

## **Strategies for Enhancing University Extension's Role as an Agricultural Information Source**

### **Abstract**

In this article, we identify factors contributing to the low use of Extension as an information source for farm management decisions and make recommendations for how to increase use of Extension in the context of midwestern row crop agriculture. Results from our mixed-methods analysis show that conservative recommendations, declines in public funding, and the perception of "cutting-edge" private sector information contribute to low use of Extension. We recommend changes to Extension at system and ground levels that could potentially increase its use among farmers. As many of the issues facing farmers and Extension span the nation, our findings and recommendations likely apply to a number of geographic and agricultural contexts.

**Keywords:** [information source use](#), [row crop agriculture](#), [Extension](#), [mixed-methods](#), [nitrogen fertilizer](#)

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## **Introduction**

The corn agricultural system in the midwestern United States is a key site of nitrogen (N) fertilizer application and pollution. About 50% of all N fertilizer in the United States is applied to corn (Ribaud et al., 2011), and approximately 50% of the N applied is not captured by the crop (Cassman, Dobermann, & Walters, 2002). Applied N not captured by crops is free to enter the atmosphere, surface water, and groundwater as pollution (Robertson & Vitousek, 2009). If management practices that reduce N loss were adopted, farmers could increase yields and profitability while significantly reducing agriculture's contribution to environmental problems (Robertson et al., 2013). Yet adoption of these practices among midwestern farmers is low, and efficiency of N

use on corn remains poor (Ribaudo et al., 2011).

Information sources providing recommendations related to management strategies are commonly found to influence farmers' management decisions, including those on nutrient management (Edge et al., 2017; McBride & Daberkow, 2003; Velandia et al., 2010). Farm advisors, including Extension agents, function as key channels through which farmers can be persuaded to improve the efficiency of their N use by changing their management practices (Mase, Babin, Prokopy, & Genskow, 2015; Mills et al., 2016).

The university Extension system recommends N fertilizer practices that minimize environmental degradation more so than other commonly used sources (Lawley, Lichenberg, & Parker, 2009). The use of Extension recommendations has, in the past, led to the adoption of nutrient best management practices that are efficient in terms of economic and environmental impact (Hoag, Chaubey, et al., 2012; Hoag, Luloff, & Osmond, 2012). Obviously, the potential for Extension's information to influence farmers' actions depends on farmers' use of Extension as an information source. However, midwestern row crop farmers appear to be relying more heavily on private sector sources, such as fertilizer dealers, than on Extension for information about N management (Arbuckle & Rosman, 2014; Stuart, Denny, Houser, Reimer, & Marquart-Pyatt, 2018; Stuart, Schewe, & McDermott, 2012). As one might expect, use of these private sector sources fails to lead to the widespread adoption of conservation N management practices (Weber & McCann, 2015). Widespread use of their recommendations is, therefore, unlikely to lead to an improvement in the environmental efficiency of N use on corn.

If increasing farmers' use of Extension information for N management decisions could lead to improved economic and environmental outcomes in midwestern agricultural N use, it is important to understand how to shift the trend of information source use in favor of Extension. The first step in determining relevant solutions is identifying key reasons for the low use of Extension information. Literature addressing this topic is sparse, and little is known about why farmers are using private sources over Extension. This article explores this issue in the context of row crop farmers in three midwestern states. Specifically, we investigated which information sources corn farmers use for making N management decisions and why many farmers do not primarily use university Extension information. Herein, we report the findings from that investigation and recommend strategies for increasing Extension's relevance in farmer nutrient management decisions at system and ground levels.

## Methods

We applied a mixed-methods approach to understand row crop farmers' information source use related to N fertilizer management in three midwestern states: Indiana, Iowa, and Michigan. To provide descriptive quantitative results, we used data from a survey mailed to 4,800 row crop farmers (1,600 in each state) in the spring of 2016. Mailings followed a modified Dillman approach (Dillman, Smyth, & Christian, 2014), with three waves of mailings and a reminder postcard between the first and second waves. We randomly selected research participants from the list of all row crop farmers in the three states who received farm payments in 2014, the most recent full year for which data were available. A total of 1,249 usable surveys were returned for an overall response rate of 26.8%. This response rate is similar to that of other recent farmer surveys (Johansson, Effland, & Coble, 2017). Our final quantitative sample size was 1,080, after we dropped cases with missing acreage responses.

