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STATE APPROACHES TO REDUCING AGRICULTURAL NUTRIENT IMPACTS ON WATER QUALITY IN THE UNITED STATES

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Abstract

Agricultural nutrients in the wrong places pose threats to water quality in the United States, but the federal government has little control over the issue. States do have authority over nonpoint sources such as agricultural nutrient runoff, but what are they doing to address water quality threats? This paper presents an overview of different approaches states are utilizing to reduce agricultural nutrient impacts on water. Approaches fall into seven categories that range from statewide reduction strategies to nutrient application restrictions and external partnerships. Voluntary incentives remain a priority, but a slight trend toward mandatory requirements exists. The current landscape is well-populated with a diversity of state actions, but funding, impact monitoring and coordination may prove critical to program and policy success.

Keywords: water quality; nutrient reduction; agricultural nutrient pollution; law; policy

Introduction

The benefits of using nutrients such as nitrogen, phosphorous and animal manure for agricultural production are well documented. Also well documented are the detrimental effects of such agricultural nutrients on water quality. According to the U.S. Environmental Protection Agency (EPA), nutrient pollution affects water quality in over 100,000 miles/160,000 km of rivers and streams and 2.5 million acres of waterbodies in the United States (U.S. EPA, 2017). Addressing nutrient pollution has proven difficult, however, as it is caused primarily by nonpoint sources such as agricultural and storm water runoff rather than by identifiable point source discharges.

The U.S. EPA has the legal authority to regulate point source discharges that create water pollution, but the primary responsibility for addressing nonpoint sources such as agricultural nutrient pollution falls to the states. Nearly ten years ago, state EPA agencies called for immediate attention to reducing nutrient pollution and pointed specifically to agricultural nutrients after concluding that animal manure and nutrient pollution from row crop agricultural operations are primary sources of adverse nutrient-related water quality impacts (State-EPA, 2009). Despite state goals to target animal operations and farmland as primary nutrient pollution sources (ACWA, 2012) and efforts by the U.S. EPA to encourage and support states in reducing nutrient pollution impacts (U.S. EPA, 2016), agricultural nutrient pollution remains an ongoing problem, evidenced by ongoing incidents of harmful algal blooms, drinking water advisories and litigation against agricultural operations.

How are the states reacting to concerns about agricultural nutrient impacts on water quality? In this study, we sought to identify recent efforts by states to address the agricultural nutrient issue by searching for and classifying state-based regulatory and policy approaches to reducing water quality impacts from agricultural nutrients. This report summarizes key findings of our study and highlights examples of state approaches.

Methods

We conducted legal research to identify regulations, policies, programs and incentives that require or encourage the reduction of non-point water pollution from agricultural nutrients. Our ongoing study is limited to state-based approaches that result from state government action. Throughout our research, we have analyzed similarities and differences to categorize types of responses taken by the states.

Results

State responses to reducing non-point agricultural nutrient impacts on water quality are numerous and varied. Our initial results reveal approaches that range from comprehensive statewide strategies for reducing nutrient pollution to fragmented, unsystematic partial measures and from mandated requirements to voluntary practices and incentivized opportunities. The components that constitute different state approaches also vary widely, but fall into defined categories. Table 1 presents our classification of different types of regulatory and policy approaches taken by the states.

Table 1
State approaches to reducing agricultural nutrient pollution

Type of approach	*Definition*
1. Statewide reduction strategies	A comprehensive planning effort or program to address nutrient reduction from a coordinated statewide perspective.
2. Nutrient management plans	Written plans for managing the amount, source, placement and timing of plant nutrients and soil amendments.
3. Conservation programs	Programs that encourage or require farmers to adopt conservation practices on the land.
4. Applicator certification	Knowledge standards for individuals who apply agricultural nutrients on the land.
5. Application restrictions	Limitations on how, when or where agricultural nutrients may be applied to land.
6. Informational tools	Tools to assist with determining the proper conditions for utilizing agricultural nutrients.
7. External partnerships	Efforts to collaborate with private and non-profit partners on nutrient reduction activities.

