Perspectives on water quality management: survey of soil and water conservation staff in Upper Mississippi River Basin states

A report prepared for water and agriculture managers

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Table of Contents

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Executive Summary

We surveyed soil and water conservation departments (or districts) in Upper Mississippi River Basin states to better understand:

1) how conservationists perceive nutrient management planning,
2) how they have adapted to extreme storm events, and
3) how they use water quality and weather forecast information.

277 representatives of soil and water conservation departments (or districts) responded to our survey in 2016 from seven states: Illinois, Indiana, Iowa, Minnesota, Missouri, Ohio, and Wisconsin. The survey had a 43% response rate.

Nutrient management planning

Although nutrient management planning was, on average, a moderate to high priority for respondent districts and departments, of conservationists who review plans, 26% were not at all to slightly confident, 58% were somewhat confident, and 16% were very to extremely confident that nutrient management plans are followed.

For respondents, the largest perceived barriers to implementing nutrient management plans were a lack of farmer buy-in and lack of ability to enforce plan implementation. Respondents indicated that increased farmer involvement, resources, and targeting would assist with improving nutrient management in the counties where they work.

Adaptations to extreme storm events

The majority of respondents thought that increases in large storms would have some to a great deal of negative impact on landowners and operators (90%), as well as on water quality (90%). In response to the impacts of these storms, respondents' offices:

- expanded cover crop programs (59%),
- expanded stormwater runoff control programs (39%),
- discussed options with state staff (39%),
- expanded stream buffer programs (25%),
- updated planning documents (22%), and
- created informational material for landowners (20%).

On average, conservationists noticed some to quite a bit more variable weather in the county in which they work and in the north central United States.

Furthermore, on average, respondents were somewhat to quite a bit concerned about the impacts of climate change on the county where they work. However, about one-quarter were only a little to not at all concerned. Those who were more concerned about climate change were more likely to update informational material for landowners ($p<0.01$), discuss options with state staff ($p<0.01$), and update planning documents ($p<0.05$) (Wardropper and Rissman 2019). Climate change concern was not significantly associated with other adaptation options.

According to Wardropper and Rissman (2019), county conservationists who use projections were significantly more likely to work in offices that create information for land owners and operators and increase cover crop implementation ($p<0.01$). The use of projections was also marginally related to higher concern with more variable weather in the region, and higher concern with general climate change impacts ($p<0.10$). Historical precipitation trend data and one- to fourteen-day precipitation forecasts were the most used types of weather information to advise landowners and land managers.

How conservationists use water quality information

Information about water quality can be useful for decision-making and come from many sources. According to Wardropper (2018), conservationists were more likely to use water quality information if:

- they believe their work helps people and the environment ($p<0.001$),
- they find water quality information to be trustworthy ($p<0.01$), and
- there is or has been a Total Maximum Daily Load (TMDL) designation in their county ($p<0.05$).

For respondents, visual assessment and soil testing were among the most useful water quality indicators for their job, followed by modeling at the field scale and manual in-stream or in-lake sampling. This information was used somewhat to extremely frequently for:

- advising clients (78%),
- stakeholder communication (73%),
- program implementation (70%), and
- evaluation (70%).

Introduction

Our research team conducted a survey of soil and water conservationists in the Upper Mississippi River Basin region. The study area encompassed seven states in the basin: Illinois, Indiana, Iowa, Minnesota, Missouri, Ohio, and Wisconsin. Here, nutrient and soil loss contribute to polluted drinking water, blue-green algae blooms that impact recreation and tourism, and impacts to agricultural productivity. Given increasing average annual precipitation and a higher frequency of large storm events, the region has the potential to experience even more soil loss (Michalak et al. 2013). Nutrient export from this region is also one cause of the approximately 14,000-km^2 hypoxic—or dead zone—in the Gulf of Mexico, with almost 90% of these nutrients coming from agricultural sources (Alexander et al. 2008). Soil and water conservationists play critical roles in reducing nutrient and soil export. Their decisions and perspectives are important to understand.

Survey respondents were staff of Soil and Water Conservation Districts (SWCDs). Almost all counties in the U.S. have SWCDs, Dust Bowl-era organizations with locally elected advisory boards, reporting to state and federal Departments of Agriculture (Rissman and Smail 2014). Each state also has its own Association of Conservation Districts, which advocate on behalf of and disseminate information to their members. SWCDs provide significant technical and financial support to farmers, with the 2014 federal Farm Bill alone providing approximately $5.8 billion in conservation assistance per year, a significant portion of which is channeled through SWCDs (USDA 2016). Farm Bill and other conservation programs fund farmer incentives to take ecologically sensitive lands out of production, to maintain vegetated riparian buffers, and to plant soil-retaining cover crops (Shortle et al. 2012). SWCD-implemented programs also pay for municipal practices such as drainage basins and erosion control.

Methods and Respondents

We began this study with informational interviews of directors of the State Associations of Conservation Districts and SWCD staff recommended to us by those directors (n = 14). We then conducted an online survey of SWCD staff across our seven study area states. A list of 644 active SWCDs was compiled with the help of the State Associations. The survey was fielded February through the first week of March 2016. Correspondence was addressed in each district to the office manager, generally called the District Conservationist, or another person who made managerial or administrative decisions if the manager was not available. A paper introductory letter was mailed first, followed by three rounds of email solicitations containing a link to the online survey, a procedure recommended by Dillman et al. (2014). The only exception to this process was for the state of Iowa, where we were only able to send a mail letter and one email due to employee privacy concerns. Eleven surveys were undeliverable through post or email. We received 320 fully or partially completed surveys. Due to incomplete responses, the effective full rate for this report is 277 out of 644, or 43%. Response rates for each state out of the total possible SWCD offices in the state were Illinois, 21/94 (22%); Indiana, 39/92 (42%); Iowa, 23/98 (23%); Minnesota, 43/91 (47%); Missouri, 51/108 (47%); Ohio, 43/88 (49%); and Wisconsin, 40/72 (56%).