To understand the "why" of our survey results, we examined qualitative data gathered from interviews with 154 farmers across the three states: 51 in Indiana, 53 in Iowa, and 50 in Michigan. Interviews occurred between May

and December, 2014. Nearly all were conducted in person on farms and were audio-recorded with the permission of participants, with a small number conducted over the phone. Initial interview participants were recruited through Extension and conservation and farmer organizations, with a reliance on snowball sampling after initial contacts (Faugier & Sargeant, 1997). Farm sizes of interviewed farmers ranged from 170 to 14,000 ac. We transcribed the interviews and analyzed the transcriptions using NVivo. Each interview was assigned a unique identifier code (e.g., IN01), representing a specific interviewee within the state referenced. We present these codes alongside our qualitative data to demonstrate the breadth of evidence drawn from our sample.

## Results

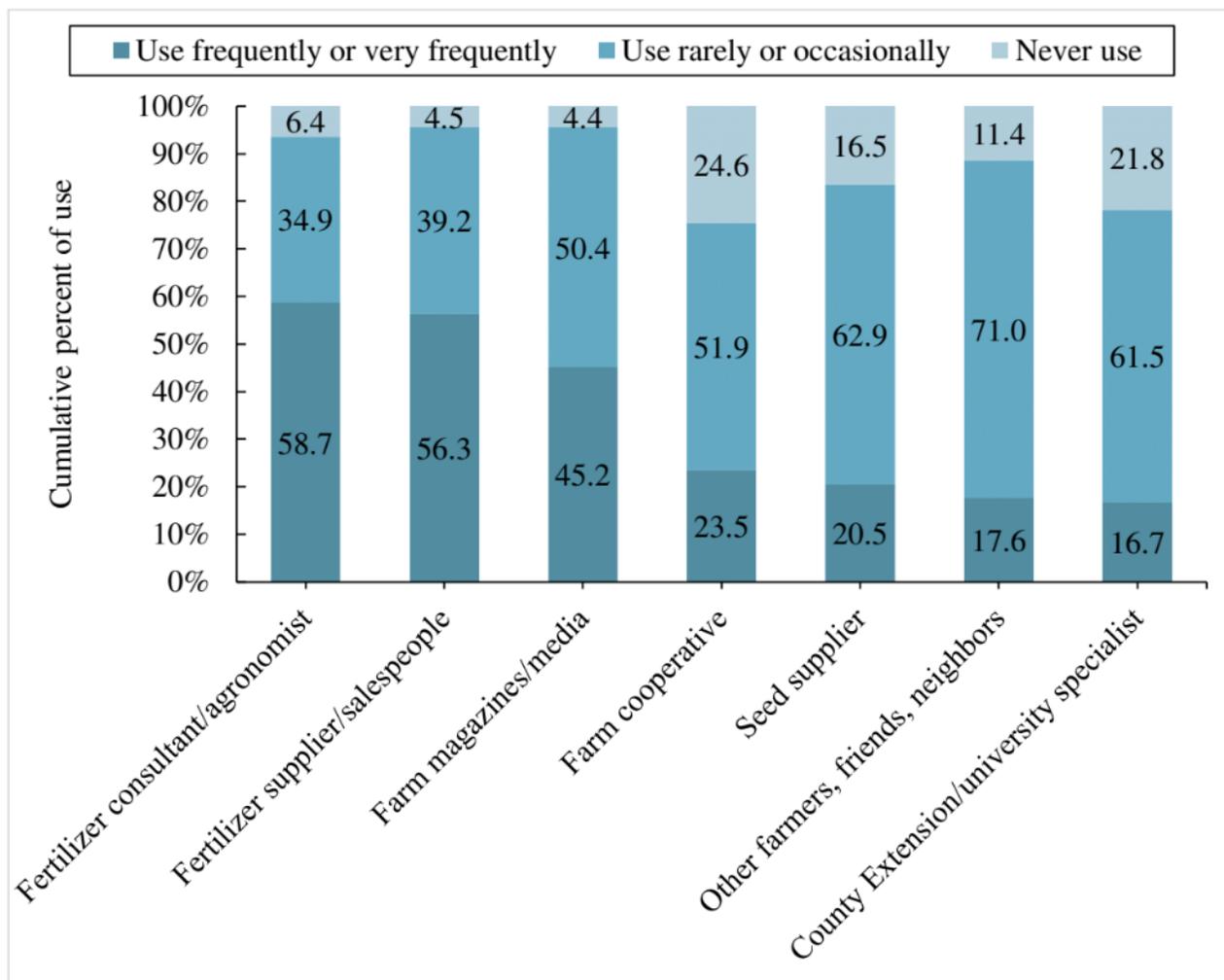
### What Information Sources Do Farmers Rely on to Guide N Management Decisions?

