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# Iowa Farmers' Nitrogen Management Practices and Perspectives

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# Iowa Farmers' Nitrogen Management Practices and Perspectives

## Introduction

Nitrogen (N) management is an issue of great importance to Iowa agriculture. Corn and other crops are highly dependent on nitrogen and other fertilizers. Most of the nutrients that are applied to agricultural lands serve their intended purpose of increasing crop yields. However, substantial quantities flow from fields into waterways, where they degrade water quality in Iowa's streams, lakes, and other water bodies. Some of that nutrient flow eventually finds its way into the Mississippi River and then the Gulf of Mexico, where it contributes to the formation of a large area of oxygen-depleted water known as a hypoxic zone. In short, the loss of nitrogen and other nutrients from agricultural activities leads to economic and environmental costs in Iowa and as far away as the Gulf of Mexico.

In 2013, the state of Iowa released the Iowa Nutrient Reduction Strategy ([www.nutrientstrategy.iastate.edu](http://www.nutrientstrategy.iastate.edu)). The strategy is a science and technology-based framework designed to guide actions that reduce the loss of nutrients to surface water. It was developed through a collaborative process between Iowa State University (ISU), the Iowa Department of Agriculture and Land Stewardship (IDALS),

the Iowa Department of Natural Resources (IDNR), and the USDA's Agricultural Research Service (ARS) and Natural Resources Conservation Service (NRCS). The strategy was prompted by the 2008 Gulf Hypoxia Action Plan, which called for Iowa and other states in the Mississippi River watershed to develop strategies to reduce nutrient loadings to the Gulf of Mexico. The Gulf Hypoxia Action Plan establishes a goal of at least a 45 percent reduction in the amount of nitrogen and phosphorus that flows into Iowa's waterways (streams, rivers). The Iowa strategy addresses both "point sources" (e.g., water treatment plants) and "nonpoint sources" (e.g., runoff from crop fields) of nutrients. The goal for Iowa agriculture is to reduce nitrogen and phosphorus loss by 41 percent and 29 percent, respectively.

The strategy document highlights numerous pathways through which farmers and agricultural stakeholders can take action toward attainment of those objectives. It presents a synthesis of research on the effectiveness of "best management practices" in reducing nutrient loss from farmland. The strategy recommends that farmers and landowners, with support from advisors, agribusinesses, farm groups, conservation

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agencies and organizations, and others, reduce their nutrient footprints by implementing an appropriate mix of management strategies and conservation practices on the land they farm and/or own.

To support the Nutrient Reduction Strategy and related activities, the 2012 Iowa Farm and Rural Life Poll included a series of questions to obtain baseline knowledge regarding Iowa farmers' nitrogen management practices and perspectives. A better understanding of what methods and strategies farmers employ can guide public and private advisors' efforts to help farmers to reduce nutrient losses. This report presents results from that survey.

## Methods

The Iowa Farm and Rural Life Poll is an annual survey of Iowa farmers. It collects and disseminates information on issues of importance to agricultural stakeholders and rural communities across Iowa and the Midwest. Conducted every year since its establishment in 1982, it is the longest-running survey of its kind in the nation. ISU Extension and Outreach, the Iowa Agriculture and Home Economics Experiment Station, IDALS, and the Iowa Agricultural Statistics Service are partners in the Farm Poll. The 2012 Farm Poll questionnaires were mailed in February to a statewide panel of 2,219 farm operators. Usable surveys were received from 1,296 farmers, resulting in a response rate of 58 percent.

## Nitrogen Management Practices

There are many methods and technologies that can be used to manage nitrogen, and the 2012 Farm Poll sought to measure farmers' knowledge and use of various methods. In consultation with ISU agronomists, a comprehensive list of practices that was originally developed for the 2002 Farm Poll survey was updated for 2012. Farm Poll

participants were posed the question, "To what extent do you use the following practices to manage nitrogen?" Five response categories were provided: not familiar with; familiar with, do not use; limited use; moderate use; and heavy use. Because nitrogen management questions are generally only applicable to farmers who grow row crops, this section presents results for farmers who planted corn or soybean in 2011.