About half of respondents do not own a farm (55%, n=277), and have a 4 Year Bachelor's degree (50%, n=276). Across all respondents, 62% were male (n=277), with a median birth year was 1969 (n=277). The average number of office staff was 3.76 staff (n=277).

Table 1. County and respondent characteristics (n= 277).
*n = 275
**n = 276

County Characteristics		All States
# of Staff in Office	**Mean**	3.76
	Range	1-22
% Agricultural Land	**Mean**	40.07%
	Range	0.01-89.65%
# of TMDL's	**Mean**	50.22
	Range	0-477
EQIP Acres	**Mean**	20.15
	Range	0-121
Farm-Related Income Per Operation*	**Mean**	$21,340
	Range	$2,474-75,378

Respondent Characteristics		All States
Birth Year	**Median**	1969
Gender	**Male**	62%
	Female	38%
Education**	**Some College, No Degree**	18%
	2 Year Associate's	12%
	4 Year Bachelor's	50%
	Some Grad or Professional School, No Degree	4%
	Master's Degree	16%
	PhD	0%
Farm Ownership	**Yes**	45%
	No	55%

In addition to survey responses, we used information on the number of full or half-time office staff for each SWCD from the 2015 directory lists provided by State Associations of Conservation Districts.

Results

Nutrient Management Planning

32% of all respondents indicated that they do not know the percentage of agricultural land in their county with an up-to-date nutrient management plan (Figure 1). Of respondents who could estimate, most believed that only between 10% and 20% of agricultural land in their county has an up-to-date nutrient management plan.

On average, respondents were slightly to somewhat confident that nutrient management plans are followed. Of conservationists who review plans, 26% were not at all to slightly confident, 58%

were somewhat confident, and 16% were very to extremely confident that nutrient management plans are followed (Figure 2).

Figure 1. Response to the question "What percent of agricultural land in your county has an up-to-date nutrient management plan (NMP)?" (n=241). 78 out of 241 respondents indicated that they do not know.

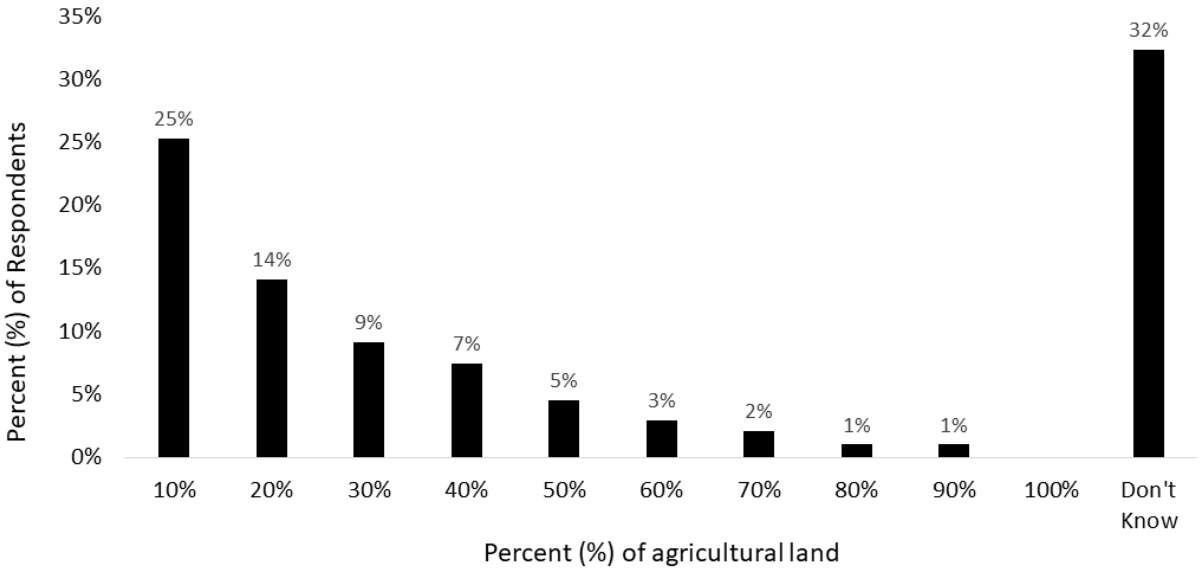
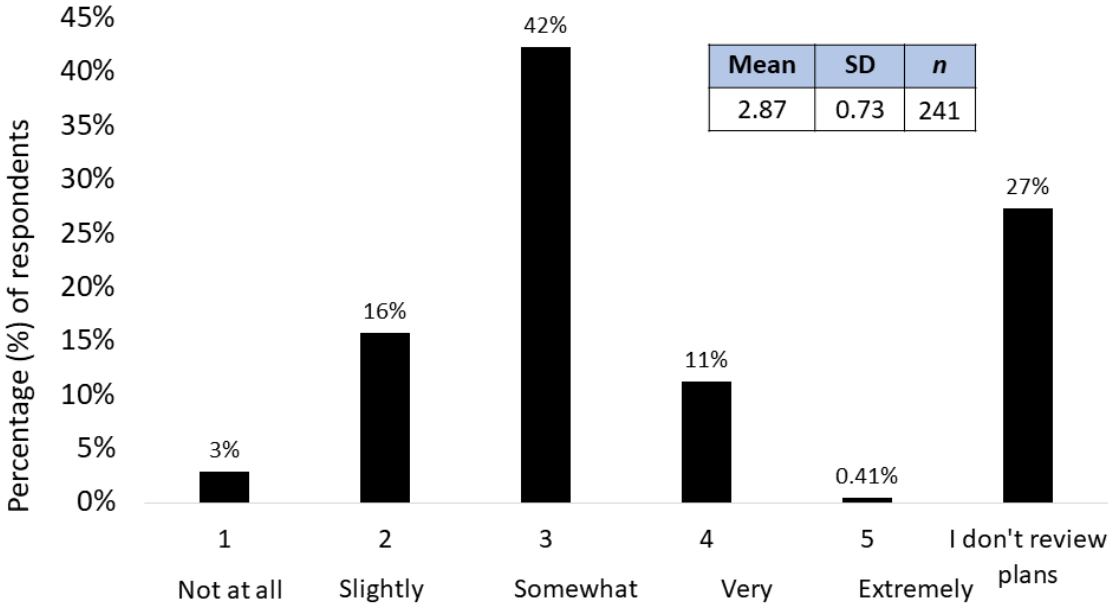


