

# Implementing nonpoint source pollution programs:

Results of interviews with agency professionals

January 2025

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*Funding for this work was provided by The Nature Conservancy and the Center for Science, Technology and Environmental Policy at the University of Minnesota's Humphrey School of Public Affairs.*



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## Abstract

Nutrient pollution from agriculture remains a leading cause of water quality impairments in the United States despite decades of policy interventions. The authority to implement water quality policies falls to states with significant variation in the development and execution of programs designed to reduce nutrient pollution. Few have evaluated how states implement these programs, limiting insights into how policy actors can improve the design and delivery of water quality policies.

State agency professionals have unique insights into the implementation of programs designed to address nutrient runoff. We report on interviews with agency staff involved in six water quality programs across three U.S. states. We asked interviewees to reflect on the implementation of each program and share recommendations for how policies could be adapted to other states or contexts.

Respondents identified several insights relevant to successful policy implementation. They stressed the need for strong partnerships between state and local agencies, robust technical tools for monitoring and compliance, and adaptable strategies that account for regional and operational differences. Agency staff noted that voluntary policies are more politically feasible but less effective, while mandatory policies can achieve broader compliance when robust enforcement mechanisms are in place.

In addition to implementation challenges, the study notes gaps in equity in agricultural policies. Many programs fail to account for barriers faced by small-scale, minority, and underrepresented farmers, including limited access to land and resources. This research provides actionable insights for policymakers, emphasizing the importance of balancing flexibility and resource allocation to create more effective and sustainable water quality programs.

## Introduction

After years of effort, policies to reduce nonpoint source pollution have had limited success in improving water quality (Dubrovsky & Hamilton, 2010; Lintern et al., 2020). Over half of U.S. stream and river miles are still considered impaired (US EPA, 2024b), as well as over 40% of lakes (US EPA, 2024b). Agricultural runoff is the largest source of pollution to rivers and streams, and the third leading source for lakes in the United States (US EPA, 2024a). Soil sediment and nutrients (e.g., fertilizer and manure) enter surface waters via runoff during rainfall or snowmelt events or in irrigation return flows (e.g., tile drainage) (Brown & Froemke, 2012).

States have implemented a variety of measures to reduce the impacts of agriculture on water quality through the adoption of Best Management Practices (BMPs) such as cover crops and riparian buffers (Liu et al., 2017; Shahady, 2022; Schramm et al., 2024). Other policies aim to regulate nutrient management by mandating the quantity or timing of fertilizer application. State policies range from voluntary to mandatory and vary in their approach to program design and enforcement. Efforts to document the impact of state-level nonpoint source pollution programs

have proven challenging due to the inability to identify specific sources of water pollution, lag times between policy interventions and measurable nutrient reduction impact, and the resources required to monitor water quality outcomes (Tomczyk et al., 2023).

Additional challenges are related to the implementation of nonpoint source pollution reduction programs. Implementation challenges include insufficient monitoring or enforcement, low adoption rates, limited resources to oversee or execute programs, or investments in practices that are ultimately ineffective in meeting the original policy goals. Existing policy implementation research on agricultural water quality has focused on the perspectives of farmers and producers. Scholars have used focus groups (Irvine et al., 2024), surveys (Denny et al., 2019), interviews (Reimer et al., 2018), mixed methods (O'Connell & Osmond, 2022; Osmond et al., 2015), and meta analyses (Baumgart-Getz et al., 2012) to assess farmer perspectives on program adoption and participation. Research has assessed farmer perspectives on climate change (Arbuckle et al., 2014), adoption of climate change adaptation practices (Soubry et al., 2020), and motivations to reduce nutrient inputs (Young et al., 2022). Insights from this work have identified the importance of trusted sources in enhancing participation in conservation programs and motivating farmer behavior and adoption of best management practices.

Relatively less attention has been devoted to the perspectives of agency staff and the practitioners that implement water quality policies. Policy scholars use the term “street-level bureaucrats” to describe policy actors that interact with the public and have considerable autonomy in decisions that affect policy and program implementation (Lipsky, 1980). In the context of state nutrient reduction policies, these actors include agency staff who oversee the implementation of state and federal nutrient management programs, as well as local Soil Water Conservation District (SWCDs, or their equivalent) professionals. In contrast to farmers and producers who are often the target of nutrient reduction programs, street-level bureaucrats offer unique perspectives on the details of policy design, implementation, and enforcement.

Previous research found street-level bureaucrats impact policy outcomes through their discretionary power and allocation of resources. Wardropper (2018) surveyed SWCD staff in the Upper Mississippi River Basin, finding variation in how staff integrated environmental performance information in watershed planning. Reimer and Prokopy (2014) interviewed Natural Resource Conservation Service (NRCS) staff involved in the implementation of the agricultural cost-share program, EQIP, identifying ways that agency staff adapted federal programs to accommodate local contexts. In a study of Missouri agroforestry programs, Kronenberg et al. (2023) found that uptake of recommended practices was hindered by a lack of in-depth knowledge by conservation officials. These examples demonstrate the potential influence of agency staff on program effectiveness. However, there remain few studies that capture the unique insights that agency staff offer on water quality program design, monitoring, and enforcement (Holstead et al., 2021).

In addition to understanding the effectiveness of nutrient reduction programs, there is growing interest in studying the equity dimensions of environmental and agricultural policies (Layman & Civita, 2022). Guidance from the Biden Administration requires federal agencies to consider the

equity and distributional impacts of federal programs (Executive Order 14096, 2023). State water quality funds have also begun to add requirements to consider how investments “celebrate cultural diversity or reach diverse communities, including reaching low- and moderate-income households” (Clean Water Fund, 2024). These efforts are often motivated by a recognition that discriminatory practices have led to differential outcomes in access to land or exposure to environmental harms. For example, scholars have highlighted how United States Department of Agriculture (USDA) policies negatively impacted access to land and farm programs by women (Samanta et al., 2022), immigrants, black people, and indigenous peoples (Carpenter, 2012; Civil Rights Action Team, 1997; Horst & Marion, 2019; Samanta et al., 2022). Specialty crop growers and beginning farm operators also face barriers in access to land, subsidies, and incentive programs (Callahan & Hellertin, 2022; McFadden & Hoppe, 2017). Our study is unique in investigating the perspectives of street-level bureaucrats on the equity implications of agricultural water quality programs.

Through interviews with agency staff, we aim to provide insights into practical and theoretical dimensions of water quality program implementation with a focus on policy successes, challenges, and equity implications. Our work identifies factors that contribute to successful policy implementation, highlighting the importance of interagency coordination and the availability of technical tools. We conclude with insights on how the reviewed policies could be adapted to other contexts.