The most commonly used nitrogen management methods were crop rotations (85 percent moderate or heavy use), yield goals (73 percent moderate or heavy use), and soil testing (67 percent moderate or heavy use) (table 1). Thirty-nine percent of farmers reported moderate or heavy use of animal manure. Thirty-six percent of farmers reported moderate or heavy use of variable rate fertilizer application methods (table 1). Consideration of soil temperature played a prominent role in nitrogen management for a similar proportion of farmers, with 36 percent reporting moderate or heavy use.

A number of N determination methods were less commonly used. Twenty-five percent of farmers reported moderate or heavy use of nitrification inhibitors. Fewer than 20 percent of farmers reported moderate or heavy use of integrated crop management (17 percent), test strips (15 percent), cover crops (10 percent), and stalk N tests (10 percent).

The least commonly used methods were late spring nitrogen test, Corn N Rate Calculator, aerial photos or remote sensing, urease inhibitors, coated urea, and canopy sensors for nitrogen (table 1). Ten percent or fewer farmers reported moderate or heavy use of these practices. It is important to note that some of these methods are among the most innovative and effective nitrogen management practices.

**Table 1. Use of nitrogen management practices, farmers who planted corn and/or soybean in 2011**

	Not Familiar With	Familiar With, But Do Not Use	Limited Use	Moderate Use	Heavy Use
— Percentage —					
Crop rotations .....	1	3	10	35	50
Yield goals .....	3	7	17	44	29
Soil testing .....	4	10	20	40	27
Animal manure .....	4	35	22	23	16
Variable fertilizer rates.....	6	35	23	23	13
Soil temperatures .....	7	31	27	25	11
Nitrification inhibitor (e.g., N-Serve)	17	43	15	14	11
Test strips .....	10	52	24	10	5
Stalk N tests .....	14	58	18	6	4
Integrated Crop Management (ICM)	19	41	23	13	4
Urease inhibitor (e.g., Agrotain).....	32	49	10	6	4
Late spring nitrogen test.....	11	59	20	7	3
Cover crops .....	12	59	18	8	2
Corn N Rate Calculator (MRTN).....	34	45	12	8	2
Aerial photos or remote sensing.....	19	57	15	8	2
Coated urea (e.g., ESN).....	29	54	10	5	2
Canopy sensors for nitrogen deficiency..	35	58	5	2	0

Equally notable, farmers were less familiar with these innovative and effective practices. For example, the Corn N Rate Calculator, which was developed by university scientists to help Midwestern corn farmers to choose nitrogen fertilizer rates that achieve profitable returns and reduce nitrogen losses, was unknown to 34 percent of corn and soybean farmers (table 1). Similar lack of knowledge was found for canopy sensors (35 percent not familiar with), urease inhibitors (32 percent not familiar with), and coated urea (29 percent not familiar with).

## Types of Nitrogen Fertilizers

Farmers can choose from several types of nitrogen fertilizer, and each source has its own management challenges. The survey asked farmers who had planted corn in 2011 what types of nitrogen fertilizers they had applied to their corn acres, and what percent of their

corn acres had received each type. Fifty-four percent of farmers reported that they used anhydrous ammonia, and they applied it to an average of 90 percent of their corn acres (table 2). Fifty percent of farmers used liquid nitrogen fertilizer on an average of 85 percent of their corn acres. Thirty-one percent applied dry (granular) nitrogen on an average of 76 percent of their corn acres. Solid manure was used by 26 percent of farmers (on 35 percent of their corn acres) and liquid manure was used by 17 percent of farmers (on 43 percent of their corn acres).

Farmers can use multiple types of nitrogen fertilizer in a given year, depending on many factors such as cost, availability, weather, and personal preference. A count of the types of nitrogen sources used showed that 38 percent of Farm Poll participants applied just one type of nitrogen to their corn acres in 2011 (table 3). Thirty-five percent applied two types.