We analyzed our survey responses to determine information source use for N management information (see Figure 1). Only about 16% of farmers we surveyed frequently or very frequently consulted Extension regarding N management. This percentage equated to Extension's being the least used source of information of the seven options presented to respondents. Fertilizer consultants/agronomists and suppliers/salespeople, as the two most used sources, were consulted frequently or very frequently by about 55% and 54% of our sample, respectively. We also examined information use by state (data not shown). Results of those analyses were consistent with those of the aggregated sample.

After obtaining these general results, we examined differences in respondents' use of Extension relative to years of farming experience (see Figure 2) and farm sizes and education levels (see Figure 3). Our analyses indicated that less experienced farmers used Extension information less often for making N fertilizer decisions than more experienced farmers did. We also found that farmers working relatively small farms (less than 500 ac) and those with more formal education used Extension information more frequently for making N fertilizer decisions than those having more acreage or less education did. These results are important for considering which groups of farmers to target with efforts to increase Extension use. We return to the significance of these findings in our concluding discussion.

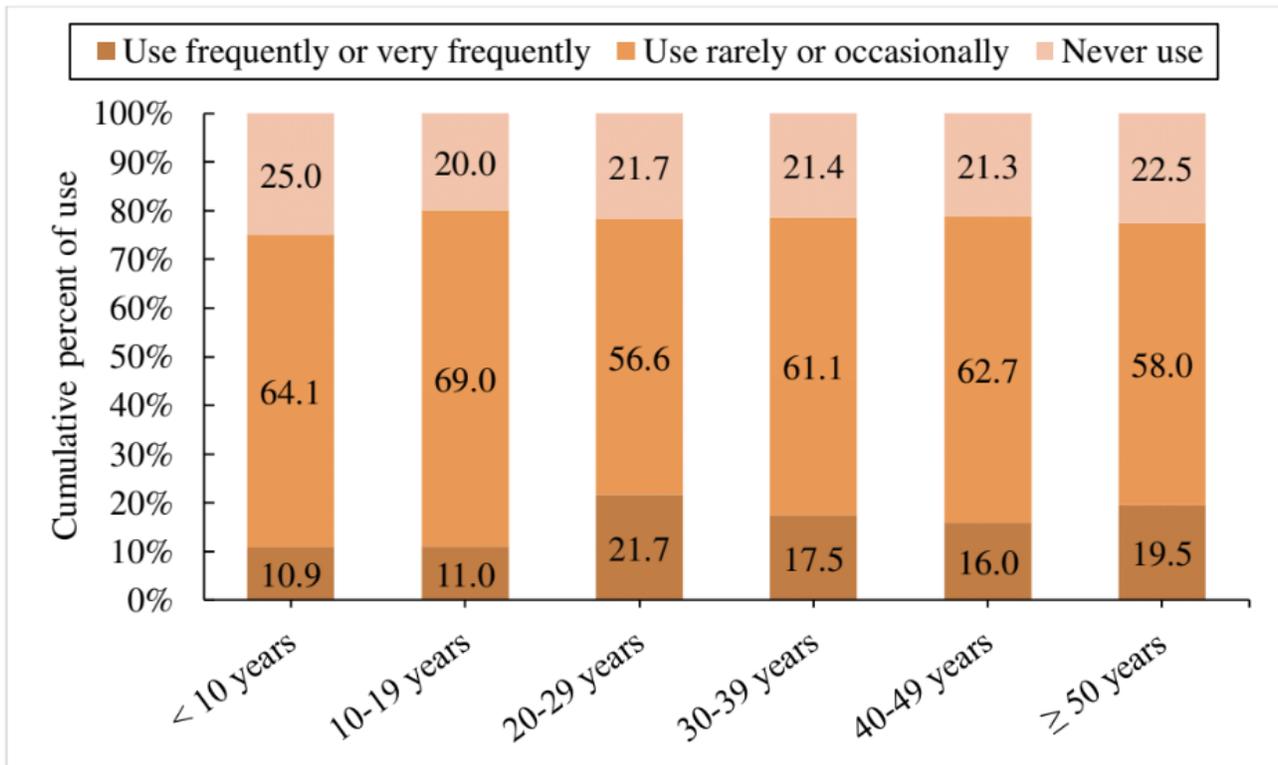
#### Figure 1.