## Methods

We focused our analysis on state policies and programs designed to reduce non-point source pollution associated with agricultural activities. We identified existing nutrient reduction policies enacted in corn belt states of the Upper Midwestern US. From this review, we selected a subset of policies that represented a range of enforcement approaches, inclusive of voluntary and mandatory programs. We were interested in policies that could be replicated in other states and where state actors held significant authority over policy implementation and enforcement. The six selected policies met all these criteria and provided a range of geographic distribution. We then reviewed publicly available documentation on each policy, including program websites, legislative statutes, and progress reports, to build a baseline understanding of each policy. All of these policies aim to reduce nonpoint source pollution through the implementation of BMPs on farm acreage in their respective states (Figure 1, Table 1).



**Figure 1:** Map showing where each policy is implemented.

Policy	State	State Agency	Year in Effect	Mandatory or Voluntary	Program Summary
Groundwater Protection Rule	Minnesota	Dept. of Agriculture	2019	Ramps from voluntary to mandatory	Restricts the application of nitrogen fertilizer in the fall and on frozen soils in areas vulnerable to contamination. Outlines steps to reduce nitrogen pollution where nitrate in public water supply wells is elevated.
Agricultural Water Quality Certification Program (MAWQCP)	Minnesota	Dept. of Agriculture	2013	Voluntary	Whole-farm conservation planning that provides regulatory certainty, recognition, and priority for technical and financial assistance to those who meet or exceed water quality risk assessments and sign an enrollment contract with the state.
Buffer Law	Minnesota	Board of Water and Soil Resources	2017	Mandatory	Requires vegetative buffers, or approved alternative practices, along public waters to reduce runoff.
Nutrient Management Plans	Wisconsin	Dept. of Agriculture, Trade, and Consumer Protection	2003	Mandatory	Farm-specific plans for fertilizer and manure application designed to reduce nutrient runoff.
Adaptive Management	Wisconsin	Dept. of Natural Resources	2010	Voluntary	Point source dischargers partner with nonpoint source landowners through a watershed approach to reduce phosphorus inputs.
Partners for Conservation Program	Illinois	Dept. of Agriculture	1995	Voluntary	Provides funding to different agriculture-related programs; provides cost share to farmers implementing pre-approved conservation practices aimed at reducing soil loss on cropland.

**Table 1:** Policies selected for evaluation in each state, characterization of policy approach, and brief summary of each selected program.

We selected interview participants based on their roles overseeing the implementation or creation of the selected policies. Using a criterion sampling method (Creswell & Poth, 2017), we identified officials associated with each policy, seeking varied perspectives on program implementation. We expanded our contact list using a snowball approach (Creswell & Poth, 2017) by asking for additional names and contact information of other people we should interview. We concluded participant outreach and sampling when we had sampled the majority of the state agency staff tasked with managing the policy; the one exception was Illinois where

we had difficulty contacting other officials beyond our single interviewee. We interviewed a total of 17 staff overseeing the implementation or creation of the six selected agricultural nutrient reduction policies across the U.S. states of Minnesota, Wisconsin, and Illinois (Table 2).

State	Policy	State Agencies				Total Interviewees
		Department of Agriculture (MN-DA, IL-DA, WI-DATCP)	Department of Natural Resources (DNR)	Board of Water and Soil Resources (MN BWSR)	Pollution Control Agency (MPCA)	
Minnesota	Groundwater Protection Rule	3				3
	Ag Water Quality Certification Program	4				4
	Buffer Law		3	1		4
	Overall nutrient reduction strategies				1	1
Wisconsin	Nutrient Management Plans	1	1*			1
	Adaptive Management		3*			3
Illinois	Partners for Conservation	1				1
	<b>Total Interviewees</b>	9	6	1	1	17

\*One interviewee had expertise in both WI policies

**Table 2.** Interviewees by department affiliation and policy expertise.

The interviews followed a semi-structured approach using a consistent set of open-ended questions (see Supplemental Material, Interview Guide). This method provided flexibility and allowed for interviewers to follow insightful conversations based on participant comments (Young et al., 2018). We asked the participants about implementation successes and challenges, considerations of equity, and potential for the policy to transfer to other state contexts. Where relevant, we also asked respondents to speak to experiences developing the policies and the politics of policy design and implementation (see Supplemental Material, Interview Guide). Interview guides were adapted to each policy to add policy-specific context and questions based on our background research.

The interview protocol and guide were reviewed and approved by the Institutional Review Board of the University of Minnesota. We conducted 13 interviews via the video conference software, Zoom, from February to April 2024. Eleven agency officials were interviewed individually, and two interviews were groups of three for a total sample of 17 participants. The group interviews included agency officials with different roles in implementing the same policy. The interviews were recorded with participant permission using the Zoom record function. Interviews lasted from 30 to 60 minutes, with the exception of one group interview which lasted 120 minutes. Interview transcripts were generated from Zoom recordings and then manually reviewed and edited to create final transcripts. No monetary compensation was provided to participants.

Interview transcripts were coded using the qualitative analysis software, ATLAS.ti (ATLAS.Ti, 2024). The research team developed a codebook by inductively coding sample transcripts for structural codes and emergent thematic codes (Tracy, 2019). Once codebook consensus was established, two individuals separately coded all of the remaining interview transcripts. We used a grounded theory approach, identifying themes that emerged from the coding process, discussing themes with the project team, and then conducting iterative reviews of the transcripts as themes and insights emerged (Rubin & Rubin, 2011; Creswell & Poth, 2017). The final themes were selected based on our research questions and relevance to theoretical and practical applications (see Supplemental Materials, Codebook).

## Results

Interviews and subsequent coding revealed themes for successful nutrient reduction policy implementation. Below, we describe each theme and present evidence from the interviews in the form of insights or illustrative quotes.

### I. Nutrient policies and programs exist in a policy ecosystem

A key insight from the interviews was that each nutrient reduction program exists within a policy ecosystem. This ecosystem consists of cross-level (state and local) partnerships, interagency partnerships, and existing policies.

Many agency respondents said local partnerships were key to successful policy implementation. Universally, agency staff noted that local conservation district (e.g., SWCD) capacity, particularly staff knowledge and staff time, were limiting factors for program success. In fact, several respondents said that a lack of consistent, long-term, well-paid staff at SWCDs was the most critical obstacle to implementation. Insufficient funding was cited as contributing to this challenge, along with struggles to hire and retain qualified candidates.

Interviewees said that SWCD staff turnover prevents the building of trust with farmers and producers. Because SWCDs are the primary implementers and providers of technical assistance related to these policies, success depends on the development of personal relationships between participants and SWCD staff. Rapid turnover prevents the building and continuation of those relationships. SWCD turnover can also prevent skill transfer. While new employees may be hired at rates sufficient to maintain staffing levels, a deficit of experienced



staff prevents new employees from receiving the necessary training to be successful in their roles. One Minnesota state agency staff member stated: “There's just not enough of those folks available that are open [to SWCD jobs]. And then we're losing a lot of our technical staff who are retiring. And so you know, you might have a crop of some really ambitious young employees. But do you have the right people to train them in?”

Interviewees identified competition and a tight job market as another reason for staff turnover. Agricultural companies will “poach” employees after two to three years, using their time in the SWCD as quasi-training for higher paying private sector jobs. A Minnesota state agency staff further described this issue, “It's just the fault of...the pay grade or the location that it's just kind of a steppingstone, and people move out of there quickly once they get a job. So you're always back there trying to get them up to speed.”