1. Statewide reduction strategies

Due in large part to nutrient task forces established for geographic regions of the U.S. such as the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force formed in 1997 and a recommended framework provided by the U.S. EPA, many states developed statewide action plans and strategies to reduce nutrient pollution. The State of Iowa's Nutrient Reduction Strategy provides a good example of a coordinated framework for assessing and reducing nutrients in surface waters. The plan, first developed by the Iowa Department of Agriculture and Land Stewardship, Iowa Department of Natural Resources and Iowa State University College of Agriculture and Life Sciences in 2012, includes targeted practices to reduce nutrient runoff from farmland as well as addressing point sources such as wastewater treatment plants. The strategy outlines steps for prioritizing watersheds and resources, improving existing program effectiveness and increasing voluntary efforts to reduce nutrient loading. Regarding nonpoint nutrient reduction, the plan focuses on conservation programs, in-field and off-field practices, pilot projects, and nutrient trading and innovative approaches. Much emphasis is placed upon strengthening outreach, education and collaboration, documenting and assessing progress, and researching new technologies and effective use and expansion of funding sources.

2. Nutrient management plans

A written nutrient management plan (NMP) helps a producer manage the amount, source, placement and timing of plant nutrients and soil amendments (NRCS, 2012). Traditionally focused on optimizing economic returns from nutrients, NMPs have more recently been utilized to address ways to minimize the negative impact of nutrients on the environment (Beegle, 2003). Our review of state NMP provisions yields similarities in the required components of an NMP but differences in whether NMPs are mandatory or voluntary. In some states, like Ohio, NMPs are voluntary, but other states now require farmers to develop and implement NMPs. For example, in the State of Maryland, all farms or operations that exceed the low thresholds of gross yearly income of at least $2,500 USD or 8,000/3,628 Kg pounds of live animal weight are required to have an NMP (Code of Maryland Regulations 15.20.07.01, 15.20.07.03). The same is true in Wisconsin, where farmers must use NMPs when nutrients are applied in a field or a pasture (Wisconsin Administrative Code ATCP § 50.04 (a)). Many states also require certification in order to write NMPs (Maryland Code of Regulations 15.20.07.05), recordkeeping by the operator (Ohio Administrative Code 1501:15-5-19) and periodic revisions of NMPs (Wisconsin Administrative Code ATCP § 50.4 (3)).

3. Conservation programs

The term “conservation programs” includes diverse approaches that encourage or require farmers to adopt conservation practices that can reduce the migration of agricultural nutrients from agricultural lands. Maryland has two conservation programs that offer financial incentives for participation in conservation programs. The Maryland Agricultural Water Quality Cost-Share Program provides farmers in areas with large amounts of agricultural runoff with cost-share funds for installing cover crops, waste treatment lagoons, fencing, riparian buffers, filter strips, grassed waterways, terraces, wetland restoration and other projects (Code of Maryland, Agriculture § 8-703). Eligibility is dependent upon how much the project will improve water quality in the watershed as well as economic return to the operator. Operators in Maryland can also receive a tax credit when purchasing conservation equipment due to the Maryland Income Tax Subtraction Modification for Conservation Equipment (Code of Maryland, Tax-General §10-208 (d)(2)). Qualifying equipment includes no-till planters and drills, manure injection equipment, certain manure spreaders, and GPS devices. Farmers can deduct 50 to 100% of the cost of purchased conservation equipment on their state income taxes.

An example of a mandatory conservation program is Minnesota's 2015 "buffer law," which requires any landowners with property located next to public waters or public drainage systems within certain mapped protection areas to install and maintain continuous buffers of perennial vegetation between their land and the water (Minnesota Statutes 103F.48 § Subdivision 3 (a)). There is an exception when the land is used for agriculture, however. Agricultural landowners may use alternate practices such as filter strips, grassed waterways, and conservation tillage if the practices would yield comparable water quality benefits. There are penalties for non-compliance and cost share incentives are available.