**Table 2. Nitrogen application in 2011, farmers who planted corn in 2011**

Type Applied	Percent of Farmers Who Applied Type	Percent of Their Corn Acres
Anhydrous Ammonia .....	54	90
Liquid Nitrogen.....	50	85
Dry (granular) Nitrogen..	31	76
Solid Manure.....	26	35
Liquid Manure.....	17	43

**Table 3. Number of nitrogen types used, farmers who planted corn in 2011**

	Percent
One.....	38
Two .....	35
Three.....	15
Four .....	5
Five .....	1
None of the options provided.....	6
Average number of N types used.....	1.8

Twenty-two percent of farmers used three or more types of nitrogen. Six percent did not select any of the options provided. On average, respondents reported using approximately two types of nitrogen fertilizer.

## Determining Nitrogen Fertilizer Rate

Farmers have a number of options to help them make decisions about how much fertilizer to apply. Farmers who planted corn and/or soybean in 2011 were provided with a list of seven methods that they might use to calculate their nitrogen fertilizer application rate and asked to check all of the ones that they generally use.

The most commonly selected practice was use of yield goals to determine crop nutrient needs, with 71 percent of farmers indicating that they use that method (table 4). Sixty-two percent of farmers indicated that they follow recommendations from a fertilizer dealer.

Fifty-eight percent reported that they base fertilizer rates on prior experience. Twenty-nine percent reported use of validated field tests from his/her own farm to establish optimal rates. Twenty-four percent followed recommendations from a crop consultant, and 22 percent indicated that they followed ISU nutrient management recommendations. Just 11 percent of farmers used the “Corn N Rate Calculator” to determine their nitrogen fertilizer rate.

Farmers tended to use multiple methods to determine nitrogen fertilizer rate. Just 15 percent reported using a single method (table 5). Twenty-two percent reported using two methods, 27 percent three methods, and 18 percent used four methods. Twelve percent indicated that they use five or more, and six percent did not select any of the options that were provided. On average, farmers reported that they used about three of the options offered.

Of particular interest was farmer familiarity with and perspectives on the nitrogen management tool known as the Corn Nitrogen Rate Calculator (<http://extension.agron.iastate.edu/soilfertility/nrate.aspx>). The calculator uses the prices of corn and nitrogen fertilizer to help determine the most economically efficient nitrogen application rate. It is believed that widespread use of the calculator could substantially reduce nutrient loss into waterways. However, only about 10 percent of Iowa farmers indicated that they generally use the calculator, and only two percent reported using it heavily (table 1, table 4). To find out why many farmers do not use it, the 2012 Farm Poll posed the question, “If you do not use the Iowa State University Corn Nitrogen Rate Calculator, please indicate why not.”

Farmers were provided with five potential reasons that could explain nonuse of the Corn Nitrogen Rate Calculator and asked to check all that apply. Over 60 percent indicated that they were not familiar enough with it (table 6). Twenty-four percent reported that someone else

**Table 4. Methods used to determine nitrogen fertilizer rates, farmers who planted corn and/or soybean in 2011**

	Percent Checked
Crop nutrient requirements based upon yield goals.....	71
Follow recommendations from fertilizer dealer/supplier.....	62
Apply fertilizer based upon prior experience.....	58
Use validated field tests from my own farm to establish optimal rates.....	29
Follow recommendations from crop consultant.....	24
Follow Iowa State University nutrient management recommendations.....	22
Corn N Rate Calculator (MRTN).....	11

**Table 5. Number of nitrogen rate determination methods used, farmers who planted corn and/or soybean in 2011**

	Percent
One.....	15
Two.....	22
Three.....	27
Four.....	18
Five.....	9
Six.....	2
Seven.....	1
None of the options provided.....	6
Average number of methods used....	2.8

**Table 6. Reasons for non-use of the Corn N Rate Calculator, farmers who planted corn and/or soybean in 2011**

	Percent Checked
I am not familiar enough with it.....	61
Someone else determines rates.....	24
Other methods are more effective.....	10
Not appropriate for my farm.....	7
Too complicated.....	4