In addition to local capacity, effective policies need strong partnerships with other state agencies. For example, many of the reviewed programs rely on water quality models to estimate and report on program outcomes. These models are often created by other state agencies. For example, the Minnesota Agricultural Water Quality Certification Program (MAWQCP), housed in the Department of Agriculture, uses a nutrient reduction estimator tool created by the Board of Water and Soil Resources (BWSR), while direct water quality measurements are collected by the Pollution Control Agency (PCA). Agency staff implementing MAWQCP must rely on technical experts from both BWSR and PCA to execute the program.

Successful policies also depend on supporting programs and policies. Interviewees described how Minnesota's Buffer Law relies on a state definition of a public water and an associated public waters map. Implementation of the Buffer Law would not be possible without this digitized map, requiring staff effort and expertise across programs. Interviewees described how their programs rely on university research to support program implementation, especially for fertilizer rate and timing recommendations. For example, Wisconsin's Nutrient Management Plans require that fertilizer be applied within the recommended rates developed by the University of Wisconsin. As one Minnesota state agency member stated: “I think it's been very helpful that we have a strong relationship with our University of Minnesota and having that technical partner has been very important. And so this doesn't stand in isolation. You need, you know, the work coming in and the research behind you.”

## II. Technical tools affect implementation outcomes

All of the reviewed policies utilize technological tools developed and maintained by other state or federal agencies (Table 3). The most frequently mentioned tools were models used to estimate nutrient loading or greenhouse gas emissions (e.g., RUSLE2, COMET, SNAP+, PTMApp) as well as online mapping applications to track program progress and disseminate results. The maps, models, and programs hold important keys to policy implementation, either through monitoring or compliance. The creation and implementation of these technologies exist under the constraints outlined above, specifically challenges related to limited financial and staff resources and dependencies on external agency or technical partnerships. In theory, technical tools hold agency staff accountable to the goals of the program while supporting evidence-

State	Policy	Tools	Developer
Minnesota	<i>Buffer Law</i>	Public Waters GIS Map	Minnesota Department of Natural Resources
		Online Public Waters Comment Tool	Minnesota Department of Natural Resources
		Satellite Imagery	
	<i>MAWQCP</i>	GIS Map of Participant Growers	Minnesota Department of Agriculture
		Assessment Tool (Model)	Minnesota Department of Agriculture
		Prioritize, Target, and Measure Application (PTMApp)	Minnesota Board of Water and Soil Resources, Minnesota Geospatial Office (MNGEO), Houston Engineering Inc., International Water Institute
		NRCS COMET (GHG Emissions)	U.S. Department of Agriculture
	<i>Groundwater Protection Rule</i>	Modeling	University of Minnesota
Vulnerable Groundwater Area Map		Minnesota Department of Agriculture	
Wisconsin	<i>Adaptive Management</i>	Soil Nutrient Application Planner (SNAP+)	University of Wisconsin
		Erosion Vulnerability Assessment of Agricultural Lands (EVAAL)	Wisconsin Department of Natural Resources Bureau of Water Quality
		Satellite Imagery	
	<i>Nutrient Management Plans</i>	Soil Nutrient Application Planner (SNAP+)	University of Wisconsin
Illinois	<i>Partners for Conservation</i>	Revised Universal Soil Loss Equation 2 (RUSLE 2)	USDA-Agricultural Research Service(ARS), USDA-Natural Resources Conservation Service (NRCS) University of Tennessee

**Table 3.** Tools mentioned in interviews used for policy design and implementation and the tools’ developers.

based decision making. In practice, many respondents noted limitations of technical tools for program implementation and monitoring.

Interviewees described technical tools as “crucial” for the evaluation of program effectiveness. Tools are used to determine phosphorus compliance, estimate the effectiveness of best management practices, and assess progress towards state nutrient reduction goals.

Technical tools also play a role in building compliance with new rules or updates to legislation. Wisconsin relies on local counties to determine compliance with state nutrient management standards. When the Wisconsin Nutrient Management Planning standard underwent a legislative update in 2015, the technical tool used for program implementation (SNAP+) was also updated. Widespread use of SNAP+ allows for the state to integrate updated standards in a tool that is already widely used by growers and agronomists. A Wisconsin agency staff member described how updating SNAP+ contributed to meeting new nutrient planning standards: “The last time this was updated most people jumped immediately to trying to meet the new standard because the software had it. We don't require [the use of the SNAP+ software]. But it's a very good software to use for planning. It had it baked in already... So then by default, if they were utilizing that software, they're meeting the new standard already.” The tool was also used to show that meeting the new standard was reasonable, which helped to alleviate grower concerns: “we were able to show people it wasn't that bad to jump from the 2005 standard to the 2015 standard.”

Agency staff expressed concern that technical tools can oversimplify complex landscape interactions. Practitioners may feel incentivized to achieve scores or outcomes provided by the tool, even if the modeled score doesn't address the root causes of soil or water degradation on a given landscape. One Minnesota interviewee stated: “The problem is, people go and look at it, think it's a video game and they go. I click this, and I click that. The score says 8.5 makes you eligible... It's not just like do whatever you possibly can to just raise those numbers. It's like, no, you know the issue is too much tillage on a hillside. Go in and fix that.”

We also heard that technical tools are susceptible to manipulation by regulated entities. Wisconsin officials disclosed an example when a point source overestimated potential phosphorus reductions by inputting unrealistic slopes (greater than 90%) across entire flat fields, and stated: “There's a tendency by these facilities that are engaged in adaptive management to paint a very rosy picture on the impact of the practices that they're implementing. So you know, there'll be a tendency to overestimate or over inflate the reductions.” The lack of comprehensive data on practice adoption, field conditions, and empirical monitoring data was noted by some staff as contributing to a general distrust of model accuracy.

Developing, maintaining, and training staff on technical tools requires significant time and resources. At the same time, agency officials described the creation process for some of these internal tools as hastily developed. One interviewee described the process of developing the assessment tool for Minnesota's MAWQCP as “flying this plane as we built it.” And another described the development of Minnesota's Public Waters Map for the Buffer Law as “done under a compressed time period.”

In addition to adequate time for development and testing of technical tools, interviewees highlighted the need for adequate allocation of staff to refine, maintain, update, and train users on tools. Interviewees described the development process of the Public Waters Map, essential for the implementation of Minnesota's Buffer Law, as requiring significant staff effort, "We spent probably at least a year of pretty intensive labor, you know, trying to make the map right and then we were still working on it pretty intensely for another year." Some programs have decided to outsource technical tool development or use existing models developed by other agencies or universities. One of the strongest examples of this is the widespread use of the USDA's Revised Universal Soil Loss Equation 2 (RUSLE2) model (USDA, 2022).