4. Applicator certification

Several states require certification for those who apply fertilizers for hire on the land of another, such as Indiana's agricultural fertilizer certification program (Indiana Code § 15-16-2). Applicators must pass an exam that encompasses fertilizer application planning, storage, equipment, transportation, techniques and environmental concerns. The State of Ohio in 2014 became the first state to require certification for individual operators applying fertilizers for themselves on more than 50 acres of land for agricultural purposes (Ohio Revised Code § 905.321). An individual must either complete an educational program or pass a test, both of which address the proper time, place, amount, application, storage and handling of fertilizers and must also maintain fertilizer records for at least three years. A similar approach for irrigation applications exists in the State of Nebraska, where the Chemigation Certification Program aims to protect irrigation water sources from nutrient pollution by requiring certification for operators who apply fertilizers and pesticides to cropland via irrigation systems (Nebraska Revised Statutes § 46-1101 et seq.). Operators must complete training and testing and be re-certified every four years. The training emphasizes proper calibration of equipment and mixing of fertilizers and pesticides used in irrigation.

5. Application restrictions

Some states restrict the application of agricultural nutrients in particular areas, at different times of the year, or when certain weather conditions are present. For example, the State of Indiana enacted its fertilizer use rule in 2013 to protect the environment from mishandling of fertilizers and manure (355 Indiana Administrative Code Article 8). Anyone who uses or distributes more than 10 cubic yards/7.65 cubic meters or 4,000 gallons/15,142 liters of commercial fertilizer or manure for producing an agricultural crop must comply with staging restrictions for fertilizers and manure, application setbacks for manure, prohibitions on applying manure to highly erodible land that does not have at least 40% crop residue or a vegetative cover crop, restrictions for manure applications on frozen or snow-covered ground, and monitoring requirements for manure applications. The State of Ohio adopted a similar approach with its restrictions on the surface application of fertilizer or manure in a heavily farmed geographic area that drains into Lake Erie (Ohio Revised Code § 905.326). Applications are prohibited when soil is either snow covered or frozen or when the top two inches/5.08 cm of the soil are saturated from rain, unless the fertilizer or manure is injected into the ground, incorporated into the soil, or applied to crops. Operators may not apply granular fertilizer when there is greater than a 50 per cent chance of precipitation exceeding one inch/2.54 cm in a 12 hour period or manure if there is a greater than 50 per cent chance of more than one-half inch/1.27 cm of precipitation in a 24 hour period.

6. Informational tools

A number of states provide informational tools for voluntary use by applicators to assist in determining optimal conditions and runoff risks for fertilizer applications. Perhaps best known is the State of Wisconsin's "Runoff Risk Advisory Forecast." The forecast features a map of the state that presents nutrient runoff risks through a color-coded system that designates low, moderate and high risks for a three day period. Risks are based on forecasts and information from the National Weather Service. Virginia's Saturated Area Forecast Model is a decision support tool that indicates hydrologically sensitive areas on a watershed basis and provides daily updates of forecasted weather conditions. The State of Washington's Application Risk Management System addresses the timing of manure applications using precipitation forecasts for both regional and field-levels. Operators are to use the system's manure spreading advisories in conjunction with nutrient management plans to help determine runoff risk and setback distances.

7. External partnerships

Many states utilize private and nonprofit partnerships to help fund and implement water and nutrient management projects and research. The State of Illinois presents several examples. In 2012, the Illinois General Assembly established the Nutrient Research and Education Council (NREC), which consists of representatives from the fertilizer and specialty fertilizer industries; grower, farm, agronomy, and environmental organizations; the state Department of Agriculture and state Environmental Protection Agency; and state and federal agricultural field stations (Chapter 505 Illinois Compiled

Statutes 80/6a). NREC's main goal is to support research on agricultural nutrient pollution, financed by an assessment fee on fertilizer that is currently set at $1.00 USD per ton/907 kg. Projects and programs funded by NREC include education on reducing nutrient runoff and installation of practices such as cover crops, buffers, and wetlands.