Farmers' Frequency of Use of Information Sources



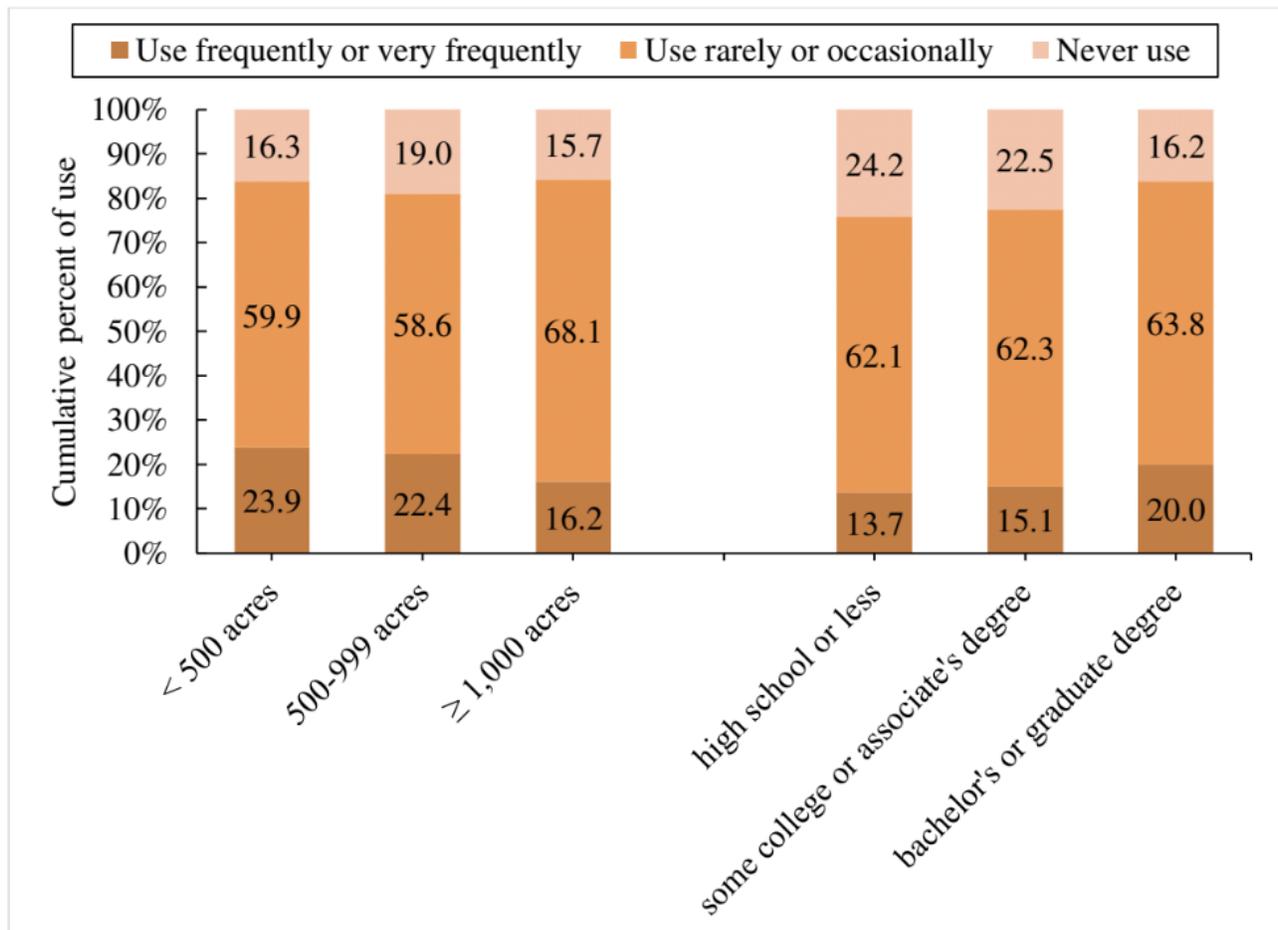
**Figure 2.**

Farmers' Frequency of Use of Extension Information by Farming Experience



**Figure 3.**

Farmers' Frequency of Use of Extension Information by Farm Size and Education Level



## Why Is Use of Extension Information Low Among Farmers?

In our interviews, many farmers discussed issues with Extension's N management information. Three main themes emerged across our interviews: (a) the "conservative" nature of Extension's N rate recommendations, (b) a decline in public funding for Extension outreach and university research, and (c) the perceived inferiority of Extension's N information compared to that of the private sector.

### ***Conservative Rate Recommendations***

Farmers in our sample generally recognized Extension N recommendations as reflecting a balance of agronomic, economic, and environmental concerns, but some farmers felt that this balance of considerations resulted in recommended N application rates that were too conservative. In Michigan, a farmer responded to an interviewer asking whether Michigan State University Extension recommended lower N rates than other sources by stating, "Well, they don't want nitrates in the water, quality and leaching, whatever, yeah" (MI01). Similarly, an Iowa farmer commented, "Iowa State Extension wants you to err on the side of caution" (IA07). Another farmer was specifically critical of Iowa State University's maximum-return-to-nitrogen (MRTN) guidance: "Iowa State University uses the MRTN. . . . That doesn't factor in weather. . . . If you put your 140 pounds on, and it rains and rains, where is the factor to tell you what you should do now?" (IA06). Extension's provision of "conservative" N recommendations is in accordance with calls from university researchers to increase the efficiency of N use (e.g., Robertson et al., 2013). This strategy is scientifically appropriate but may not be practically appropriate. Some interviewees found these recommendations problematic enough to discourage their use of Extension: "If I get a flyer in the mail from Purdue University or Michigan State or Ohio [State] that says you shouldn't be over 180 pounds of applied nitrogen, but I've got my own studies here that say we need to be at 240, guess what? I'm going to throw theirs in the trash" (IN15).