Despite noted challenges associated with technical tools, agency respondents broadly acknowledged the importance of models, noting reduced costs relative to monitoring data and contributions to program implementation and communication of policy outcomes. There was broad support among agency staff for additional investments in monitoring and modeling. As noted by one agency staff in Minnesota, "I think more monitoring would help us understand the effects of programs and would actually allow us to improve our modeling, too. And we're trying to estimate the effects of these practices, we can have better data to improve our models."

### III. Mandatory and voluntary policies have tradeoffs in political feasibility, public acceptance, and adoption rates

The policies included in our analysis relied on both voluntary and mandatory enforcement strategies. In our interviews, we asked agency staff to reflect on the implementation challenges of these different approaches to ensuring program compliance. A key finding was that mandatory and voluntary policies have tradeoffs in political feasibility, public acceptance, and adoption rates.

Respondents noted that mandatory policies lead to more widespread adoption than voluntary programs, but the effectiveness of mandatory programs are constrained by investments in enforcement. For example, Minnesota's Buffer Law has installed buffer strips or alternative practices on over 98% of required public waters. In contrast, Wisconsin's Nutrient Management Plans are mandatory, but have only 32% compliance statewide. Wisconsin's state agencies do not have enforcement authority for Nutrient Management Plans except in limited circumstances, leaving the majority of enforcement up to local authorities. These local authorities may choose to implement enforcement mechanisms, but many do not. Piecemeal enforcement of some programs has prevented widespread adoption and limited program effectiveness.

Agencies described mandatory policies as being more politicized than voluntary programs. When asking agency staff about the implementation of mandatory programs, respondents noted that acceptance of these programs depended on public participation in the political process that led to the passage of these policies. Agency staff received significant public backlash when there was no stakeholder engagement process prior to enactment of the policy. One Minnesota interviewee summarized this issue: "What you don't want to have is farmers thinking that it was unfairly done or ill-conceived or forced upon them without their input... The cost isn't just a

financial cost. It's also a social cost. It's a cost to people's freedoms. That's a cost to...building trust." As a result of strong opposition to the buffer rule, one interviewee described the policy as "always kind of on the edge of being politically repealed."

In contrast, agency staff described voluntary policies as offering the potential to garner public acceptance beyond early adopters and sustainability-minded producers. As one Wisconsin state agency staff member stated: "Wisconsin is the way it is because people really wanted local control and they wanted the voluntary conservation methods. It really does work a lot better when you have local buy-in for these things. People are more willing to adopt practices, or more willing to communicate with you. If you know me going out to a farm and telling them, 'well, you have erosion. You're not meeting nutrient management standards' that comes out very differently than your neighbor, who is also a farmer coming on and being like, 'Hey, I got some assistance from [agency staff] or the county. Would you be interested in chatting some more about that?'"

Minnesota's Groundwater Protection Rule integrates both voluntary and regulatory policy mechanisms. Participants are encouraged to participate in voluntary programs as a way to avoid future regulatory action. As described by one interviewee: "If the state has a regulatory program, they really may be able to use that as some leverage to offer a voluntary program. Say, 'hey, we can work with you before the state comes in and regulates,' so that balance between a regulatory and voluntary approach is often effective even in the absence of regulation going into effect."

#### IV. Flexibility allows a program to adapt, but increases program complexity and resource needs

Another theme that emerged from our interviews was how programs were forced to adapt over time to complex and changing conditions. Multiple interviewees described how the diversity of agricultural systems, farmer behaviors, and land use conditions posed challenges for program implementation. In addition to local context, climate change, dynamic global commodity markets, political differences, and rapidly evolving science made consistent and uniform implementation of programs difficult.

When participants explained how they adapted to these complexities, they mentioned the benefits of flexible programs. Examples of policy implementation strategies that allowed for flexibility included expanded eligibility for field-scale practices, shifts in policy design in response to feedback from the public and producers, and use of adaptive management strategies. For example, staff overseeing Minnesota's Buffer Law received public pushback associated with farm conditions that didn't easily accommodate the mandatory buffers. In response, a state agency (BWSR) created six alternative practices that could be adopted as alternatives to riparian buffers. Describing this approach, agency staff stated, "BWSR developed what we called alternative practices...They had a six pack of alternative practices and that made a huge difference... One of the acceptance issues was, 'Hey, one size doesn't fit all'... And those alternative practices really took care of a vast majority of those kind of criticisms or complaints."

Another example of policy flexibility is Wisconsin's Adaptive Management program, which provides a compliance option for point source facilities to meet nutrient reduction targets by working with other sources in their watershed (Water Quality Standards for Wisconsin Surface Waters: Phosphorus, 2010). The interviewees discussed the potential benefits of allowing for collaboration among partners, noting: "With any of these point source offset programs, their primary application is to achieve the point source's goals. And it's very clear. ... adaptive management goes above and beyond just that offset equation. Because you now have an entity that has committed to holistically restoring their watershed."

Agency staff cautioned that adaptation to program complexity required increased efforts by staff as well as greater technical expertise to navigate policy nuance. Flexible policies can be more challenging and labor intensive to implement, requiring tailored guidance and enforcement rather than one-size-fits-all approaches. Interviewees described extensive technical assistance needs by the farmers or point source facilities in the early stages of program development. A staff overseeing Wisconsin's Adaptive Management program said: "There was a lot of education and outreach explaining the different compliance strategies. To some extent certain facilities sort of got overwhelmed... You could do adaptive management. There's water quality trading, and then you may qualify for variance, right? And for smaller communities, this ends up being like: 'Whoa, a lot of options.'"

Navigating a complex web of policy options demands more staff time from agencies and partners. Flexible programs can place additional requirements on agency staff to develop and update training and outreach materials for implementation partners and the public. This is especially taxing on SWCD staff who are already stretched in terms of resources and capacity.

In summary, respondents discussed ways in which policy flexibility allowed programs to adapt to dynamic conditions. At the same time, flexibility introduced complexity to policy implementation that came with additional demands on staff time and expertise.

## V. Programs have not been able to meaningfully disrupt existing equity problems

In addition to questions related to program effectiveness, we were interested in the ways nutrient reduction programs impact equity and distributional considerations. We asked how the following groups may differentially benefit from nutrient reduction policies in terms of eligibility, access to benefits, or increased costs or regulatory actions: 1) Farmers that lease land vs own land; 2) Farmers that primarily grow specialty crops vs commodity crops; 3) Small farms vs large farms; and 4) Farmers that identify as an Immigrant, Black, or Indigenous. We also asked if outreach was conducted to underrepresented groups and if demographic information was collected on participants of the program.

Not unsurprisingly, agency staff reported that the studied programs have not meaningfully advanced equity goals. When interviewees were asked whether their programs impacted

underrepresented groups, most stated that their program impacted all people equally or that the program staff had not considered it. The common answer to a question about how nutrient reduction policies impacted equity was “I don’t know”.

Some interviewees acknowledged that land access was an underlying issue that few programs were designed to address. Programs are available to all *farmers*, but farming is only accessible to those who can access land, as described by a Minnesota state agency staff, “They get absolute access to us, but we're already, you know, one layer in agriculture. Right? They gotta get through that very first door first, and there's clearly obstacles to that... The first door just being access to land.”