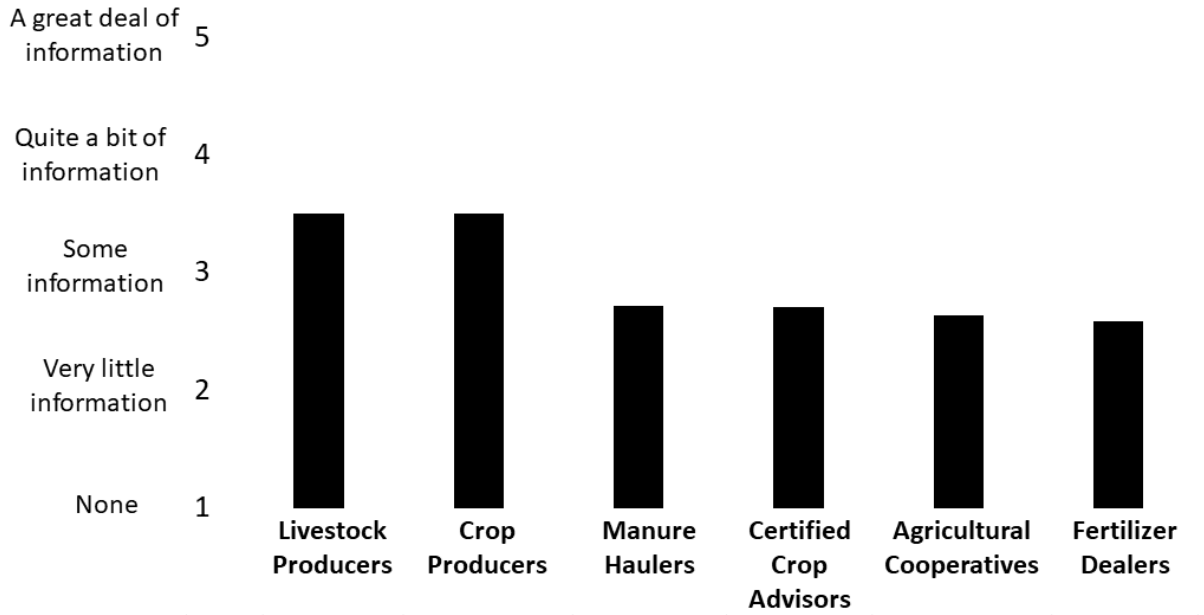
Figure 2. Response to the question "When you review a nutrient management plan, how confident are you that it is being followed?" (n=241). 66 out of 241 respondents indicated that they do not review plans.



Respondents indicated that, to help determine contributions to nutrient runoff, they have more information available from crop and livestock producers, compared to CCAs, manure haulers, agricultural cooperatives, and fertilizer dealers (Figure 3).

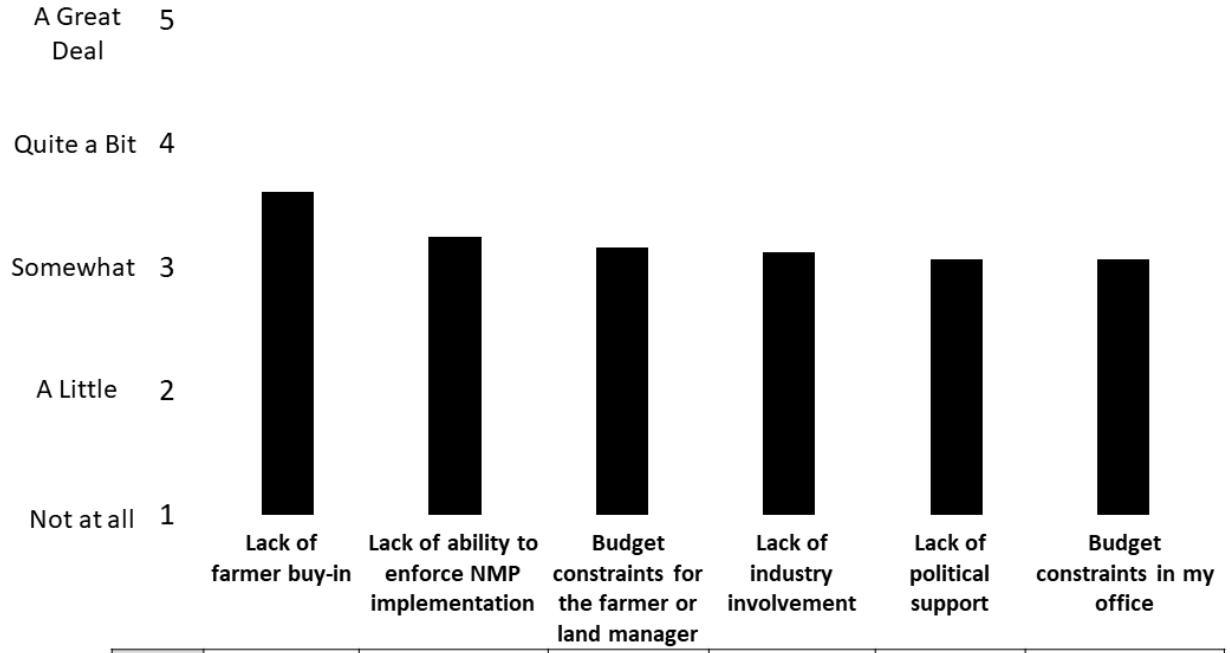
At the same time, the largest barriers to implementing nutrient management plans were the lack of farmer buy-in and lack of ability to enforce plan implementation (Figure 4).