### ***Decline in Public Funding***

In recent years, federal funding for Extension outreach has declined, causing a decrease in the number of Extension specialists and county agents throughout the country (Wang, 2014). Farmers throughout our sample noted the in-state effects of these decreases. For instance, a Michigan farmer commenting on the impact of budget cuts to Extension concisely stated, "It's terrible what Michigan State [University] is doing to. . . . all of those guys [in Extension]" (MI14). Farmers also described how decreased support for Extension outreach has affected their use of Extension. One Iowa farmer stated, "Our Extension is not financially able to put information out and [put on] workshops like they used to, which is unfortunate" (IA38). Similarly, another farmer noted, "[Extension] was more valuable in years past; Purdue's staff has been dwindled down" (IN14). Even farmers who preferred Extension noted the negative impacts of these changes: "I place a lot of value in those university research trials [but] at Iowa State, [Extension has] been gutted. They talk about cutting the fat out, but they've been cutting into muscle for the last decade" (IA09). In general, the farmers' comments indicate their perceptions that funding cuts have reduced Extension's capacity for in-person outreach, which the farmers valued highly. Internet access proved significant for some farmers' continued use of Extension and the university: "[W]ith the Internet, we can call any state specialist that we want" (IN23), but this method does not fully address critiques that Extension's information is "generic" (IA64) or "not relevant" (IA55), critiques we believe reflect Extension's lack of in-person on-farm consultation services.

Similarly, the decline in public funding for university research, which supports Extension's recommendations, was another factor related to low use of Extension information. Public funding for university research has declined in recent years, with a greater proportion now provided through private sources (Jahnke, 2015). Though this shift does not necessarily insert bias into university research ("Private Funding for Science," 2016), some farmers perceived increasingly biased results: "[Michigan State University] used to be the leader on doing all this kind of stuff, and they kind of sold out to the Monsantos. . . . Let's go back to nonbiased results' (MI38). Indiana and Iowa farmers commented similarly about their respective states' universities: "They're not doing practical research anymore; they're doing paid research by companies" (IA14); "I don't know who's going to fund the university research on that, I suppose the seed companies" (IN15). Whether or not these feelings reflect reality, such perceptions can lead to decreased credibility of university research and, therefore, reduce the use of Extension's recommendations.

## ***Perceived Inferiority of Extension N Information as Compared to That of Private Sources***

Related to concerns over the declining quality of university research, farmers perceived Extension's information as inferior in quality to that of private sources in a number of ways. Often, farmers thought this relationship had changed over time. One Indiana farmer explained this perception at length:

[G]o back to my dad, and his information probably came from an Extension agent. . . . Well, then we moved on from there [Extension]. And your company—like your fertilizer companies, your seed companies—got to be a lot more knowledgeable, and they were putting on, like you say, growers' meetings and stuff, and just the way things have progressed, we've gotten to where an Extension agent isn't quite as important as he was 50 years ago (IN33).

Some farmers emphasized that this shift toward private industry was based on how advanced that sector's information appears to be: "For what [information] Extension is coming out with, for us, it seems like they're 5 years behind what the aggressive people [i.e., the private agronomists] are doing" (IA55). A Michigan farmer commented similarly: "[The] university's a little too far behind. Private industry is out there because they're trying it, because they're looking for the edge to move their product" (MI32).

The decline in the perceived relevance of Extension's information appears to be, in part, related to the above-discussed decline in funding for Extension outreach and university research. As Extension funding has declined, private industry has expanded into service markets that were previously provided by the public sector. Farmers now have access through local and regional retailers to personalized consulting services provided by trained agronomists. As one farmer expressed, "It used to be just that they were a salesperson, selling the product. Now most of them are doing the continuing education and are certified crop consultants. So they're providing more and more services than they ever used to" (IA20). Although many farmers feel skepticism about private sector recommendations in general, these concerns can be mitigated by long-term personal relationships with consultants. The effect of the concurrent contraction of Extension outreach and increase of private sector services, along with Extension's efforts to encourage environmentally efficient N use, has been to bolster the position of the private sector in the agricultural information environment of the Midwest. These sources of information are now more readily available and provide information that is perceived to be at the cutting edge of N use.