## VI. Policies can be replicated in other states, but must be adapted to state contexts

We closed each interview by asking respondents what advice they might have for other states considering the possible adoption of their policy or program. Agency staff were generally supportive of scaling programs to other geographies, but cautioned that programs must be adapted to state and local contexts. Respondents noted that particular programs may not be transferable to a different state if agencies have different authorities or if programs have been adapted to specific soil types, geologic conditions, or climates.

As noted above, some programs rely on supporting policies or tools as part of a policy ecosystem. Implementation of the Buffer Law was dependent on a state-created Public Waters Map, mandated by state statute. Quoting a Minnesota official, “It's imperative in the sense that again, we have this regulatory requirement to maintain [the Public Waters Map]. And there's a need to have some form of map available to the public.” Programs transferred or scaled to other states need to consider how new programs interface with existing policy supports, agency authorities, and local capacities.

Another common theme related to policy replicability was the need to build strong relationships with farmers and producers in order to assess policy feasibility. The offices of the individuals tasked with implementing nutrient reduction policies are often located in the same communities as the affected program participants. Agency respondents were careful to note that successful programs relied on local buy-in and should be coupled with investments in outreach and education, along with opportunities for residents to help shape policy design and implementation. Table 4 provides a summary of recommendations from agency staff organized by policy and associated theme.

## Discussion

Our work supports the need to consider policy implementation as an ecosystem consisting of policies, state-local partners, interagency partners, and supporting programs (Weaver-Hightower, 2008). Existing literature on the implementation of nutrient reduction programs has similarly articulated the criticality of partnerships to policy success (Bitterman et al., 2023; Fales

State	Policy	Theme or Key Takeaway	Quote
		Policy endorsement	"Yes, do this program. I just think it's particularly effective. I think it's actually readily transferable."
		Stakeholder involvement	"I think that kind of stakeholder process is really good, though, to, you know, not just drop it on people. Bring them in. Bring him into the process."
Minnesota	MAWQCP	Policy ecosystem: foundational policies and partnerships	"One of the fascinating things I learned from California is like, Oh, we don't have any of those fertilizer recommendation rates... So those challenges exist for other states."
		Policy ecosystem: partnerships	"The most important, I think, is to know their delivery model. Who's delivering the program? Is it going to be SWCD, is it going to be say department of ag, or whoever."
		Flexibility	"You need to build up enough support to get some type of law passed and you need to be flexible."
		Time for technical tool development	"From a map and implementation perspective, I think more lead time would be really helpful to plan through how that implementation is going to occur."
Minnesota	Buffer Law	Messaging	"You gotta sell it. You're gonna get resistance, of course. Get people used to the idea, kind of promote what other states have done, and kind of enumerate some of the benefits they'd see."
		Partnerships	"Find friends and keep them close and expect opposition, but try, you know, be persistent and articulate the benefits."
		Transparency and stakeholder involvement	"You need to be transparent about what it is you're doing and you need to base your arguments for doing it on both science and economics. And you need to include a good cross section of everybody"



		Policy exists within, and as a result of, the complexity of the world	“We have karst geology, and of course, textured soils and soils with shallow bedrock here. So we've designed the rule to address those issues.”
		Policy ecosystem: agency context and authority	“And another thing I would have to suggest they look at as their policy, because in Minnesota MPCA's got the authority for manure feed lots. We've got authority for nitrogen fertilizers. So our role mainly addresses nitrogen fertilizer, and we can address manure rates. But if a different state has a different setup in their manure and fertilizer regulation is in one agency, then they might have a little bit different rule that addresses it all in one aspect of the rule.”
Minnesota	Groundwater Protection Rule	Policy ecosystem: funding	“Funding is critical. When you really get into these areas, some of these practices are expensive, and so our ability to leverage our Clean Water Fund has just been a game changer for us.”
		Center science in development and capacity	“As you begin to develop something similar to the Groundwater Protection Rule, keep the science central to it, making sure that we've got that strong technical background.”
		Policy ecosystem: partnerships and technical tools	“I think it's been very helpful that we have a strong relationship with our University of Minnesota and having that technical partner has been very important. And so this doesn't stand in isolation.”
		Goal development	“Defining your goals clearly”
Wisconsin	Adaptive Management	Policy ecosystem: adapt don't adopt	“Don't underestimate the staff it takes to support the development of the program and the time it takes to develop the program. It's not just an off the shelf solution, it takes time. And other states can benefit from our existing program, but there will have to be things that will probably have to be tailored.”
		Monitoring tools	“Have clear measurement tools in mind.”
Wisconsin	Nutrient Management Plans	Voluntary	“I'm always good to advocate, for, like locally led voluntary conservation just in general. Because I see a lot better buy in.”
		Requires local support	“I would caution trying to adopt it one for one. But it's gonna require a lot of local buy in, I think, from people, and not just anti-farm or pro-farm groups or industry groups”

Illinois	Partners for Conservation	Partnerships for enforcement	"Keep the soil and water districts in check... make sure they're following the rules and your guidelines and carrying the program out."
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**Table 4.** Answers from participants when asked, "What advice would you give if another state was considering adopting this same program?" and the theme associated with their statement. *See an expanded table under Supplemental Materials, Policy Advice.*

et al., 2016; Hardy & Koontz, 2008). We find that state nonpoint source programs depend on multi-level partnerships, local capacity and expertise, and supporting technical tools and policies.

In an analysis of federal conservation programs, Reimer & Prokopy (2014) determined that "the premier partnership in each of the study states is with the local conservation districts." Our research illustrates that local conservation districts or SWCDs are critical to the success of state programs. At the same time, our interviews established that many SWCDs are understaffed and under-resourced, limiting program effectiveness, an observation supported by previous surveys and interviews with conservation practitioners and residents in the Midwestern U.S. (Pradhananga et al., 2015; Reimer & Prokopy, 2014; Wardropper et al., 2015, Trouba, 2023).

Limited SWCD capacity prevents the building of trusting relationships between participants and program staff (Osmond et al., 2015; Baumgart-Getz et al., 2012; Reimer et al., 2018). Along with local partnerships, we find that strong interagency partnerships are necessary for program success. In a 2018 analysis of coastal counties of the United States, researchers similarly found that increased interagency collaboration improved nonpoint source pollution outcomes (Scott 2018).

Technical tools also play a critical role in policy implementation, connecting field scale conditions and management decisions to programmatic goals set by states. We find that technical tools are subject to discretionary choices made by street-level bureaucrats. The role of professionals in tool adoption and use was previously explored by Arnold in their review of the use of a wetland assessment tool (2014). Ghosh similarly observed an appetite of imprecision in the federal Conservation Management Tool used by the NRCS staff (2019). Respondents in our interviews expressed concern that tools are often developed under resource and time constraints and rely on technical partnerships with other agencies or academic institutions. Ghosh found time and resource constraints present in the development of a Conservation Stewardship Program algorithm (2024). Ghosh also noted a concerning lack of transparency and accountability for the development of a tool used to allocate billions of federal dollars for conservation activities (2024). The continued proliferation of these tools with increased agricultural digitalization (Ehlers et al., 2021), big data (Coble et al., 2018), and drone use (Westbrooke et al., 2023) will necessitate continued investments in tool transparency and accountability.

