4R NUTRIENT STEWARDSHIP: A COMPONENT OF AGRICULTURAL NON-POINT SOURCE POLICY

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Abstract

A challenge of agriculture is to increase production and feed the world without adversely affecting the environment. Fortunately, there is an immediate connection between applying the 4Rs (the right fertilizer source at the right rate, the right time and in the right place) and their beneficial impacts on crop performance, soil health and decreased environmental pollution. While any approach to addressing non-point source nutrient losses from agriculture must involve fertilizer best management practices (BMPs) and other conservation practices, it is notable that many conservation practices are mitigation approaches rather than preventative approaches. In other words, fertilizer BMPs can help retain nutrients in the crop's root zone whereas many conservation practices act to mitigate nutrients before they escape to surface waters - not before they escape the root zone. Fertilizer BMPs play a key role in addressing nutrient losses.

As states debate approaches for agricultural non-point source nutrient loss reductions strategies, they will need to consider input from all stakeholders including those that represent the public, agriculture, and various other entities. Ensuring agriculture retains the ability to make site specific decisions regarding fertilizer inputs is paramount to productivity, and these site specific decisions must make economic sense in a grower's operation and management scheme. Regarding state non-point policies for agriculture, this paper provides details regarding actions affecting state decisions, examples of state activities and opportunities for engagement by agronomic stakeholders.

Background

As a society, we are faced with the challenge to increase food production in an economically viable way while simultaneously retaining the ecological integrity of food systems; that is we must increase production to feed the world without adversely affecting the environment. The use of fertilizer is currently responsible for 50% of the world's food supply. Fertilizers are used to replenish the soil's nutrients after each harvest to promote healthy and abundant crops for food production. Unmanaged nutrient applications can increase nutrient losses and potentially degrade air and water quality, yet ignoring fertilizer needs can result in decreased soil fertility and decreased yields.

Increasing nutrient use efficiency must be considered in conjunction with productivity. Striving to improve nutrient use efficiency without also increasing productivity simply increases the pressure to produce more on lands which may be less suited to agricultural production. One can achieve increased efficiency by reducing inputs, but this will eventually negatively affect yields. Likewise, squandering of resources to maximize productivity results in increased environmental impacts and decreased profitability.

Policymakers, environmental groups and media representatives sometimes focus on fertilizers as a problem for the environment, and not necessarily a solution to meeting the food needs of a growing population. There is not a one size fits all answer to this challenge, however, fertilizer best management practices that are good for the grower and good for the environment are clearly a part of the solution.

In a 2011online blog, a lead scientist for The Nature Conservancy summed up the solution for hypoxia with an analogy. Hypoxia is like a zombie in a horror movie, it just keeps coming back; there is no one silver bullet to kill hypoxia, rather it must be a combination of efforts (Fargione, J. 2011). Similarly, the recent United States Department of Agriculture (USDA) Conservation Effectiveness Assessment Program (CEAP) reports have a common finding that indicates voluntary practices work and practices to reduce erosion help control surface runoff of particulate phosphorus. However, to achieve the necessary load reductions nutrient management addressing fertilizer form, amount, time and placement method must be utilized in combination with other conservation practices.

The USDA findings mirror efforts being led by the fertilizer industry to increase the implementation of fertilizer best management practices (BMPs) through 4R nutrient stewardship. There is an immediate connection between applying the right fertilizer source at the right rate, the right time and in the right place and their beneficial impacts on crop performance, soil health and decreased environmental pollution (IPNI, 2012). Federal government leadership often serves as guidance to states' efforts to address nutrient pollution.

Federal Policy Engagement Regarding Agricultural Non-Point Sources

EPA Legal challenges and statutes, public comment, water quality issues, and Executive Orders all guide the U.S. Environmental Protection Agency's (EPA) actions regarding nutrients in the environment. In a 2011 memo to its regional administrators, EPA sought state collaboration and action to protect state waters from nitrogen and phosphorus pollution (EPA, 2011). With the memo, EPA provided a guidance document "Recommended Elements of a State Nutrients Framework". See excerpts in Figure 1.

