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RESEARCH BRIEF

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Does it Matter Who Writes Your Nutrient Management Plan?

Evidence from Voluntary Nutrient Management Plans in Maryland

Dr. Erik Lichtenberg and Dr. Doug Parker of the University of Maryland, along with Dr. Chad Lawley of the University of Manitoba, studied the content of nutrient management plans written before they were required by law to see if that content varied according to the type of provider.

AT A GLANCE

- Over application of nutrients such as nitrogen and phosphorus negatively impacts water quality threatening the health of plants and animals in lakes, streams and the Chesapeake Bay.
- When too much nutrients enter water bodies, they trigger eutrophication: the rapid growth of algae which blocks sunlight and depletes the dissolved oxygen in the water.
- Nutrient pollution can lead to mass fish kills, clogged pipelines, and cloudy unappealing water which are not attractive for tourism or recreation.
- To increase yields and decrease risks, farmers may apply more fertilizer than necessary discharging the extra nutrients in water runoff – i.e. agriculture is a

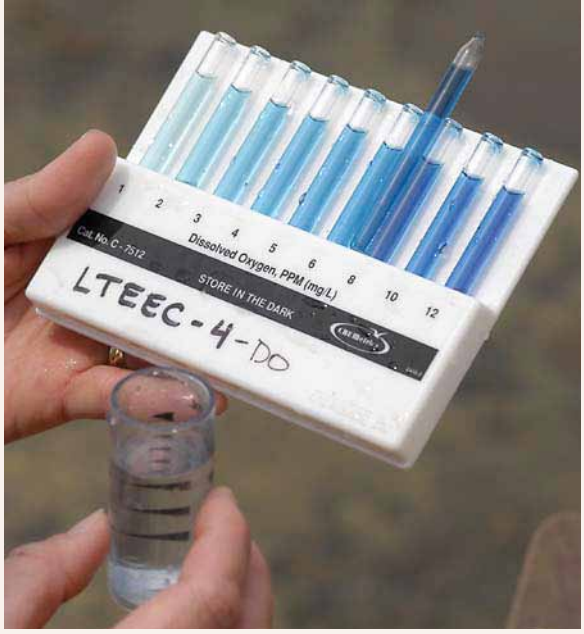
Glance continued on page 2

Nutrient pollution, primarily excess nitrogen and phosphorus, increasingly threatens the health of plants and animals in lakes, estuaries, rivers, and streams. Excess nutrients added to bodies of water act like a fertilizer. They trigger a process known as eutrophication: a rapid growth of algae that leads to the depletion of dissolved oxygen. Severe algal growth blocks light that aquatic plants need to grow; consequently, most plants die. When these plants and algae die, the process of decay consumes and depletes oxygen in the water. While some aquatic life can adapt to lower levels of oxygen, most cannot. Therefore, nutrient pollution leads to mass fish kills, as well as pipelines clogged by algae and reduced recreational opportunities as water becomes cloudy and unappealing.

The sources of nutrients can be classified into two groups: point and non-point sources. Point sources

Dr. Erik Lichtenberg

are facilities that discharge wastewater containing nutrients directly into the waterway. Non-point sources discharge nutrients indirectly by rainwater runoff. Essentially, rain lifts and carries nutrients from land, and subsequent runoff either travels directly over land to a waterway or sinks into the groundwater until it eventually reaches a waterway. Agricultural producers applying commercial fertilizer and manure to their fields are major contributors of non-point nutrient runoff. In efforts to address nutrient pollution from agriculture, many states are mandating or providing incentives for farmers and livestock producers to develop nutrient management plans.



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One water quality test examines the level of dissolved oxygen. Excess nutrients will trigger eutrophication: a rapid growth of algae which depletes dissolved oxygen.

