Nutrient Management in Maryland: A 1998 Snapshot

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Over a decade ago, Maryland Cooperative Extension (MCE) and the Maryland Department of Agriculture (MDA) initiated a program aimed at reducing runoff of nutrients from agriculture into the Chesapeake Bay by improving on-farm nutrient management. With funding from MDA, MCE began training consultants to prepare nutrient management plans that would balance farmers' nutrient application rates with crop requirements appropriate for their overall operation. These plans were intended to help Maryland meet its nutrient reduction commitments under the Chesapeake Bay Agreements (while simultaneously saving farmers money) by helping farmers reduce excess applications of fertilizer. In the early years of the program, all nutrient management plans were formulated under the direct supervision of MCE specialists. In 1993, in an attempt to accelerate the adoption of nutrient management planning MCE began training and certifying private consultants to prepare plans. Some of these private consultants are employed by commercial fertilizer dealers, some are independent crop consultants, and some are active farmers.

Maryland's 1998 Water Quality Improvement Act put nutrient management planning in a spotlight by making it mandatory on all farms with annual sales over $2500 or more than 8 animal units (8,000 pounds) of livestock. Operators applying chemical fertilizer must have certified management plans for nitrogen and phosphorus effective December 31, 2001 and must implement that plan by December 31, 2002. Operators applying biosolids or animal manure must have and implement a certified management plan for nitrogen by the same dates but have until July 1, 2004 to have a certified plan for

both nitrogen and phosphorus and until July 1, 2005 to implement that plan. Once in place, plans must be updated every three years. (The regulations implementing the Act can be found on the MDA website at http://www.mda.state.md.us/nutrient/regsred.html. MCE's "A Citizen's Guide to the Water Quality Improvement Act of 1998", which describes the Act, is available on the Web at http://www.agnr.umd.edu/waterquality/CitizWQ.pdf).

MCE's Nutrient Management Program estimates that by 1998 certified plans had been written for 1,101,000 acres. In 1999, new plans were written for over 204,000 acres while plans covering an additional 130,000 acres were updated (see the Nutrient Management Program website, http://www.agnr.umd.edu/users/agron/nutrient). Even so, certified plans will be needed for nearly all of the Maryland farmland not currently under a plan. Demand for plan updates (required every three years) will also be considerable.

MCE and MDA expect to meet the demand for nutrient management planning in large measure by training private consultants to prepare plans meeting MCE's certification standards. Relying on the private sector has been somewhat controversial. Some worry that consultants working for chemical dealers will develop plans that overstate nitrogen and phosphorus application rates in order to keep fertilizer sales high. A MCE study of nutrient management plans using data from a survey conducted in 1997 gave some support for this view (see M.F. Smith, *Nutrient Management: Evaluation of Maryland's Statewide Nutrient Management Program*, College of Agriculture and Natural Resources, University of Maryland, College Park, September 1999). The study found that private consultants recommended higher nutrient application rates than MCE consultants.

This article uses data from a 1998 survey of Maryland farmers to examine this and other questions about nutrient management planning. The observations were weighted to make the data representative of Maryland farmers as a whole. Earlier versions of this survey have been used to estimate Maryland farmers' use of soil and water conservation practices (see Erik Lichtenberg, "Using Soil and Water Conservation Practices to Reduce Bay Nutrients: How Has Agriculture Done?", *Economic Viewpoints*, Fall 1996, available on the Web at http://www.arec.umd.edu/areces/ev.htm and Erik Lichtenberg, "Soil and Water Conservation on Maryland Farms: A 1998 Update", *Economic Viewpoints*, Spring 2000).

We first use the data to examine how many farmers used nutrient management planning and other nutrient management practices in 1998. We then look at the effects of nutrient management plans on nutrient application recommendations, including differences in plans formulated by private and MCE consultants. Finally, we investigate the extent to which nutrient management planning is associated with soil and water conservation effort more generally, in terms of both overall effort and the use of specific best management practices.

How Widespread Were Nutrient Management Practices in 1998?

The survey data indicate that almost 38 percent of Maryland farmers, representing about 35 percent of Maryland crop acreage, had nutrient management plans by the end of 1998 (Table 1). The use of several other nutrient management practices was quite widespread. Almost half of Maryland farmers reported using pre-plant soil testing, which helps farmers match fertilizer application rates with crop requirements by allowing them

to factor in existing soil fertility. Almost two-fifths of Maryland farmers reported using split fertilizer application and fertilizer incorporation. Split fertilizer application reduces runoff and leaching by matching the timing of fertilizer application with crop uptake rates. Fertilizer incorporation reduces surface runoff. Manure incorporation, which also reduces surface runoff, was used by 27 percent of Maryland farmers. Stream fencing, installing gates at stream crossings, and installing watering troughs are measures designed to keep livestock out of streams. About 28 percent of Maryland farmers with livestock reported using these measures. Manure crediting and pre-sidedress nitrogen testing can reduce excess fertilizer application by having farmers measure total nutrient applications and existing soil fertility. About one-fifth of Maryland farmers reported using each of these practices. Finally, somewhat less than one-fifth of Maryland farmers with livestock reported using waste storage structures or lagoons, which reduce nutrient runoff from storm related events.