Whereas previous interviews with state agencies found a lack of data, particularly field level data, to hinder nutrient reduction policies (Wardropper et al., 2015), our study's interviewees

rarely mentioned this as a limitation. This may be due to a greater reliance on modeled data. That, in turn, could result from more investment in technical capacity and wide availability of high-resolution geospatial data.

Concerns raised by agency staff regarding the reliability of technical tools in nonpoint source policy implementation have been observed in previous studies. A study of agency officials found that many expressed mistrust of a watershed planning model used to meet nutrient reduction goals in the Chesapeake Bay (Bitterman & Webster, 2024). In fact, a recent publication found discrepancies between modeled nutrient reductions from the planning tool and the observed monitoring data for the Chesapeake Bay (Zhang et al., 2024). These quantitative and qualitative assessments support the sentiments of the agency officials we interviewed who felt a skepticism about the accuracy of the models used for the implementation of their policies.

Previous research has identified potential tradeoffs between public acceptance and effectiveness in voluntary and mandatory policy approaches. We found that voluntary policies were better received by the public and were less politicized. However, voluntary programs had lower adoption rates that may reduce program effectiveness. Dowd et al. (2008) and Rissman et al. (2017) also found that voluntary policies had greater public acceptance, but that the voluntary nature can limit the widespread adoption (Ribaudo, 2015; Segerson, 2013). Agency staff in our study noted that the threat of regulatory measures can encourage participation in voluntary programs, a finding also articulated in Wardropper et al. (2023) based on their analysis of Midwest nutrient reduction programs.

Ostrom (2010) observed that investments in stakeholder engagement can enhance the legitimacy and trustworthiness of the policymaking process. Similar insights were described by Perez (2015), who found that regulatory approaches to nutrient reduction had better outcomes when agencies prioritized gaining buy-in from farmers rather than taking an adversarial approach. Our interviews detailed multiple ways that a lack of public participation in policymaking could limit the public acceptance of mandatory policies. At the same time, agency staff we interviewed stressed that mandatory policies should be coupled with robust enforcement mechanisms in order to increase program adoption and compliance.

The challenge of addressing non-point source nutrient pollution is often referred to as a wicked problem associated with high policy complexity and implementation challenges (Head, 2022; Patterson et al., 2013; Reimer et al., 2020). The idea that flexibility is a crucial part of adapting to complex policy contexts is well understood in policy theory (Marchau et al., 2019; Pahl-Wostl, 2009; Patterson et al., 2013). However, existing scholarship has focused on why it is necessary to design policy that adapts to complex conditions; few studies have analyzed the perspectives of the street-level bureaucrats tasked with implementing complex and adaptive programs.

A recently published analysis of policy complexity and implementation in the European Union found higher administrative transaction costs were associated with more complex policies (Haag et al., 2024). Interviews with Michigan officials and forest owners on forestry voluntary incentive programs identified program funding and complexity as key challenges to policy implementation

(Rouleau et al., 2016). In our study, respondents mentioned the complexity and diversity of agricultural systems as reasons for increased policy flexibility. At the same time, agency staff noted how adaptive and flexible policies increased demands on staff time, as well as increasing the need for technical and financial resources to administer more complex programs. This finding emerged through multiple policies and at different scopes, as in one instance the policy itself was the feature that provided a flexible solution to a rigid rule (Adaptive Management, WI).

As noted earlier, existing inequities prevent low income, minority, and beginning farmers from accessing land (Callahan & Hellerstein, 2022; Hinson & Robinson, 2008; Horst & Marion, 2019). While inequity in agriculture has been extensively studied, our review of existing literature on agricultural nutrient policy implementation revealed limited attention to equity considerations. Programs assessed in our study were not designed to disrupt systemic inequities in agricultural systems and respondents were largely unable to articulate how their programs meaningfully addressed issues of equity or justice. Our work identifies equity considerations as an important gap in future nutrient policy design and implementation, particularly if existing guidance related to environmental justice remains a priority for state and federal regulatory agencies.

We acknowledge several limitations of our study that may affect the interpretation of results and associated insights. Our relatively small sample size and reliance on perspectives from state agency staff skew the findings toward insider viewpoints, potentially overlooking external stakeholder experiences. Additionally, the research focused on a subset of policies in three Midwestern states, limiting the scope and generalizability of our conclusions to broader state and federal contexts. Some respondents may have been reluctant to disclose challenges associated with policy design or implementation in order to protect their reputation or that of their associated program or agency. We had difficulty recruiting participants from some state programs, leading to an overrepresentation of perspectives from Minnesota agencies.

Future research could explore how themes identified in our interviews emerged in other forms of qualitative data, including focus groups, surveys, or public comments. An expanded scope could include the perspectives of other policy actors such as farmers and producers, local conservation district staff, legislators, trade associations, industry lobbyists, or conservation organizations. Repeated studies after additional years of program implementation would also add value, allowing for comparisons of how implementation challenges evolve as programs mature and adapt over time.

## **Conclusion**

The building blocks of successful nutrient reduction policies as articulated by agency staff in charge of program implementation, are as follows. First, strong local capacity is essential, with adequate staffing and resources for conservation districts and partner agencies forming the backbone of implementation efforts. Second, policies do not exist in a vacuum. Policy success is determined by the ecosystem of policies that interact and support nutrient reduction programs, including strong interagency collaboration, effective monitoring and modeling, and partnerships with universities and technical experts. Third, technical tools and clear metrics are

critical for evaluating and guiding program outcomes, but require initial and ongoing investments in tool development and training. Fourth, voluntary programs promote public acceptance but often lack widespread adoption, whereas mandatory policies require robust enforcement mechanisms to ensure effectiveness and may encounter public resistance that challenges program buy-in. Fifth, flexibility in policy design enables adaptation to complex and variable conditions but increases demands on staff and technical capacity. Together, these elements provide a roadmap for designing resilient, effective, and equitable policies to address the ongoing challenge of non-point agricultural nutrient pollution.

Our study also demonstrates the importance of centering the perspectives of agency professionals in an understanding of policy implementation. Lipsky writes that the decisions of “street-level bureaucrats, the routines that they establish, and the devices they invent to cope with uncertainties and work pressures effectively become the public policies they carry out” (1980). We find that these street-level bureaucrats play an essential role in the communication and execution of program objectives. They oversee the development and use of technical tools and models, build networks that support the sustainability and political feasibility of programs, and hold valuable insights into how to adapt programs to local contexts. Scholarship on policy implementation would benefit from additional research that investigates the perspectives of agency staff across multiple policy domains and sectors.

