Revising nutrient management recommendations for the Chesapeake Bay watershed, a Q&A

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What is nutrient management?

Nutrient management is a term that can include a wide variety of practices aimed at optimizing the application of nutrients and minimizing losses to the environment. In the post World War II years, the widespread availability of new fertilizers, along with new crop varieties, dramatically increased crop production. However, crops typically do not use all nutrients applied to the soil, and excess applications lead to nutrient losses that impact both local waterways and downstream lakes, bays, and coastal waters.

Nutrient management is a science — and a bit of an art — that evolved over time to better match nutrient manure and fertilizer applications with the soil nutrient supply and expected crop yields. Initially, nutrient management was primarily an economic tool to help farmers achieve optimal economic returns by avoiding the purchase of excess fertilizer. Over time, nutrient management has become more sophisticated, with more emphasis placed on reducing pollution to waterways.

Nutrient management may be the oldest best management practice (BMP) used to reduce nutrient runoff to the Chesapeake Bay, and it is one of the most widely implemented, affecting millions of acres of farmland in the Bay watershed. Because of its widespread use, nutrient management has been one of the most important conservation practices for the state-federal Chesapeake Bay Program partnership.

What does nutrient management consist of?

The heart of nutrient management is a plan, which ideally uses information from soil and manure tests, the type of crop being grown, climate and expected yields to determine the amount of nutrients to apply. Nutrient management plans are built around the "4Rs:"

- the Right Source
- at the Right Rate
- at the Right Time
- in the Right Place

The plan factors in the type of fertilizer or manure being applied, its nutrient content, and recommends application rates for particular fields as well as the timing and placement of those applications.

Plans can get much more detailed, though, especially when involving the use of animal manure which typically is both more difficult to precisely apply, and more likely escape the field. For example, some plans may provide more specific recommendations about the timing of applications and whether they should be split over time, whether manure should be incorporated into the soil, and whether applications near streams or other environmentally sensitive areas are restricted. The type of tillage used on the land may also affect plan recommendations. In some cases, the plan may recommend the transport of manure away from the farm if the volume generated exceeds crop needs.

Are definitions of nutrient management consistent among the six watershed states?

No. While the core principles of the "4Rs" remain similar among the states, the details of plans does vary among jurisdictions. For example, the requirements for large vs. small animal operation often varies among states. Some states have different types of requirements for different types of manure, such as poultry litter. Setback requirements for waterways, wells and other sensitive sites also vary, as do requirements for documenting the transport and application of manure taken from a farm to another location. Requirements for phosphorus soil testing and application also varies among states. There are also differences in who can write plans, whether they need to be reviewed and who can access them.

Why is nutrient management sometimes controversial?

The core element of nutrient management — the nutrient management plan — is just that, a *management* plan. Unlike a cover crop, a riparian forest buffer, or a variety of structural best management practices, it is difficult to know whether a nutrient management plan is being fully implemented as written. Farms with excess manure may have little incentive to follow recommendations, and in years with high commodity prices, a financial incentive exists to apply extra fertilizer or manure in the hope that — combined with good growing conditions — it will increase yields.

Surveys show that nutrient management plans often are not fully implemented. At the macro scale, evidence that nutrient application rates have significantly changed in the watershed is limited. That has resulted in controversy over how much nitrogen and phosphorus reduction credit should be given for nutrient management, and the extent to which plan implementation should be demonstrated in order to get credit.

What led to the Bay Program's recent nutrient management review?

The amount of nitrogen and phosphorus reductions credited to nutrient management plans was decreased in 2010 when the Bay Program adopted a new watershed model —Phase 5.3.2 — which is used to estimate how BMP implementation affects the amount of nutrients and sediment reaching the Chesapeake Bay. The Phase 5.3.2 Watershed Model incorporated many changes, including the use of new procedures for representing nutrient application in the watershed which assumed that all manure and fertilizers were applied to agricultural land within a county unless there were records of it being transported elsewhere. This resulted in higher application rates in many areas, which also reduced benefits being attributed to nutrient management.