Impacts of Nutrient Management Planning on Fertilizer Recommendations

The goal of nutrient management planning is to promote more efficient nutrient use (from manure or commercial fertilizer). Reductions in nutrient runoff occur because less excess fertilizer is applied and, thus, a larger share of the fertilizer applied is taken up by the crop. However, more efficient fertilizer use does not necessarily mean lower fertilizer application rates. In some situations (for instance, favorable weather conditions or soils with low fertility), farmers may be underestimating crop uptake requirements; in those situations, nutrient management plans will actually suggest increasing fertilizer

application rates. Even so, nutrient runoff will not increase because the crop takes up the extra fertilizer.

The 1998 survey asked farmers how their nutrient management plans recommended they change their fertilizer application rate on corn, soybeans, small grains, vegetables, tobacco, hay, and other crops. For most crops, two-thirds or more said that their nutrient management plan recommended no change (Table 2). For corn, soy beans, vegetables, and hay crops the majority of the recommendations for change called for a decrease in fertilizer application rates. For small grains, an equal number of growers were told to decrease fertilizer use as were told to increase fertilizer use. For other crops, the majority of those told to change rates were told to increase them.

The 1998 survey asked respondents who prepared their nutrient management plans: MCE, a chemical dealer or dealer employee, an independent crop consultant, the farmer himself (or herself), or another certified person. MCE prepared 52.5 percent of the plans, chemical dealers or their employees 13.9 percent, independent crop consultants 6.5 percent, farmers themselves 11.1 percent, and other persons 16.0 percent. We tested statistically whether the recommended change in the fertilizer application rate for each crop differed according to who prepared the plan. There was no statistically significant difference for any crop. Thus, our survey provides no evidence supporting the claim that plans prepared by chemical dealers are more likely to recommend increases in fertilizer application rates than plans prepared by MCE or independent crop consultants.

Nutrient Management Planning and Conservation Effort

Nutrient management planning also provides opportunities for consultants to give farmers information about—and encourage them to use—other practices that reduce runoff and erosion. In this way, nutrient management planning may help expand overall conservation efforts by Maryland farmers. The 1997 survey, for example, found that farmers with nutrient management plans were more likely to use several conservation practices, including manure crediting, pre-sidedress nitrogen testing, cover crops, and vegetative buffers.

The 1998 survey data indicate that farmers with nutrient management plans engage in more conservation effort than those without plans (Figure 1). The median number of conservation practices used by farmers with nutrient management plans was 8, twice the median number of practices used by farmers without nutrient management plans. The survey data also indicate that farmers with nutrient management plans engage in more nutrient management effort, as measured by the number of nutrient management practices, than those without plans (Figure 2). The median number of nutrient management practices used by farmers with nutrient management plans was 3, compared to 1 for farmers without plans.

Farmers with nutrient management plans were statistically significantly more likely to use all but 3 of the 24 conservation practices about which the survey asked (Table 3). The exceptions were grade stabilization (used by about 15 percent of both groups), ponds (used by about a quarter of both groups), and permanent vegetative cover (used by about one-third of both groups).

It should be noted that these statistical results do not necessarily mean that nutrient management planning causes increases in overall conservation effort. While it may be that the nutrient management process is an opportunity to educate growers on a variety of conservation oriented practices, an equally plausible explanation is that farmers who exert greater conservation effort do nutrient management planning as a part of their overall conservation activity, in other words, that more conservation-minded farmers are more likely to have nutrient management plans. Both could be true as well: Some farmers might be encouraged to increase their conservation effort as a result of what they learn from the nutrient management planning process while others get nutrient management plans as part of conservation activity they had decided on independently. It is not clear whether there is anything about nutrient management planning that would make the process a more "teachable moment" than any other conservation oriented planning process. Further research is needed to determine the extent to which each of these two explanations is correct.

Conclusion

Maryland's 1998 Water Quality Improvement Act gave the state's farmers 4 to 6 years to acquire and implement nutrient management plans prepared by certified consultants. Our survey data indicate that almost two-fifths of Maryland farmers had certified plans around the time the Act was passed.