In the memo, EPA encourages states to work collaboratively with their stakeholders to develop innovative approaches for addressing non-point source runoff of nitrogen and phosphorus pollution. Regarding agricultural areas, the guidance framework suggests approaches such as stewardship incentives, certainty agreements, and nutrient trading markets to accelerate adoption of conservation practices. Fertilizer BMPs are clearly a consideration within these approaches.

USDA Certainty programs encourage agricultural producers' participation to voluntarily implement affordable conservation practices that make economic sense and that are specifically tailored to producers' operations for addressing the risks of sediment and nutrient run-off. In turn, these programs give producers assurances that, for as long as they continue to address such risks, they are meeting the state's expectations for what the producers must be doing to deal with water quality concerns. To address the states' interest in certainty agreements, USDA engaged with Minnesota to show support to collaborative creation of a certainty program. From there, as a result of additional stakeholder engagement, USDA developed a guidance document for

voluntary state certainty programs; see document content in Figure 2. Again, fertilizer BMPs are clearly a consideration within the approach.

Figure 1. Excerpts from the March 16, 2011 EPA memo to regional administrators on working in partnership with states to address phosphorus and nitrogen pollution through use of a framework for state nutrient reductions.

Page 2, paragraph 1

States, EPA and stakeholders, working in partnership, must make greater progress in accelerating the reduction of nitrogen and phosphorus loadings to our nation's waters. While EPA has a number of regulatory tools at its disposal, our resources can best be employed by catalyzing and supporting action by states that want to protect their waters from nitrogen and phosphorus pollution. Where states are willing to step forward, we can most effectively encourage progress through on-the-ground technical assistance and dialogue with state officials and stakeholders, coupled with cooperative efforts with agencies like USDA with expertise and financial resources to spur improvement in best practices by agriculture and other important sectors.

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EPA's focus for nonpoint runoff of nitrogen and phosphorus pollution is on promoting proven land stewardship practices that improve water quality. EPA recognizes that the best approaches will entail States, federal agencies, conservation districts, private landowners and other stakeholders working collaboratively to develop watershed-scale plans that target the most effective practices to the acres that need it most. In addition, our efforts promote innovative approaches to accelerate implementation of agricultural practices, including through targeted stewardship incentives, certainty agreements for producers that adopt a suite of practices, and nutrient credit trading markets. We encourage federal and state agencies to work with NGOs and private sector partners to leverage resources and target those resources where they will yield the greatest outcomes. We should actively apply approaches that are succeeding in watersheds across the country.

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The attached framework is offered as a planning tool, intended to initiate conversation with states, tribes, other partners and stakeholders on how best to proceed to achieve near- and long-term reductions in nitrogen and phosphorus pollution in our nation's waters. We hope that the framework will encourage development and implementation of effective state strategies for managing nitrogen and phosphorus pollution. EPA will support states that follow the framework but, at the same time, will retain all its authorities under the Clean Water Act.

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4. Agricultural Areas

In partnership with Federal and State Agricultural partners, NGOs, private sector partners, landowners, and other stakeholders, develop watershed-scale plans that target the most effective practices where they are needed most. Look for opportunities to include innovative approaches, such as targeted stewardship incentives, certainty agreements, and N & P markets, to accelerate adoption of agricultural conservation practices. Also, incorporate lessons learned from other successful agricultural initiatives in other parts of the country.

Figure 2. USDA NRCS Guidance to State Conservationist on state water quality certainty programs.