Figure 3. Response to the question "For each of the following groups, how much information is available to your office to help determine their contribution to nutrient runoff? (n=241). Mean response is shown.



	Livestock Producers	Crop Producers	Manure Haulers	Certified Crop Advisors	Agricultural Cooperatives	Fertilizer Dealers
Mean	3.50	3.50	2.72	2.71	2.64	2.59
SD	1.00	1.00	1.07	1.10	1.12	1.13

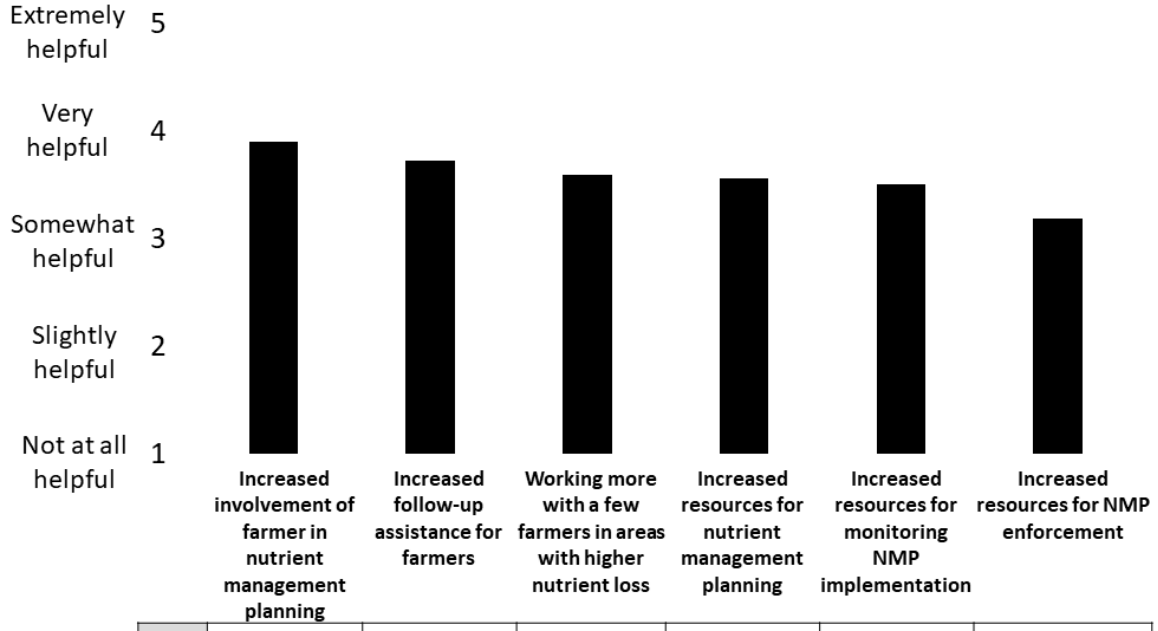
Figure 4. Response to the question "From your perspective, how much of a barrier are each of the following factors in getting nutrient management plans implemented?" Mean response is shown.



	Lack of farmer buy-in	Lack of ability to enforce NMP implementation	Budget constraints for the farmer or land manager	Lack of industry involvement	Lack of political support	Budget constraints in my office
Mean	3.62	3.25	3.17	3.13	3.07	3.07
SD	0.96	1.28	1.10	1.12	1.21	1.30
n	239	238	239	238	237	236

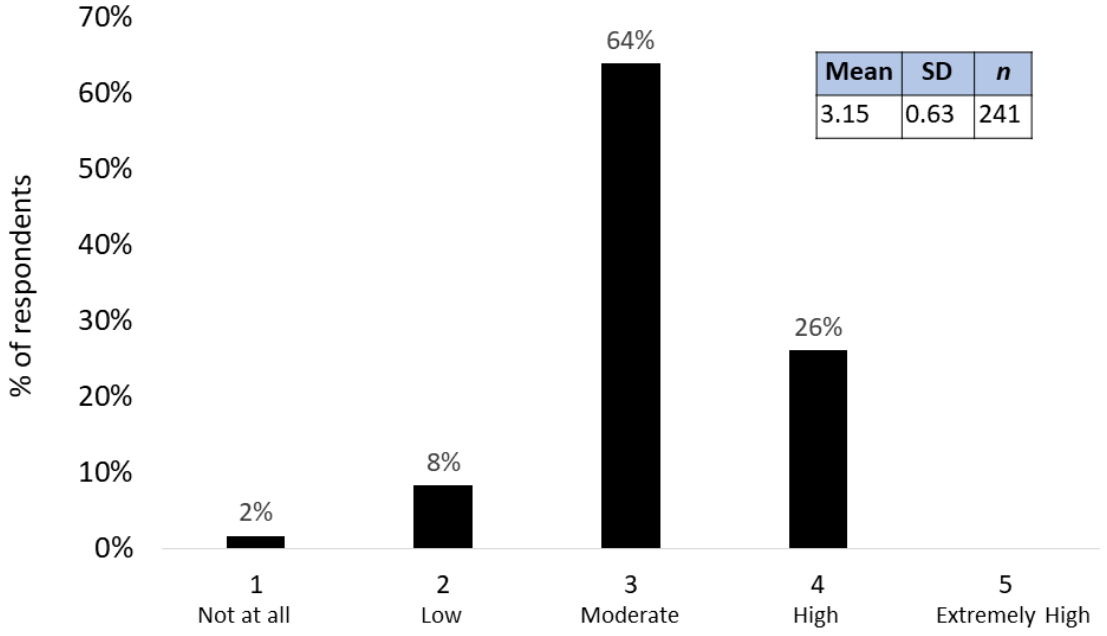
While farmer buy-in and lack of ability to enforce plans remained the top barriers, respondents also indicated that increased farmer involvement, resources, and targeting would assist with improving nutrient management in the counties where they work (Figure 5). On average, nutrient management was a moderate to high priority for their district or department (Figure 6).