Some have worried that nutrient management plans prepared by chemical dealers or others not supervised by MCE might recommend that farmers use more fertilizer than necessary, weakening implementation of the Act. We found no evidence to support this

view: There was no statistically significant difference in fertilizer application rate changes recommended by plans prepared by different kinds of consultants.

Sizeable numbers of Maryland farmers also reported using practices that help improve the efficiency of nutrient applications. Farmers with nutrient management plans reported using larger numbers of nutrient management practices in addition to being more likely to use each of two dozen individual conservation practices. Some research has been done to quantify the water quality benefits from implementing conservation practices. The prevalence of the adoption of multiple conservation practices suggests a need for additional research on the synergistic effects from the implementation of multiple conservation practices.

Table 1. Percentage of Maryland Farmers Using Nutrient Management Practices

Practice	*Percent of Farmers Reporting Use*
Nutrient management planning	37.8
Manure storage structure or lagoon[a]	18.4
Stream fencing, stream crossings, or watering troughs[a]	27.9
Pre-plant soil testing	49.1
Pre-sidedress nitrogen testing[b]	21.2
Manure crediting	20.0
Split fertilizer application	38.4
Manure incorporation	27.1
Fertilizer incorporation	36.6
Manure composting	15.5

[a] Percentages of farmers with livestock.
[b] Percentage of growers with corn.

Table 2. Plan-Recommended Changes in Fertilizer Application Rates

Crop	Percentage Reporting Change in Fertilizer Application Rate		
	Increase	Decrease	Keep the Same
Corn	9.4	27.3	63.3
Soybeans	14.0	16.3	69.7
Small Grains	16.5	16.9	66.6
Vegetables	1.5	9.7	86.7
Hay	16.7	20.4	62.9
Other Crops	11.1	2.6	86.3

Table 3. Use of Soil and Water Conservation Practices by Maryland Farmers

Practice	Percentage of Farmers Using Practice	
	With Nutrient Management Plan	Without Nutrient Management Plan
Critical area seeding	36.8*	22.4
Filter strips	52.2*	21.4
Riparian buffers	27.6*	15.2
Contour farming	32.0*	14.4
Stripcropping	41.0*	20.8
Cover crop	55.4*	27.5
Reduced tillage	65.4*	37.3
Grade stabilization	16.8	14.5
Grass- or rock-lined waterway	43.1*	22.3
Terrace	8.8*	3.2
Diversion	20.9*	4.7
Pond	27.6	23.3
Sediment trough	10.5*	3.0
Manure storage structure or lagoon	32.2*	4.5
Permanent vegetative cover	35.8	29.1
Wildlife habitat	37.1*	26.7
Stream fencing, stream crossings, or watering troughs	28.3*	16.1
Pre-plant soil testing	78.4*	32.6
Pre-sidedress nitrogen testing	32.5*	7.1
Manure crediting	33.6*	10.7
Split fertilizer application	48.1*	33.5
Manure incorporation	43.1*	18.2
Fertilizer incorporation	45.4*	30.9
Manure composting	20.8*	12.7

* Farmers with nutrient management plans are more likely to use this practice than farmers without nutrient management plans.

Figure 1. Conservation Effort By Maryland Farmers

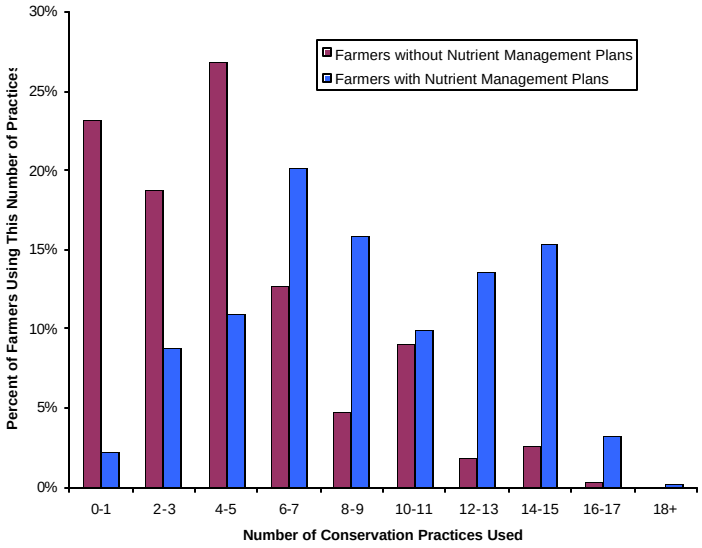

Figure 2. Nutrient Management Effort By Maryland Farmers