Sent on September 6, 2012 USDA_NRCS

State Water Quality Certainty Programs

States are pursuing a range of programs to facilitate the voluntary adoption of systems of conservation practices that improve and protect water quality. "Certainty", "assurance", and "certification" programs, when properly designed with the input and support of state stakeholders, can provide states with additional, optional, tools to address state water quality concerns. These programs can also recognize the environmental stewardship of farmers and ranchers and can help lay the groundwork for establishment of markets for ecosystem services. Certainty programs encourage agricultural producers' participation where they voluntarily implement affordable conservation practices that make economic sense and that are specifically tailored to producers' operations for addressing the risks of soil erosion and sediment/nutrient run-off. In turn, these programs give producers assurances that, for as long as they continue to address such risks, they are meeting the state's expectations for what the producers must be doing to deal with these water quality concerns.

USDA fully supports states' efforts to adopt, develop or explore Certainty programs, and offers the following considerations to states as they undertake these efforts:

1. Certainty programs may take many forms and are developed and administered by states.
2. Farmer participation in Certainty programs should be voluntary and not a condition of eligibility for any other program.
3. USDA will assist states with their programs, giving priority to those that will give participating producers tangible assurances that they fully meet the state's water quality expectations.
4. Producers voluntarily participating in state Certainty programs will be among those given priority consideration for technical and financial assistance in a manner that is fully consistent with USDA's authorities.
5. States must determine the proper mix of incentives to encourage farmer participation. Benefits to farmers should be meaningful and clearly communicated. Options include:
    - A program to publicly recognize and commend farmers for their participation;
    - Branding the products from participating farms.
6. States should document and effectively communicate to the public how certainty programs benefit water quality.
7. Farmers' existing conservation efforts should be recognized and given credit.
8. Confidentiality of information about farmers and farm operations must be maintained.
9. Appropriately designed Certainty programs can support and advance existing and developing ecosystem service market programs, and states pursuing a Certainty program should consider how to take advantage of this and how it affects the level of documentation needed.

NRCS As a result of the USDA CEAP reports, the Natural Resources Conservation Service (NRCS) updated their existing 590 nutrient management conservation practice standard. The standard was always intended for use with both commercial and organic fertilizers, but in practice it was generally used for manure management. Because the CEAP reports pointed out the need to address both manure and commercial nutrients as well as to address practices tied to form, amount, timing and placement, NRCS incorporated 4R language and practices into the revised standard (see excerpts in Figure 3). The 590 standard is used to provide growers incentive payments related to nutrient management implementation, and in the past many states have incorporated the 590 into their animal feeding operation policies for nutrient management.

Figure 3. Excerpts from the 2012 USDA NRCS 590 nutrient management conservation practice standard.

DEFINITION

Managing the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments.

PURPOSE

- To budget, supply, and conserve nutrients for plant production.
- To minimize agricultural nonpoint source pollution of surface and groundwater resources.
- To properly utilize manure or organic by-products as a plant nutrient source.
- To protect air quality by reducing odors, nitrogen emissions (ammonia, oxides of nitrogen), and the formation of atmospheric particulates.
- To maintain or improve the physical, chemical, and biological condition of soil.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands where plant nutrients and soil amendments are applied. This standard does not apply to one-time nutrient applications to establish perennial crops.

Nutrients must be applied with the right placement, in the right amount, at the right time, and from the right source to minimize nutrient losses to surface and groundwater. The following nutrient use efficiency strategies or technologies must be considered:

- slow and controlled release fertilizers
- nitrification and urease inhibitors
- enhanced efficiency fertilizers
- incorporation or injection
- timing and number of applications
- soil nitrate and organic N testing
- coordinate nutrient applications with optimum crop nutrient uptake
- Corn Stalk Nitrate Test (CSNT), Pre-Sidedress Nitrate Test (PSNT), and Pre-Plant Soil Nitrate Test (PPSN)
- tissue testing, chlorophyll meters, and spectral analysis technologies
- other land-grant university recommended technologies that improve nutrient use efficiency and minimize surface or groundwater resource concerns.