Figure 5. Response to the question "How helpful would each of the following options be to your office for improving nutrient management in the county where you work?" Mean response is shown.



	Increased involvement of farmer in nutrient management planning	Increased follow-up assistance for farmers	Working more with a few farmers in areas with higher nutrient loss	Increased resources for nutrient management planning	Increased resources for monitoring NMP implementation	Increased resources for NMP enforcement
Mean	3.91	3.73	3.60	3.57	3.51	3.19
SD	0.87	0.90	0.96	0.97	0.98	1.18
n	239	238	239	239	239	238

Figure 6. Response to the question "How much of a priority is agricultural nutrient management for your district or department?" (n=241). 36 out of 277 total respondents indicated that their district or department does not do nutrient management work.

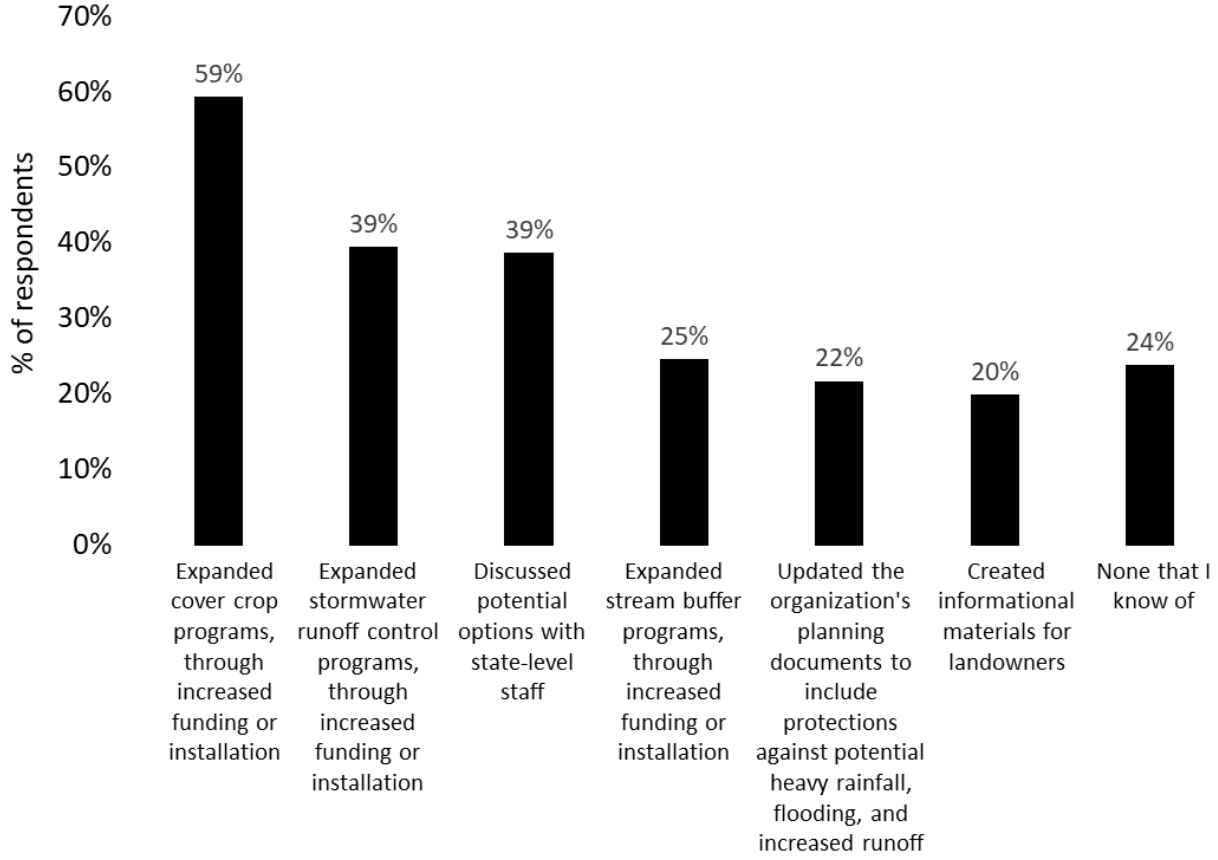


Mean	SD	*n*
3.15	0.63	241

Extreme Storm Events

The most common change in a respondent's office related to the impacts of extreme storm events on water quality was expanded cover crop programs, followed by expanded stormwater runoff control programs and discussing potential options with state-level staff (Figure 7).