## **Conclusions/Implications**

Our results indicate that a number of factors are contributing to farmers' low use of Extension in making N management decisions, particularly as compared to their use of private sector sources. We must note that many interviewed farmers still readily used Extension and did not express the aforementioned criticisms. However, our survey results indicated that use of Extension is low compared to use of private sector sources, particularly among larger farmers who may have greater financial capacity to hire private sources. Extension has a critical role to play in improving N efficiency at the farm- and cropping-system scales by providing unbiased, science-based information. Given the current budgetary environment and expanded role of private advisors, Extension personnel must adjust how they provide recommendations and interact with farmers. To that end, we offer recommendations based on our findings. Extension personnel and university researchers can use these recommendations to overcome obstacles presented by budgetary constraints and private sector competitors as they endeavor to increase use of Extension by midwestern row crop farmers. Some recommendations are at the system level, steps administrators and policy makers should consider. Other recommendations are for individual Extension educators and those working directly with farmers to improve N efficiency. Many educators likely already use some of these strategies due to their experience and interactions with producers. Our intent is to reinforce strategies here on the basis of our research findings.

## System-Level Recommendations

*Field-trial-based practices.* Farmers want recommendations that have demonstrable impacts that they can see. As some quotes from our participants indicate, farmers' N management is influenced by their on-farm results or "studies." To promote nutrient efficiency practices, Extension should direct more funding toward field-based demonstrations and trials, where farmers can see the results of the practices.

*Partnerships with private industry.* Agricultural retailers and private consultants offer a much wider range of services and products than in previous decades. Our findings indicate that this circumstance has resulted in greater use of private advisors for N management information, especially among less experienced farmers who have come into the industry during the retraction of Extension services. It remains unclear where private advisors receive their information about appropriate management practices or how these advisors balance often competing agronomic, economic, and environmental considerations when making recommendations (Doll & Reimer, 2017). Extension could play an important role in the future by "training the trainer" and working to ensure that information coming from private sector advisors is scientifically accurate and environmentally responsible.

## Ground-Level Recommendations

*Personalization.* Information on N management, especially fertilizer rate recommendations, should be personalized to a farmer's individual situation as much as possible. Although web-based decision support tools are valuable, farmers often perceive them as too generalized to offer accurate information for their situations. In contrast to web-based recommendations, private sector advisors often directly collect information and provide in-person recommendations, simplifying how some farmers make decisions. Extension can increase its relevance by offering similar services, including educating farmers about how to use decision support tools, regardless of whether they are from university or private sector sources.

*Flexibility.* Many farmers perceive Extension recommendations to be too low for specific farmers' contexts. Although much of the information Extension provides is rooted in science-based research, Extension

recommendations can and should take into account the different goals and experiences of individual farmers. Many farmers were dismissive of Extension recommendations that they perceived as too low. Farming practices (including variable-rate and side-dress application) that allow for yields to do the same (or better) with less fertilizer are likely to be more positively received by farmers than straight rate reductions. Extension educators should focus on recommending practices that improve efficiency as an avenue to eventually lowering application rates rather than recommending rate reduction itself as a practice.

*Education.* Some of the criticisms of Extension may stem from a lack of knowledge among farmers about how recommendations are derived. It may be that lack of familiarity with academic agronomic perspectives and traditional scientific procedures drives perceptions of Extension's "inferior" information. Extension services can play a powerful role in improving science literacy among farmers, giving them better awareness of the factors involved in N cycling and the rigorous scientific process university scientists adhere to in determining best practices. This type of education, in turn, may lead to more knowledge that better equips farmers to evaluate the information they receive from a variety of sources.

## Concluding Thoughts

Though these recommendations are derived from our focus on midwestern row crop farmers, previous literature has shown low use of Extension across various contexts (Edge et al., 2017; Weber & McCann, 2015). Relatedly, agricultural producers throughout the country face similar pressures to reduce contributions to environmental degradation while maintaining productivity. Given these dual circumstances, we believe that Extension professionals performing outreach in numerous regions face issues similar to those identified here. Consequently, the recommendations we have provided may be useful to Extension in a number of regional and agricultural settings, as well as to researchers interested in further understanding how Extension can best adapt to dynamic policy and economic and environmental circumstances. Our findings make important contributions to these efforts, but more research on this topic is needed to assist in Extension's efforts to encourage an agricultural system that is profitable yet minimizes environmental harm.

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