Nutrient Management Plans

Nutrient management plans (NMPs) are farm-specific plans that outline the ways in which the farmer will make efficient use of the nutrients—maximizing the economic benefit while minimizing environmental impacts. Plans typically address soil testing, manure testing, erosion control practices, and the timing and frequency of commercial fertilizer and manure application. As of 2002, twenty-seven states required livestock producers to develop manure management plans. On a national scale, the U.S. Environmental Protection Agency's rule for Confined Animal Feeding Operations requires all large animal operations to prepare NMPs as a component of applications for water pollution discharge permits.

Farmers apply most, if not all, fertilizer at the beginning of the growing season. Their crops need nutrients in place when water and sunlight are available. When growing conditions are better, crops need more nutrients, but the weather is hard to predict. Too, each application of fertilizer is expensive in terms of fuel use, machinery wear and tear, and labor time. And farmers may not be able to make extra applications if fields are too wet for machinery. So farmers have an incentive to apply extra nutrients as long as the expected gain in profit from increased yield when growing conditions are good exceeds the expect loss from excess fertilizer application when growing conditions are bad.

Glance continued from page 1

source of non-point source pollution.

- Using farm specific information, Nutrient Management Plans (NMP) can be developed for each farm enterprise to help farmers use just the right amount of fertilizers and manure to maximize their profits with the minimum of environmental impacts.
- Maryland began a NMP planning program in 1989; in 1993, UME began certifying fertilizer dealers, independent crop consultants, and farmers to prepare NMPs.
- Although NMPs were voluntary in 1998, certified NMPs had been drawn up for 1.1 million acres in Maryland, about 35% of the state's cropped area.
- These NMPS were initially designed by public institutions, like UMD extension. Between 1989 and 1998, 52% of plans were written by UMD extension educators. However, the private sector, which includes fertilizer dealers and independent consultants, also wrote NMPs. Over 11% of farmers wrote their own.
- Farms with intensive livestock operations were the most likely to have a plan.
- Sixty-three percent of the plans recommended the farmer keep their fertilizer applications the same; 27% said use less and 9% said increase the application rate.
- Fertilizer dealers recommend higher rates of fertilizer application on corn than UMD extension agents; however, independent consultants recommend even higher application rates.
- Farmers who draw up their own plans & those for their neighbors actually recommend lower application rates than other NMP specialists (UMD extension educators, fertilizer dealers and independent consultants).

Possible Biases in Nutrient Management Planning

Originally, NMPs for farms were developed by the public sector, mainly by land grant universities and extension agencies. However, as nutrient management planning expanded, extension agencies began to train and certify private sector parties such as consultants and farmers to prepare NMPs. For example, eleven of the twenty-four states that participated in the 2005 Nutrient Management Plan State Survey—including Maryland—reported having programs to train and certify private sector NMP preparers. The trend towards privatization of NMP preparation has created concerns about the recommendations private sector planners might make. Many private consultants work for fertilizer dealers; they may have an incentive to overestimate fertilizer requirements to maintain sales.

With this possible bias in mind, Dr. Erik Lichtenberg and Dr. Doug Parker of the University of Maryland Department of Agricultural and Resource Economics worked with Dr. Chad Lawley of the University of Manitoba to analyze fertilizer application rate recommendations in NMPs prepared by the public and private sector in Maryland. Maryland has long been committed to meeting strict targets for reductions in nitrogen and phosphorus pollution in the Chesapeake Bay, and it has relied on nutrient management planning as one of the principal means of meeting targeted reductions from agricultural sources. Therefore, Maryland's extensive experience with nutrient management planning provided an excellent backdrop for this study.