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## **Supplemental Materials: Interview Guide**

### ***Email***

Hello [Interviewee],

I'm [Taylor Hohensee/Meghan Anderson], a Master's student at the University of Minnesota's Humphrey School of Public Affairs and research assistant with Professor Bonnie Keeler. Our research team is looking into the implementation of state agricultural nutrient reduction policies. We are working in collaboration with Cornell University and The Nature Conservancy to better understand the impact of these policies and if they could be adapted elsewhere in the Midwest. My UMN colleagues, copied on this email, and I would be happy to answer any questions you have regarding this project.

We are specifically interested in talking to you about your work on [policy]. We have read a lot about this program, but would benefit from an insider perspective on how you see this program working in practice, any lessons learned from implementing this policy in [state], and whether you would recommend this program be adopted by other states. Your insights may be used to inform advocacy and outreach related to water and nutrient policy.

We are conducting interviews via Zoom over the next three weeks. Would you be willing to speak with us for 30-60 minutes? Interviews will be recorded for use by our research team, but all personally identifiable information will be kept private.

You can find my availability on this appointment schedule. Please let me know if any of these work, and I will send you a Zoom invitation. If none of these work, please send a few times that would work for you. If you think we would benefit from speaking with anyone else about [policy], we would really appreciate their contact information.

Thank you for the consideration and have a great day,

### ***Interview***

#### **Intro**

Thanks for your willingness to speak with us. I represent a small team at the University of Minnesota researching agricultural nutrient reduction policies, their effectiveness, and implementation. Our team is interested in understanding how current policies and programs are working, with the goal of providing guidance to other states on how they might implement nutrient reduction strategies.

The intent is not to evaluate you or your program, but only to learn from you and gain insights into how you perceive the effectiveness of current policies and any recommendations for how to improve their implementation in other geographies or contexts.

We anticipate the interview will take around 30-60 minutes.

You can skip any questions or stop at any time.

We won't use your name, though we may identify your position/relationship to the policy evaluated if we use direct quotes in the final report.

I will assume you are speaking on behalf of your professional self and the organization you represent with your responses to these questions.

Is it okay if we record, just to make sure we get your words down accurately?

### **Section 1: Organization and Role**

*First, I'd like to begin by asking you about your organization and your role there.*

1. Tell me about your role within [organization name].
2. Can you describe your involvement in programs or policies designed to reduce nutrient pollution?
  - a. Funding? Rulemaking? Implementation? Monitoring? Communication? Evaluation?

### **Section 2: Specific policies**

We understand [their primary program] to be...[include a 1-2 sentence of the policy program summary, consulting fact sheet]. There are a few questions about this program that we were unable to understand from our own research.

3. Our first question is related to monitoring. Are you aware of any monitoring data that has been collected in order to evaluate the effectiveness of the program? [adapt where we know of existing monitoring data]
  - a. Do you think the level of investment in monitoring is sufficient to understand and communicate the environmental impacts of the program?
4. Next I want to ask you about compliance. What can you tell us about how the program is enforced or how agencies ensure compliance with the program?
  - a. Do you have any insights into how often enforcement mechanisms are used or how often disciplinary actions have been taken over the lifetime of the program? Are these actions documented? Would this be data/info that could be shared?
  - b. Do you think more should be done to ensure compliance? If so, what? What are some of the challenges associated with compliance?
5. Now I want to ask about other aspects of program implementation. What are some of the program's successes? What do you think contributed most significantly to that success?
  - a. What hasn't worked as well - where has the program fallen short of its intended goals?
  - b. Have there been any unforeseen outcomes (good or bad)?

6. Has there been stable funding for this program? What would you do with more resources? What would you prioritize with less?
7. What groups have supported the program and where have you seen opposition? How would you describe the political implications of the program?
  - a. Do [group x or y] seem to think the policy goes too far? Not far enough?
8. In your assessment, does this program represent a good return on investment? In other words, do you see the benefits of the policy as outweighing the costs?
  - a. Has there been any formal evaluation of the program's costs and benefits? For example, are you aware of data on practice implementation costs at farm/ field level and/or total program costs? Would you be able to share that data with us, even if they're only estimations?
  - b. Anything else you would like to say relating to the costs of the program?

### **Section 3: Equity Related Questions**

*Next, I will ask questions about the ways policies might relate to specific segments of the population.*

9. We're interested in how some groups may differentially benefit or be harmed by the program. Can you talk about how the program may affect the following groups differently in terms of eligibility, access to benefits, or via increased costs or regulatory actions?
  - a. Farmers that own vs. rent?
  - b. Small vs. large farms?
  - c. Farmers that produce specialty crops vs. commodity growers?
  - d. Immigrant, black, or indigenous farmers?
10. Are you aware of any outreach or engagement of underrepresented communities that was done during the design or implementation of the program?
11. Do you have any insights into how the demographics of the program participants compare to the demographics (race, ethnicity, gender, age) of those eligible but who are not involved in the program?
  - a. What does equity look like for this program?

### **Section 4: Final thoughts**

12. If you were in a position to consult with other states about the design and development of nutrient reduction policies or programs, what advice would you give if another state was considering adopting this same program?
13. Is there anything else you would like to share with me about [your state's] approach to nutrient reduction programs before we conclude?
14. Is there anyone else you recommend we speak to for our project?

## Supplemental Materials: Codebook

Theme	Code name	Code Definition
Admin	followup	Tasks mentioned during interviews that were worthy of follow-up, ie- requests for documents or further interview participants
	quote	Quotes to use in a report
	Q_role	Organizational Code for question 1: Information provided on the role interviewee plays within the policy
	Buffer Law	Information provided on the Buffer Law in interviews for other policies
	GW Protect Rule	Information provided on the Groundwater Protection Rule in interviews for other policies
	MAWQCP	Information provided on the Ag Water Quality Certification Program in interviews for other policies
Complexity/ flexibility tradeoff	complexity	Complexity of the program or complexity in navigating the program/law
	flexible	Flexibility of the program as a strength
Cost and Benefit	benefits_\$	Monetary benefits
	benefits_other	Non-monetary benefits
	cost_high	Associated with high monetary costs
	cost_low	Associated with low monetary costs
	incentives	Discussion of the incentives a program provides - ex: cost share, regulatory certainty, recognition
	Q_benefits	Organizational Code for question 8: Do you believe this program is a good return on investment? Do the benefits outweigh the costs? Answers that emphasize the benefits
	Q_costs	Organizational Code for question 8: Do you believe this program is a good return on investment? Do the benefits outweigh the costs? Answers that emphasize the costs
Equity	equity_BIPOC	Equity considerations for BIPOC farmers

	equity_equal	Policy is viewed as having equal equity considerations
	equity_language	Equity considerations for non-English speakers
	equity_large	Equity considerations for small vs. large farms
	equity_outreach	Organizational Code for section 3, question 10. Equity considerations in outreach.
	equity_ownrent	Equity considerations for farmers that own vs. rent
	equity_speciality	Equity considerations for commodity vs specialty growers
	Q_demographics	Organizational Code for section 3, question 11. How demographics of program compare to non-participants
	Q_equity	Organizational Code for section 3, question 9. Equity considerations for different groups.
Implementation Details	implementation	Specific details about implementation
	Q_advice	Organizational Code for section 4, question 12: Advice given to future states that might implement policy
	Q_challenge	Organizational Code for question 5a:Where has the program fallen short of its goals? Also used when participants mentioned challenges for the program
	Q_compliance	Organizational Code for question 4: How is compliance measured? Participant opinions on compliance
	Q_enforcement	Organizational Code for question 4a: How is this program/law enforced? How often? Are they well documented?
	Q_funding	Organizational Code for question 6: Has there been stable funding for this program? What would you do with more resources? What would you prioritize with less? Other answers that relate to funding of the program/law
	Q_monitoring	Organizational Code for question 3: How is this program/law monitored by the relevant agency? By partners? Is the investment in monitoring sufficient?



