Management Program." October 2010. *Virginia Department of Conservation and Recreation.* http://www.dcr.virginia.gov/soil_and_water/nutmgt.shtml (accessed November 2010).

[7] "Managing Urban Runoff." November 2009. *United States Environmental Protection Agency.* http://water.epa.gov/polwaste/nps/outreach/point7.cfm (accessed November 2010).

[8] "Protecting Water Quality from Agricultural Runoff." March 2005. *United States Environmental Protection Agency.* http://www.epa.gov/owow/NPS/Ag_Runoff_Fact_Sheet.pdf (accessed November 2010).

Source: Virginia Department of Conservation and Recreation