Maryland Nutrient Management Plans

The Maryland Department of Agriculture and Maryland Cooperative Extension initiated a nutrient management planning program in 1989. In 1993, the Maryland Cooperative Extension began certifying fertilizer dealers, independent crop consultants, farmers, and other individuals to prepare NMPs. Additionally, up until the 1998 Water Quality Improvement Act, participation in Maryland's program was voluntary. Afterwards, the Water Quality Improvement Act made NMPs mandatory with the requirements phased in from 2002 to 2005. As of 1998, certified plans had been written for over 1.1 million acres, representing 35 percent of Maryland crop acreage. Lawley, Lichtenberg, and Parker concentrated on the period when NMPs were strictly voluntary (pre-1998), as is the case in most states today. They examined the characteristics of

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Nutrient management plans use soil tests to determine nutrient content in the soil to enable farm specific recommendations for manure and fertilizers.

farmers voluntarily adopting NMPs and explore whether systematic differences exist in the fertilizer application rate recommendations made by different kinds of preparers.

Data for the study was provided through a telephone survey of 487 Maryland farmers conducted by the Maryland Agricultural Statistics Survey in the fall of 1998. The survey collected information regarding farm demographics, characteristics of the farm operation, best management practice adoption and use, the preparation of NMPs, and participation in cost-share programs. Farmers were asked whether or not a NMP had been prepared for their land; if a NMP had been prepared, they were asked about the year the plan was prepared, what crops the NMP covered, and whether the NMP recommended an increase, decrease, or no change in the fertilizer application rate on each crop. Lawley, Lichtenberg, and Parker focused only on recommendations for corn fertilizer applications because

Nutrient Management Planning Survey

QUESTION	RESPONSE	WEIGHTED POPULATION (%)
Do you have a nutrient management plan?	No	62.26
	Yes	37.74
In what year was the nutrient management plan written?	1989	12.61
	1990	10.46
	1991	5.4
	1992	8.54
	1993	3.71
	1994	8.78
	1995	16.36
	1996	11.02
	1997	13.75
	1998	9.38
Who prepared your nutrient management plan?	Extension	52.46
	Fertilizer Dealer	13.93
	Crop Consultant	6.47
	Self	11.13
	Other	16.02
Does the plan recommend that you decrease / use the same / increase fertilizer application rate on corn?	Decrease	27.28
	Stay the same	63.28
	Increase	9.44

corn makes heavy use of fertilizer and is a staple grain crop in Maryland.

The survey revealed that approximately two-fifths of the farmers had an NMP prepared. The earliest year of preparation was 1989, coinciding with the first year of the Maryland nutrient management program. Roughly half of the farmers had plans prepared by the Maryland Cooperative Extension, one-seventh by fertilizer dealers, one-tenth by the farmers themselves, one-sixteenth by independent crop consultants, and the remaining one-sixth by others—mainly farmers preparing plans for other farmers. Although most plans recommended that farmers maintain current commercial fertilizer application rates, over twenty-five percent of the plans recommended that farmers decrease their application rates, and slightly less than ten percent recommended that farmers increase application rates.

Determinants of NMP Adoption

Adoption of a NMP is significantly influenced by extension targeting and individual farmer attributes. With this in mind and using data from the survey, Lawley, Lichtenberg, and Parker found that the likelihood of a farm adopting a NMP was systematically associated with

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Some precision agriculture techniques can be used to refine nutrient application rates decreasing the amount of nutrients entering waterbodies while maintaining yields.

the size of farm's cattle herd; total acreage of the farm; the share of corn, soybeans, and small grains in crop acreage; and proximity to surface water.

Farms with intensive livestock operations likely offer the greatest economic and environmental gains from nutrient management planning. Therefore, Extension staff target and promote nutrient management planning to large livestock operations as a matter of priority. And indeed, Lawley, Lichtenberg, and Parker confirmed that the farms with greater numbers of cattle are more likely to adopt a NMP. In fact, an increase of a single head increased the likelihood of NMP adoption by a twentieth of a percent.

Larger farms were also more likely to adopt NMPs. The effect of farm size was rather small, though: increasing farm size by ten acres increased the probability of NMP adoption by less than one percent.