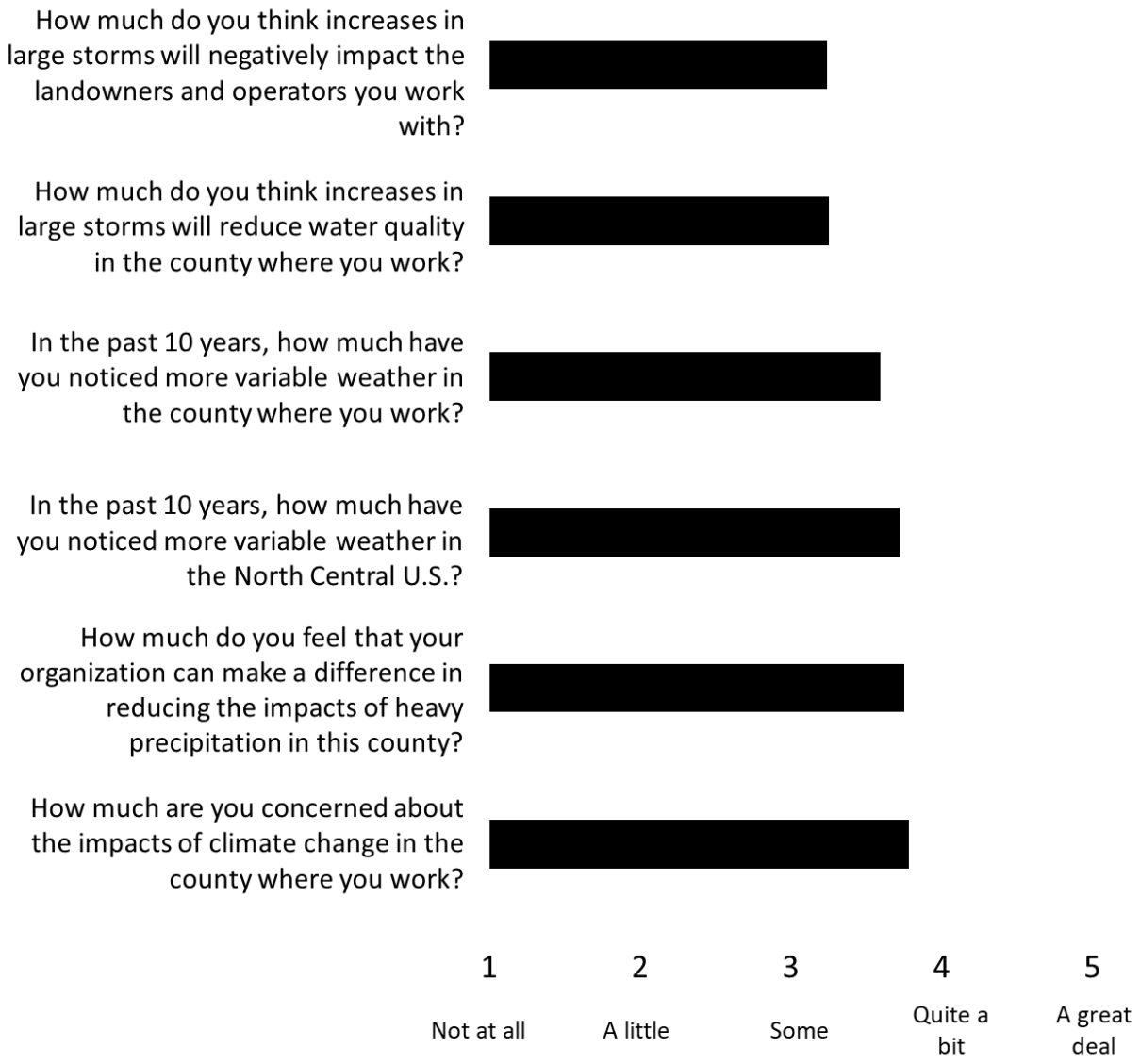
Figure 7. Response to the question "What changes, if any, has your office made related to the impacts of extreme storm events on water quality? Choose all that apply." (n=276) The percentage of respondents who indicated "yes" is shown.



The majority of respondents thought that increases in large storms would have some to a great deal of negative impact on landowners and operators (90%), as well as on water quality (90%). Respondents were, on average, somewhat to quite a bit concerned about the impacts of climate change on the county where they work and noticed some to quite a bit more variable weather in the county in which they work and in the north central United States. However, about one-quarter of respondents were only a little to not at all concerned.

At the same time, 79% of respondents believed that their organizations can make some to quite a bit of difference in reducing the impacts of heavy precipitation (Figure 8).

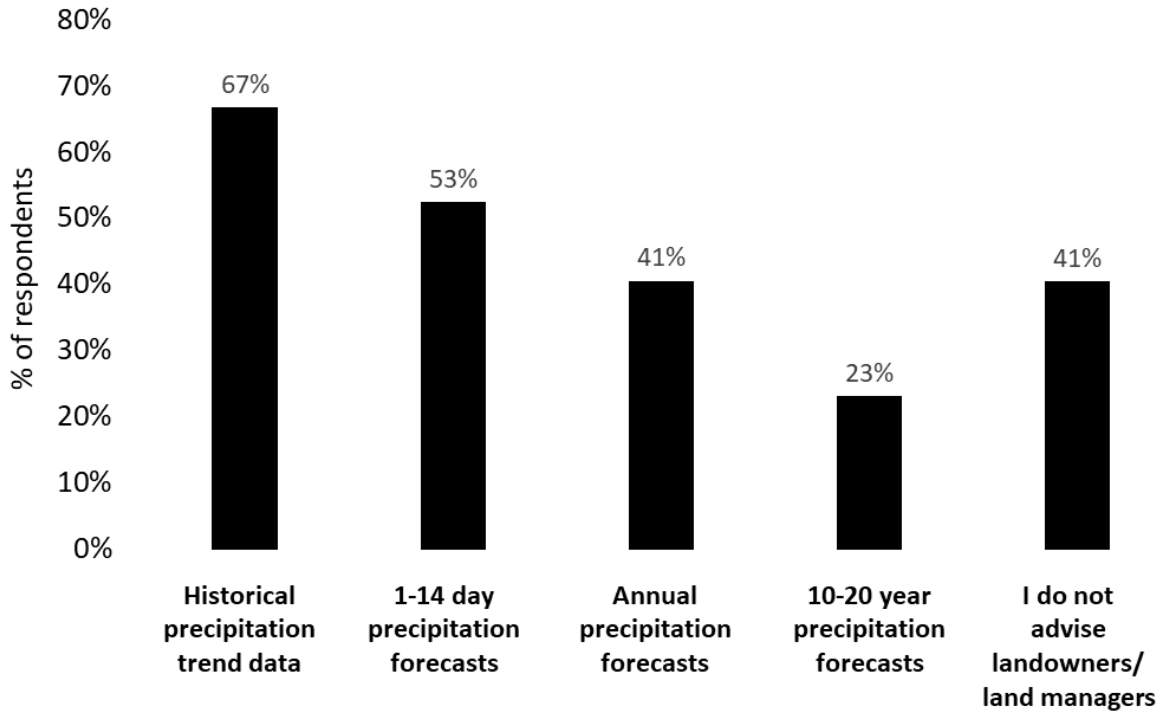
Figure 8. Response to the question "Please indicate your experience or views on each of the following questions." Mean response is shown.