That change resulted objections from states, as nutrient management was one of the most widely used best management practices. Further, they noted that uneven data quality in some areas resulted in greatly distorted application rates for some counties. In response, the Chesapeake Bay Program's Agriculture Workgroup in late 2011 created an "Expert Panel" to review the nutrient management issue. It was one of many Expert Panels convened by the Bay Program partnership in recent years to determine the nutrient reduction "efficiencies" — the amount of nutrient reduction credit — that should be credited for implementation of various best management practices.

What did the Expert Panel examine?

The Nutrient Management Expert Panel, consisting of representatives from universities, state and federal agencies, conservation districts and some stakeholder groups sought to establish nutrient reduction efficiencies for use in the Phase 5.3.2 Watershed Model for three tiers of nutrient management. Each tier representing different levels of precision in planning and nutrient application management. They included:

• Tier 1: Crop Group Nutrient Management. This essentially assumes a basic nutrient management plan with applications that are consistent with recommendations of state land grant universities during the early years of the Bay Program regarding nutrient source, application rates, timing and placement for nitrogen and phosphorus.

• Tier II: Field Level Nutrient Application Management. This represents an elevated level of nutrient management, which can be supported with records, that more precisely aligns nutrient application with field level crop needs to reduce environmental impacts. This can include such activities as more precise timing of manure and fertilizer applications, incorporating manure into the soil to reduce runoff, splitting the applications of nitrogen, and following phosphorus site index recommendations for each state.

• Tier III: Adaptive Nutrient Management. This assumes a higher level of rigor for nutrient management that goes beyond Tier II by adapting nutrient applications over time based on more precise, and ongoing, field level tests that can evaluate nutrient management practices. These could include measuring the actual amount of nitrate in the soil during the growing season, measuring the nitrate content of corn stalks at the end of the growing season, and using of more precise application techniques, along with other practices. This tier is considered the ultimate goal of nutrient management in the watershed.

What did the Expert Panel recommend?

In the fall of 2013, the Nutrient Management Expert Panel produced a recommended Tier I nutrient reduction efficiency. It called for:

• a 9.25 percent total nitrogen reduction and 10 percent phosphorus reduction from high-till and low-till fields that apply manure.

• a 5 percent total nitrogen reduction and an 8 percent total phosphorus reduction from high-till lands that do not use manure, as well as for pasture lands, hay, alfalfa and nursery lands.

Those recommendations replaced previous nutrient management efficiencies for these land uses in the Chesapeake Bay Watershed Model beginning with data reported by states for 2013.

At that time, the panel did not make recommendations for Tier II and Tier III, citing limitations in time and data. State representatives expressed concern about the lack of Tier II and Tier III efficiency recommendations as many believed they had farm acreages that qualified for greater nutrient reductions than provided by Tier I. The Expert Panel was directed by the Agriculture Workgroup to further work on the issue and was given a short timeframe in which to make recommendations. The Expert Panel made new Tier II efficiency recommendations in fall 2014. They included:

• a 15.75 percent total nitrogen reduction and 20 percent total phosphorus reduction for high-till and low-till land with manure applications.

• an 11.5 percent total nitrogen and 18 percent total phosphorus reduction from high-till land without manure, pasture, hay alfalfa and nursery lands.

No Tier III recommendations were made because of time constraints.

What were the responses to the Tier II recommendations?

Many stakeholders and some Bay Program partners, including the U.S. Environmental Protection Agency, the Chesapeake Bay Commission and the Bay Program's Citizens Advisory Committee expressed concerns about the new Tier II recommendations. Generally, concerns cited vagueness about the recommended efficiencies, what agricultural land uses these efficiencies would apply to, and which of the several potential Tier II actions were required in order to qualify for the nutrient reduction benefits. Among the those concerns:

• The need to better document the scientific basis for both the recommended nitrogen and phosphorus reduction efficiencies. Much of the research that was cited took place in areas outside the watershed and were conducted on small plots, and reviewers wanted to better understand how that information was translated to Bay watershed conditions for the recommended efficiencies.