Current State Efforts Following Federal Guidance

Many states are taking steps in response to EPA's request to develop innovative approaches for addressing nonpoint nitrogen and phosphorus pollution from agricultural non-point sources. As previously stated, successful efforts will likely involve collaborative engagements with agriculture, the use of fertilizer BMPs, and conservation practices. While conservation practices (such as grassed waterways, buffers, tile-line biofilters, and treatment wetlands) are also necessary to the solution, it is important to realize that many of these practices are mitigation

approaches rather than preventative approaches. In other words, properly selected fertilizer BMPs help retain nutrients in the root zone for the plant to utilize, thus reducing losses, increasing nutrients for crop production and protecting a farmer's valuable inputs; whereas many conservation practices act to catch, store or utilize nutrients before they escape to surface waters - not before they are lost from the crop's root zone.

Additionally, with regard to approaches using fertilizer BMPs, implementation must recognize their site specific nature. Practice selection varies by location and those chosen for a given farm depend on local soil and climatic conditions as well as crop, management, and other site specific factors. Here, the 4R framework has an advantage because it does not spell out specific practices, rather it addresses the need for site specificity by prescribing the use of guiding scientific principles.

> RIGHT SOURCE: Ensure a balanced supply of essential nutrients, considering both naturally available sources and the characteristics of specific products in plant available forms. Specifically – consider nutrient supply in plant available forms, ensure nutrient suits soil properties, and recognize the synergisms among elements.
> RIGHT RATE: Assess and make decisions based on soil nutrient supply and plant demand. Specifically – appropriately assess soil nutrient supply (including those from organic sources and existing soil levels), assess plant demand, and predict fertilizer use efficiency.
> RIGHT TIME: Assess and make decisions based on the dynamics of crop uptake, soil supply, nutrient loss risks, and field operation logistics. Specifically – assess the timing of crop uptake, assess the dynamics of the soil's nutrient supply, recognize weather factors, and consider logistics.
> RIGHT PLACE: Address root-soil dynamics and nutrient movement, and manage spatial variability within the field to meet site-specific crop needs and limit potential losses from the field. Specifically – recognize root – soil dynamics, manage spatial variability issues, consider the tillage system, and limit potential off-field transport.

Each state will ultimately decide what approaches will be utilized in their states. Below are examples of state actions that have utilized 4R nutrient stewardship in their approach.

Illinois Following receipt of the EPA framework memo, Illinois EPA approached the state agriculture community to pursue their engagement in addressing non-point source nutrient losses from crop production systems. Through efforts under the umbrella of the Illinois Council on Best Management Practices, several entities have committed to a partnership with state agencies and other nutrient stakeholders to make measurable progress in the adoption of enhanced nutrient stewardship practices to protect water quality. The nutrient stewardship program entitled "Keep it for the Crop by 2025" (KIC) is supported by the Illinois Corn Growers, Illinois Farm Bureau, Illinois Fertilizer and Chemical Association, Illinois Soybean Association, and the Illinois Pork Producers. The KIC effort has established goals for reducing nutrient losses from agriculture through adoption of the 4Rs.

The KIC website (IL CBMP, 2012) states that "KIC by 2025" seeks to educate the agricultural sector, dedicate significant resources toward research to reduce nutrient losses and enhance

nutrient efficiency, educate suppliers and farmers, and measure the adoption of in-field practices to enhance nutrient stewardship beginning in priority watersheds and expanding over years to a state-wide nutrient stewardship program. To fund "KIC by 2025" the stakeholders worked with Illinois legislators to successfully pass an amendment to The Illinois Fertilizer Act to establish a stable, industry derived funding mechanism for nutrient management research and education and to facilitate industry and farmer involvement on nutrient and water quality issues. The legislation was supported by the agricultural organizations, Illinois EPA, Illinois Department of Agriculture and environmental organizations such as the Illinois Sierra Club.

Ohio As a result of nationwide industry efforts to step-up the awareness of 4R nutrient stewardship and inclusion of the 4Rs in USDA NRCS messaging, Ohio retailers took action. In the spring of 2011, the Ohio fertilizer industry increased engagement in Ohio state water quality issues using the 4Rs and began spreading the 4R message to their stakeholders. Industry efforts led to recognition by stakeholder groups like The Nature Conservancy and the Sandusky River Watershed Coalition. Meanwhile, the Ohio State Department of Agriculture, the Ohio Department of Natural Resources, the Ohio Governor's Office and the Ohio EPA were considering ways to address non-point sources from agriculture in response to state water quality issues and the EPA guidance memo.