The percentage of cropland planted in corn, soybeans, and small grains also was also a factor in adopting NMPs. Most cropland in Maryland is devoted to a corn- soybean-small grain rotation that requires relatively intensive use of commercial fertilizer. The potential for cost savings and pollution reductions tend to be higher on farms with a greater share of land planted in this grain rotation. Therefore, Extension staff is more likely to target those farms practicing grain rotation and, consequently, those farms are more likely to adopt NMPs.

Lastly, Extension outreach focused on farms posing environmental concerns to water quality. The farms most likely to cause water quality problems are those with sloped lands and those in greater proximity to surface water bodies. This suggests that environmental vulnerability would influence the adoption of NMPs. However, Lawley, Lichtenberg, and Parker found that slope of the land did not play a statistically significant role in the adoption of NMPs. That is, farms with greater percentages of moderately and highly sloped land, which presumably pose greater risks of nutrient runoff, were no more likely to adopt nutrient management planning than farms with lower percentages. Proximity to surface water did have a statistically significant effect on NMP adoption, though. Each one mile decrease in distance to the nearest surface water body raised the average probability of NMP adoption by almost 3.5 percent.

Determinants of NMP Preparer

As hypothesized, Lawley, Lichtenberg, and Parker found that fertilizer dealers were indeed more likely than Extension staff to recommend increases in fertilizer application rates and less likely to recommend decreases. Furthermore, their analysis revealed that fertilizer dealers recommended increased commercial fertilizer application rates on one out of every twenty-four farms, whereas Extension staff recommended increased application rates on one out of every sixty farms.

Independent crop consultants, on the other hand, recommended increased fertilizer application rates on one out of eight farms. Thus, independent crop consultants were more likely to recommend increases in

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Doug Parker and Erik Lichtenberg of the Department of Agricultural and Resource Economics have studied nutrient management within Maryland for two decades.

fertilizer application rates than fertilizer dealers. This result is consistent with the assertion that fear of yield losses dominates independent crop consultants' nutrient management planning and suggests that potential cost savings from lower nutrient application rates are a secondary concern.

Farmers who prepared their own plans recommended fertilizer application rate decreases over sixty percent of the time. Moreover, they recommended increases in fertilizer application rates less than one percent of the time. The fact that farmers themselves, in contrast to all other plan preparers, virtually never recommended increased commercial fertilizer application rates and almost always recommended decreases, suggests that farmers may know more about the fertility of their fields than outsiders. Alternatively, these results may indicate that outsiders are unwilling to provide recommendations that are as strict as they ought to be.

Lastly, farmers with greater dependence on farming as a source of income are more likely to receive recommendations to decrease commercial fertilizer application rates and less likely to receive recommendations for an increase. This is consistent with predictions: households that are more dependent on farming should be more sensitive to the risk of yield losses from under-application of fertilizer and hence more likely to be over applying fertilizer prior to an NMP. Therefore, NMPs prepared for farmers with a greater dependence on farming as an income source are more likely to recommend decreases in commercial fertilizer use. The magnitude of this effect is substantial. A one percent increase in the share of income earned from farming increases the likelihood of a recommended decrease by over three-quarters of a percent.

Conclusion

The research of Lawley, Lichtenberg, and Parker suggests that the main objectives of NMPs—increased farm profitability and improved environmental performance—were most often obtained when farmers prepared their own plans, suggesting either that farmers used knowledge about their farms not available to others or that Extension and outside crop consultants were too conservative about recommending decreases in nutrient application. Those results raised questions about the extent to which voluntary nutrient management planning results in "win-win" outcomes of increased farm profitability and improved environmental quality. It remains to be seen whether these results carry over to mandatory nutrient management planning like that now required in Maryland. ■

For more information about this research, contact Dr. Erik Lichtenberg at ***(301)405-1279*** *or* ***elichtenberg@arec.umd.edu***

Center For Agricultural & Natural Resource Policy

University of Maryland Department of Agricultural and Resource Economics

Symons Hall, Room 2119
College Park, MD 20742
www.arec.umd.edu
(301) 405-1293