The Illinois Fertilizer and Chemical Association (IFCA) promotes the "4R Code of Practice" that encourage applicators to use the right source of nutrients, applied at the right rate, right time, and right place. IFCA allows its membership, which consists primarily of crop production businesses, to pledge commitment to the 4R Program, and then publishes the names of the companies who have done so. The members pledge to applying nitrogen in the fall only when the temperature reaches 50 degrees Fahrenheit/10 degrees Celsius or below, not applying fertilizer on soil that is frozen or covered with snow, having soil tested every four years, and educating their employees and farmer customers on the 4R practices.

The Illinois Buffer Partnership brings together many partners—the nonprofit Trees Forever, the agricultural group Illinois Council on Best Management Practices, chemical company Syngenta, the agricultural cooperative GROWMARK, and governmental agencies to promote and showcase voluntary conservation efforts of farmers and landowners that improve water and soil quality. The Partnership chooses 10 to 20 Illinois landowners every year to receive cost-share funds and on-site assistance to implement conservation projects such as buffer strips along fields or livestock operations, stream bank stabilization, and restoring wetlands.

Discussion

Our initial research results indicate increasing state interest in laws, policies and programs to address agricultural nutrient impacts on water quality. More activity is occurring in states that experience higher rainfall or are near significant water resources such as the Great Lakes, Mississippi River Basin and Chesapeake Bay. There appears to be continued reliance on voluntary practices coupled with a slight movement toward mandatory practices, a trend that may raise concerns with agricultural landowners and operators.

Most common are two traditional approaches states are pursuing as both voluntary and mandatory actions—nutrient management planning and conservation programs. These approaches raise several important issues. First, nutrient management planning requires extensive technical resources and assistance. Estimates of the cost of developing a farm NMP ranges from $2,400 to $12,100 USD, dependent upon the size and complexity of the operation (Ohio Department of Agriculture, 2018). These costs may hinder the success of NMP approaches if public resources for assisting with NMP development are limited or operators are unwilling or unable to fund NMPs. Second, recent litigation against a dairy operation in the case of *Community Association for Restoration of the Environment, Inc. v. Cow Palace LLC* led a federal court judge to closely examine the dairy's NMP. The court concluded that the dairy's applications of manure were "untethered" from the NMP and that the NMP failed to account for residual nutrients in the soil, both of which resulted in water quality impacts from over application of nutrients. The court's close analysis of the NMP and the dairy's actions suggest that NMPs must be carefully drafted and implemented to accomplish the purpose of preventing agricultural nutrient runoff.

Similar to NMPs, conservation programs and practices can require significant financial resources. Without funding assistance to landowners, mandatory conservation programs such as Minnesota's buffer law face opposition from landowners concerned with high costs and the loss of property rights (Baumgarten, 2017). External partnerships that can provide funding for NMPs and conservation practices may be critical to the success of such approaches.

Given the challenges that face nutrient reduction approaches, there is a high need for data that can verify the success of different policies, practices and programs. Only a few approaches include provisions and funding for monitoring and assessing impact, however. Conversely, monitoring and assessment appear to occur independently of specific programs. Modeling and assessment studies do indicate that agricultural conservation practices can reduce nitrogen and phosphorous in waterways (Garcia, et al, 2016). Funding for monitoring and analysis should be integrated into programs that center on practices aiming to reduce nutrient impacts.

While many states have adopted statewide nutrient reduction strategies and plans, the landscape of state approaches appears outwardly disjointed. Nutrient reduction laws, policies and programs can originate from different sources and may exist in several different governmental agencies of the state. External partnerships directed by non-governmental partners could be distanced from or duplicative of agency-led approaches. Some state approaches are singular and without a foundational statewide strategy.

Successful statewide reduction may require an emphasis on statewide planning and coordination that does not appear to exist in many state situations.

Conclusion

States have taken action in recent years in response to concerns about agricultural nutrient impacts on water quality. The resulting landscape of laws, policies and programs is varied and increasingly populated. With further research, our study will continue to identify and classify the state approaches, identify challenges and advantages of different approaches, and seek to determine whether internal coordination of approaches exists.

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