As a result of the Ohio fertilizer industry's' efforts and additional stakeholder engagement, the 4Rs were named the foundation of nutrient management efforts in Ohio for non-point sources. Given the announcement by the Ohio Department of Agriculture and the Ohio Department of Natural Resources, 4Rs gained broader recognition. In 2012, the 4Rs were highlighted at Ohio winter conferences and trade shows, development of an Ohio 4R retailer recognition program was initiated, and broader outreach and training is now being developed. Most recently, the Ohio governor's office announced the appropriation of $3M to encourage farmer adoption of the 4Rs. Additionally, major Ohio agricultural retailers have joined with producer organizations to provide funds to support research validating 4R efficacy to reduce edge-of-field losses. In November of 2012, Ohio's Nutrient Forum Visioning Workshop will take place and the 4Rs will be the centerpiece of the industry's message for further state engagement.

Pennsylvania In July 2012, the PennAg Industries Association formed an affiliate within PennAg to be designated as the "PA 4Rs Alliance." The Alliance was created as a result of dialogue surrounding the revised NRCS nutrient management (590) standard. The goals for the Alliance are for PennAg members and other Pennsylvania agricultural stakeholders to collectively work with farmers to deliver science-based systems that improve crop productivity through increased nutrient use efficiency and to reduce losses of nutrients to the environment. PennAg embarked on a discovery process to focus these goals and gain support among farm groups, government agencies, industry and certified crop advisors.

PennAg also engaged with farmers to form the Alliance. Farmers said the environmental debate had moved the public dialogue away from crop productivity, farm profitability, and food security and that there was a need for more knowledge on field-specific 4R management tools. Government agency stakeholders were very enthusiastic and supportive.

The effort relies on collaboration. The Alliance, with Pennsylvania NRCS and Penn State University extension, is developing a communication strategy. The strategy will identify and publicize farm 4R success stories and is designing 4R fact sheets to be utilized in farmer incentive program application/contract process to elevate awareness of 4Rs practices for financial and technical assistance. The Alliance is also working with conservation district nutrient management technicians, private crop consultants, and fertilizer retailers to create awareness for crop management systems to increase nutrient use efficiency.

Opportunities for Engagement and Outreach

4R nutrient stewardship provides a clear framework, a succinct message, and the opportunity to address water quality and crop production concerns. Opportunities for stakeholder engagement with the states are abundant.

- Expand your 4R knowledge with available tools (www.nutrientstewardship.com).
- Be a 4R advocate at local watershed and state agency meetings.
- Engage with the NRCS state technical committee and explore opportunities for using the 4Rs within the 590 nutrient management standard, consider involvement with your conservation district.
- Increase implementation of 4Rs on the farm by broadening suites of practices and services offered through your organization.
- Educate other agricultural stakeholder groups about 4R nutrient stewardship and encourage their participation and advocacy.
- Provide input when input from agriculture is sought.

References

EPA. 2011. Working in partnership with states to address phosphorus and nitrogen pollution through use of a framework for state nutrient reductions. Memo from EPA to its Regional Administrators. http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/upload/memo_nitrogen_framework.pdf

Fargione, J. 2011. How to kill off the Gulf's dead zone zombie. The Nature Conservancy. http://blog.nature.org/2011/08/how-to-kill-gulf-dead-zone-zombie-fargione/

IL CBMP. 2012. Keep it for the Crops by 2025. http://www.kic2025.org/

IPNI. 2012. 4R Plant Nutrition: A manual for improving the management of plant nutrition. International Plant Nutrition Institute. Norcross, GA. www.ipni.net/4r

USDA NRCS. 2012. 590 nutrient management conservation practice standard. http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/crops/npm

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