	Q_success	Organizational Code for question 5: What are some of the program's successes? What do you think contributed most significantly to that success? Also used when participants mentioned successes for the program outside of this question
	staffing_state	Staffing considerations at the state level
	staffing_SWCD	Staffing considerations at local conservation offices ie-SWCD
	technical tools	Used when interviewee mentions technical tools used in implementation of policy
Interactions and Oversight	local	Used when interviewee mentions SWCDs, counties, preferences for local control, etc
	participation	Related to discussions of participation levels in the program/law - eg. how to get more participants to join program
	partnerships	Agency-agency partnerships
	relationships	Theme: Importance of personal relationships
Politics	politics_against	Groups that were against program/law
	politics_participation	Participation in process of developing program/law
	politics_pro	Groups that were in favor of program/law
	Q_politics	Organizational Code for question 7: What groups have supported the program and where have you seen opposition? How would you describe the political implications of the program?
Voluntary/ Mandatory	mandatory	Used when interviewees mentioned specific aspects of the policy that relate to its mandatory nature or compare voluntary and mandatory policies
	statutory requirement	Used when interviewees mentioned requirements of the policy explicitly written in statute. Coded when they directly mention administrative code, regulatory requirement, "written into law" etc

	voluntary	Used when interviewees mentioned specific aspects of the policy that relate to its voluntary nature or compare voluntary and mandatory policies
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## Supplemental Materials: Policy Advice

Expanded version of Table 4.

State	Policy	Theme or Key Takeaway	Quote
Minnesota	MAWQCP	Education requirements	“Don’t assume because we’ve been doing nutrient management through the farm bill programs since the early 2000s and beyond that there’s not more work to do... They are at a very basic level in nutrient management.”
		Policy endorsement	“Yes, do this program. I just think it's particularly effective. I think it's actually readily transferable.”
		Stakeholder involvement	“I think that kind of stakeholder process is really good, though, to, you know, not just drop it on people. Bring them in. Bring him into the process. And as with our state, the more diverse the better. And it, you know, that's really important. At the same time, you know, it should look like agriculture in your state.”
		Policy ecosystem: foundational policies and partnerships	“One of the fascinating things I learned from California is like, Oh, we don't have any of those fertilizer recommendation rates... So those challenges exist for other states.”
Minnesota	Buffer Law	Policy ecosystem: partnerships	“The most important, I think, is to know their delivery model. Who's delivering the program? Is it going to be SWCD, is it going to be say department of ag, or whoever. Ultimately I think it will be something where we're kind of cobbled together in that regard... Make sure you have that buy in for who's gonna be delivering the program.”
		Flexibility	“Be realistic about what you can get. Like something's better than nothing. Like you're probably not going to get the gold standard.”
		Flexibility	“You need to build up enough support to get some type of law passed and you need to be flexible.”
		Flexibility	“I mean there’s always some give and take, some flexibility to get the law passed.”
		Time for technical tool development	“From a map and implementation perspective, I think more lead time would be really helpful to plan through how that implementation is going to occur.”

	Technical tools	“You gotta have a variety of different technical information tools out there for landowners, and as you know the SWCDs and LGUs to utilize.”
	Messaging	“You gotta sell it. You're gonna get resistance, of course. Get people used to the idea, kind of promote what other states have done, and kind of enumerate some of the benefits they'd see.”
	Relationships	“And there's a relationship there that you don't have as a state agency, and that really helps bring about voluntary compliance. And I think that's key to having some entity that has a more of a relationship with whatever folks that you're dealing with.”
	Partnerships	“Find friends and keep them close and expect opposition, but try, you know, be persistent and articulate the benefits.”
	Transparency and stakeholder involvement	“You need to be transparent about what it is you're doing and you need to base your arguments for doing it on both science and economics. And you need to include a good cross section of everybody.”
Minnesota	Groundwater Protection Rule	Policy exists within and as a result of complexity of the world
		“We have karst geology, and of course, textured soils and soils with shallow bedrock here. So we've designed the rule to address those issues.”
		Policy ecosystem: agency context and authority
		“And another thing I would have to suggest they look at as their policy, because in Minnesota MPCA's got the authority for manure feed lots. We've got authority for nitrogen fertilizers. So our role mainly addresses nitrogen fertilizer, and we can address manure rates. But if a different state has a different setup in their manure and fertilizer regulation is in one agency, then they might have a little bit different rule that addresses it all in one aspect of the rule.”
		Messaging
		“It's most effective when there's a common message around this and a willingness.”
	Policy ecosystem: funding	“Funding is critical. When you really get into these areas, some of these practices are expensive, and so our ability to leverage our Clean Water Fund has just been a game changer for us.”
	Center science in development and capacity	“As you begin to develop something similar to the Groundwater Protection Rule, keep the science central to it, making sure that we've got that strong technical background.”

		Policy ecosystem: partnerships and technical tools	“I think it's been very helpful that we have a strong relationship with our University of Minnesota and having that technical partner has been very important. And so this doesn't stand in isolation.”
		Decisionmaking	“At some point in rule writing, you just need to make decisions at what scale you would implement it and how you would do that.”
		Messaging	“It would be challenging if we didn't have that foundation to really communicate with the industry about the benefit for this”
		Goal development	“Defining your goals clearly”
Wisconsin	Adaptive Management	Policy ecosystem: adapt don't adopt	“Don't underestimate the staff it takes to support the development of the program and the time it takes to develop the program. It's not just an off the shelf solution, it takes time. And other states can benefit from our existing program, but there will have to be things that will probably have to be tailored.”
		Monitoring tools	“Have clear measurement tools in mind.”
Wisconsin	Nutrient Management Plans	Voluntary	“I'm always good to advocate, for, like locally led voluntary conservation just in general. Because I see a lot better buy in.”
		Requires local support	“I would caution trying to adopt it one for one. But it's gonna require a lot of local buy in, I think, from people, and not just anti-farm or pro-farm groups or industry groups”
Illinois	Partners for Conservation	Partnerships for enforcement	“Keep the soil and water districts in check... make sure they're following the rules and your guidelines and carrying the program out.”

**Table 4.** Answers from participants when asked, "What advice would you give if another state was considering adopting this same program?" and the theme associated with their statement. *Expanded version.*