	Impacts on landowners	Water quality impacts	Local variable weather	Regional variable weather	Making a difference	General climate change impacts
Mean	3.78	3.75	3.72	3.60	3.25	3.24
SD	0.95	0.99	1.00	1.03	1.03	1.18
n	276	276	275	275	276	274

Historical precipitation trend data and one to fourteen-day precipitation forecasts were the most used types of weather information to advise landowners and land managers. Ten to twenty-year precipitation forecasts were least used. (Figure 9).

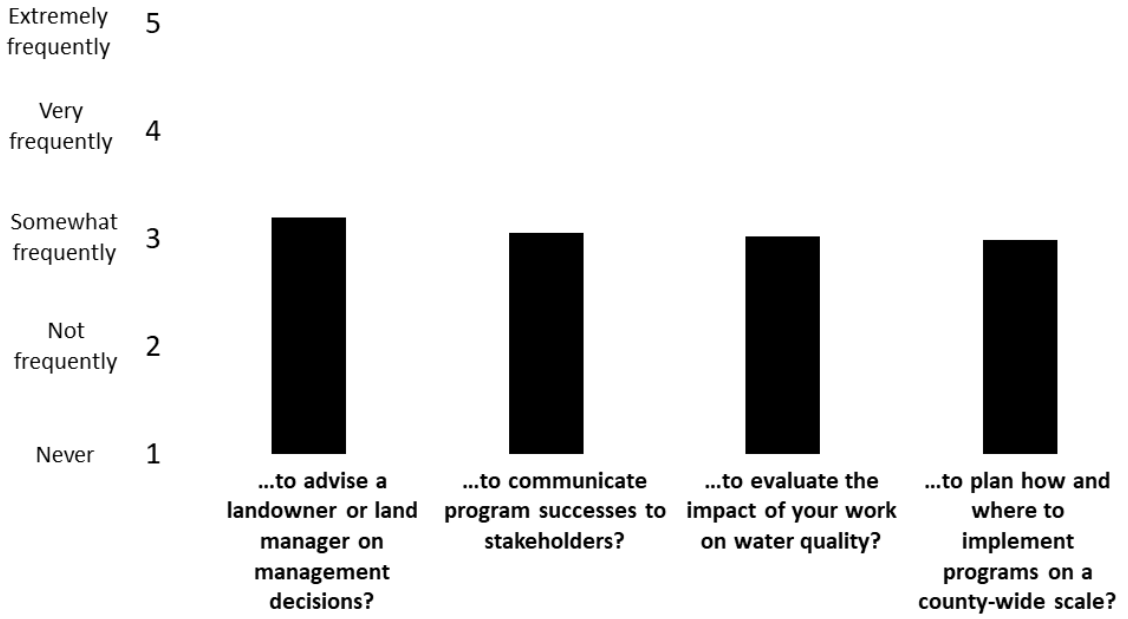
Figure 9. Response to the question "In the past year, have you used any of the following types of weather information to advise landowners/land managers? Choose all that apply." (n=269) The percentage of respondents who indicated "yes" is shown.



Water Quality Information

Water quality indicators were used somewhat to extremely frequently for advising clients (78%), stakeholder communication (73%), program implementation (70%), and evaluation (70%) (Figure 10).

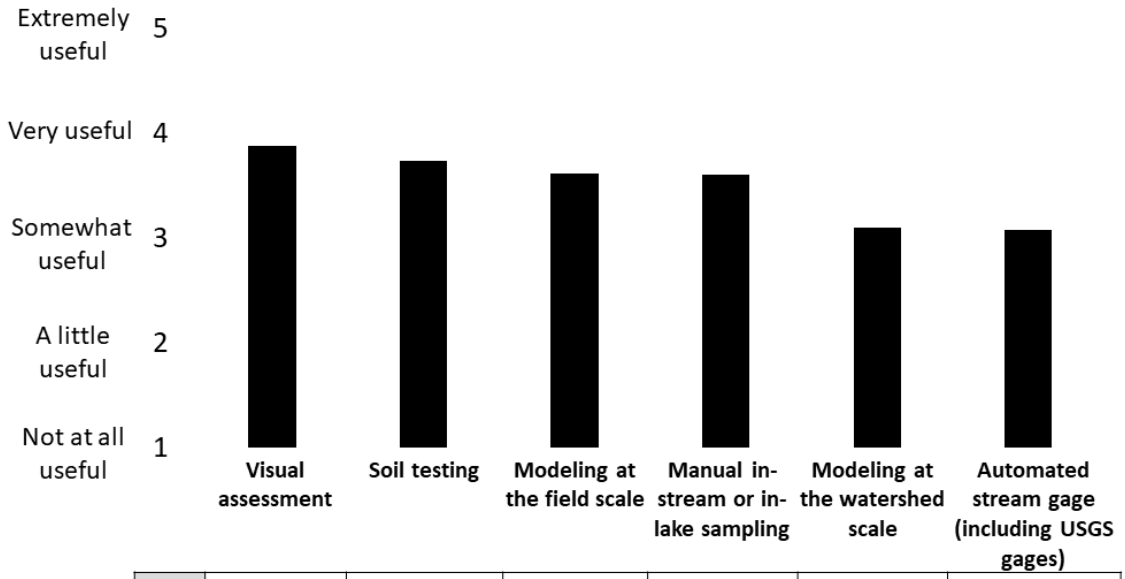
Figure 10. Response to the question "In the past year, how *frequently* did you use any of the indicators of water quality listed above…" Mean response is shown.