• The recommendations lacked sufficient clarity about what actions constituted Tier II implementation as opposed to Tier I implementation. Because nutrient management program requirements vary widely among states, program requirements do not always align with those of the Tier II recommendations. It is important that necessary components for Tier II lands be clearly defined so states can properly document that acreages submitted to the Bay Program are eligible for Tier II's greater efficiencies. Otherwise, greater nutrient reductions could be reported without actual changes taking place.

How are the concerns being addressed?

The Nutrient Management Expert Panel was reconvened by the Agriculture Workgroup in early 2015, and re-charged with the responsibility for of addressing concerns raised with the panel's Fall 2014 recommendations. Among its new charges:

• Conduct a short re-evaluation for possible separation of nitrogen and phosphorus benefits for Tier II and Tier III levels of nutrient management.

• Reconsider the agricultural land uses for which the Tier II benefits will be realized.

• Better describe and justify the level of nutrient reduction recommended for Tier II efficiencies and the program components needed to be eligible for those efficiencies.

• Develop a checklist of the data needed for assessing the presence/absence of the level of nutrient management necessary to qualify for each Tier.

The Expert Panel's updated recommendations are expected in spring 2015.

Will the Expert Panel's recommendations address verification?

The Expert Panel's recommendations are directed at the science of nutrient management and do not directly address the issue of verification — ensuring those plans are implemented as written. States have varying levels of oversight to check for nutrient management plan implementation. Recommending verification procedures was not a charge of the Nutrient Management Expert Panel when it was originally established in 2011.

Since then, the question of whether BMPs are fully implemented and functioning has gained new attention in recent years, in part because water quality monitoring since 1985 by the U.S. Geological Survey, the Susquehanna River Basin Commission, state agencies and others show that for many rivers, declining downward nitrogen and phosphorus concentrations observed earlier have leveled out over the past decade.

The Bay Program partnership has adopted a new basinwide BMP verification framework which will be implemented over the course of the next several years. The framework requires that comparable procedures be established among states, and among pollutant source sectors, to verify that all best management practices counted toward Bay cleanup goals are implemented, functioning properly and not double-counted.

Verification is particularly problematic for nutrient management because of the difficulty in documenting whether a plan is implemented as written. Farmer data collected for two recent U.S. Department of Agriculture reports assessing the effect of conservation practices on cropland in the Bay watershed showed that nutrient application rates increased in recent years. In addition, fertilizer sales have edged upward in recent years, which could be suggestive of increased nutrient applications.

How long will the new nutrient management efficiencies be in place?

Most likely through 2017. The Expert Panel's recommendations specifically deal with nutrient efficiencies based on how the Phase 5.3.2 Watershed Model handles land uses and nutrient applications. After 2017, the Bay Program plans to switch to a new "Phase 6" Chesapeake Bay Watershed model, which is now under development, and will include many new land uses and crop categories, and will handle nutrient applications and movement differently than the current model. As a result, a new Expert Panel is being convened specifically to make nutrient management recommendations for incorporation and application by the Phase 6 Watershed Model.

The new Phase 6 Expert Panel will review the definitions and effectiveness estimates developed for the Phase 5.3.2 Watershed Model and recommend adjustments for incorporation into the new model. The new Expert Panel will also need to examine how nutrient management — and potentially, the many components that make up nutrient management — should be applied to new agricultural land uses and crop types included in the new Phase 6 model. It will also cover new issues, such as how to deal with residual nutrients which are carried over from one year to another on a field.

In addition, the Expert Panel will make recommendations back to the Bay Program partnership about how the implementation of nutrient management can be verified. That could include new random sampling protocols, or other methodologies, to assess the degree to which nutrient management plans are being followed by farmers.