	…to advise a landowner or land manager on management decisions?	…to communicate program successes to stakeholders?	…to evaluate the impact of your work on water quality?	…to plan how and where to implement programs on a county-wide scale?
Mean	3.21	3.06	3.03	3.00
SD	0.99	1.02	1.01	1.07
n	277	277	277	277

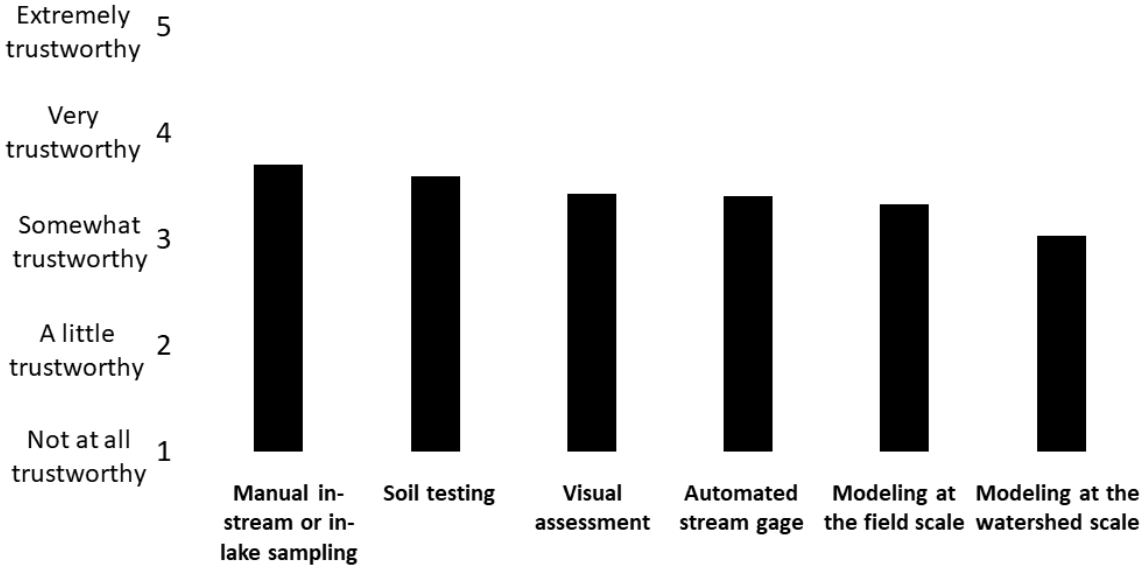
Respondents found visual assessment, soil testing, modeling at the field scale, and manual in-stream or in-lake sampling among the most useful water quality indicators for their job (Figure 11). In regards to trustworthiness, respondents found, on average, visual assessment, soil testing, manual in-stream or in-lake sampling, stream gages, and modeling at the field and watershed scales to be somewhat to very trustworthy measures of water quality (Figure 12).

Figure 11. Response to the question "How *useful* do you find the following indicators of water quality to your job overall?" Mean response is shown.



	Visual assessment	Soil testing	Modeling at the field scale	Manual in-stream or in-lake sampling	Modeling at the watershed scale	Automated stream gage (including USGS gages)
Mean	3.88	3.74	3.63	3.61	3.10	3.08
SD	0.89	0.99	0.98	1.15	1.05	1.21
n	268	255	251	209	188	175

Figure 12. Response to the question "For each of the following, how *trustworthy* do you think it is as a measure of water quality?" Mean response is shown.



	Manual in-stream or in-lake sampling	Soil testing	Visual assessment	Automated stream gage	Modeling at the field scale	Modeling at the watershed scale
Mean	3.71	3.60	3.43	3.41	3.34	3.04
SD	0.81	0.94	0.89	0.96	0.79	0.75
n	277	276	276	277	277	277

Published Papers

For full results, please see the below published papers:

Wardropper CB (2018) Environmental performance information use by conservation agency staff. Environmental Management 61:563-576

Wardropper CB, Rissman AR (2019) Adaptations to extreme storm events by conservation organizations. Climatic Change 152:85-101

Conclusion

Nutrient runoff and extreme storm events are increasing in the Upper Mississippi River Basin, underlining the importance of understanding the opportunities and challenges to implementing data-informed land and water conservation.

Nutrient management plans are an important tool for reducing nutrient runoff and unnecessary input costs. Of conservationists who review plans, 26% were not at all to slightly confident, 58% were somewhat confident, and 16% were very to extremely confident that nutrient management plans are followed. Conservationists also indicated facing important barriers to implementing nutrient management plans including a lack of ability to enforce implementation, lack of farmer buy-in, lack of industry involvement, lack of political support, and lack of capacity. Respondents indicated that increased farmer involvement, resources, and targeting would assist with improving nutrient management in the counties where they work.

In response to the impact of extreme storms on water quality, many offices were already making changes to their practices, including expanding cover crop and stormwater runoff control programs. The increased knowledge surrounding perceived barriers can help inform next steps, and ultimately, inform dynamic decision-making for land and water conservation practice implementation.

Water quality indicators such as visual assessment and soil testing were perceived as both useful and trustworthy to respondents, ultimately used for activities such as program evaluation, communication, implementation, and advising. The most used weather information included historical precipitation trends and one- to fourteen-day precipitation forecasts.

County conservationists' perspectives and choices are important for soil and water quality on farms, in streams and lakes, and throughout the Mississippi River Basin.

Appendix

Stakeholders

The group most involved in soil and water conservation issues was the USDA – Natural Resources Conservation Service, followed by the Soil/Land and Water Conservation board. The State Department of Agriculture was perceived as somewhat to quite a bit involved (Table 2).

Table 2. Response to the question, "In your experience, how involved are the following groups in soil and water conservation issues in your county?" (n= 276). [1 = not at all involved, 2 = a little involved, 3 = somewhat involved, 4 = quite a bit involved, 5 = extremely involved]

Stakeholder Involvement	Mean	SD	Number of respondents (where the organization was applicable)
USDA - Natural Resources Conservation Service	4.36	0.87	272
Soil/Land and Water Conservation Board	4.12	1.07	267
State Dept of Agriculture	3.43	1.17	274
Environmental nonprofits	2.63	1.25	254
Grassroots watershed organizations, like "Friends of" groups	2.83	1.27	249
State Environmental Protection Agency	2.97	1.14	270
Farmer organizations, like Farm Bureau	2.94	1.11	273
County Executive's Office	2.6	1.11	251
U.S. EPA	2.47	1.15	276
Agricultural seed, chemical, and fertilizer companies	2.61	1.1	271

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