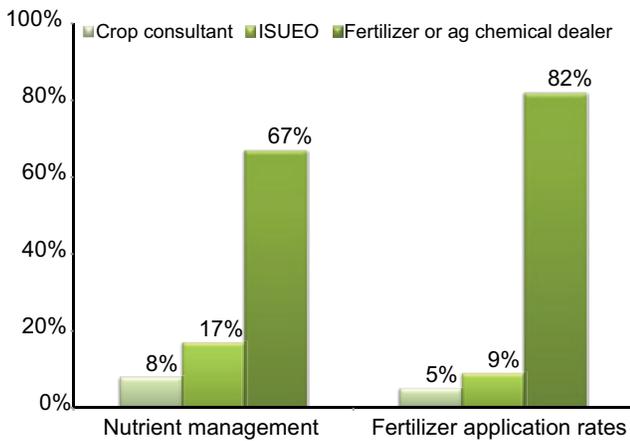
determines N fertilizer rates. “Other methods are more effective” was checked by 10 percent of farmers, and seven percent selected “not appropriate for my farm.” Only four percent indicated that the calculator is too complicated.

## Use of Information Sources

As ISU Extension and Outreach and other agricultural advisors develop strategies to help farmers improve nutrient management strategies, it is important to understand who farmers look to for information. The 2012 survey contained a question set that asked farmers where they “would go first for information” on a number of agricultural topics. Two of the topics were related to fertilizer use: “nutrient management” and “fertilizer application rates.” Six information source response categories were provided: fertilizer or ag chemical dealer, seed dealer, USDA/NRCS/SWCD service center, private crop consultant, Extension, commodity association, and other.<sup>1</sup>

Substantial majorities of farmers indicated that their first source of information would be a fertilizer dealer (figure 1). Sixty-seven percent of farmers would go to a fertilizer dealer first for nutrient management information and eighty-two percent would turn to that source first for information on fertilizer application rate. ISU Extension and Outreach was cited as the preferred first source of nutrient management information by 17 percent of farmers, and nine percent indicated that they would use Extension first for information on fertilizer application rates. Private crop consultants were indicated as a first source of information on these topics by minor percentages of farmers.

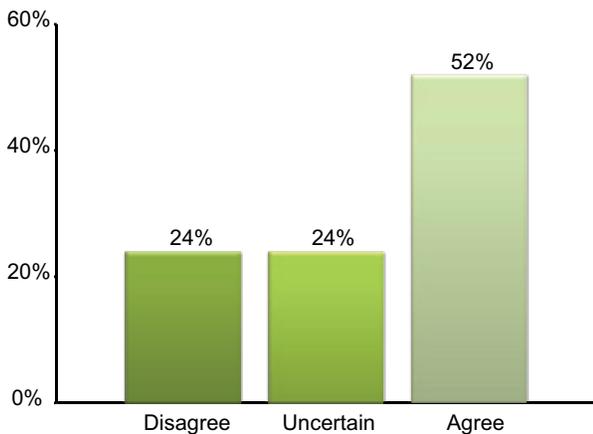
<sup>1</sup> See the Iowa Farm and Rural Life Poll 2012 Summary Report for full results on information source use.



**Figure 1. Where farmers would go first for information on nutrient management and fertilizer application rates, farmers who planted corn and/or soybeans in 2011**

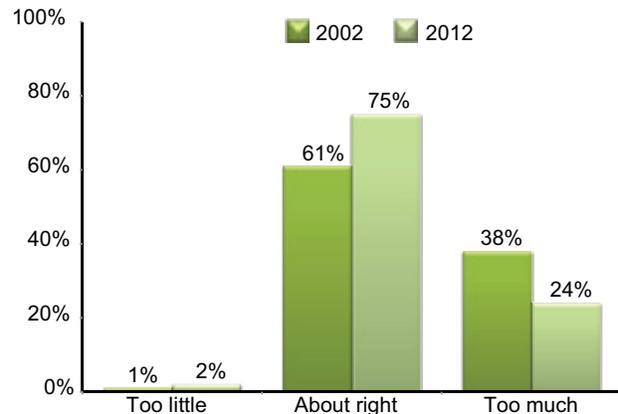
## Perspectives on Fertilizer Use

Several questions focused on beliefs regarding the amount of fertilizer that Iowa farmers use. Anecdotal evidence suggests that farmers sometimes apply more fertilizer than is necessary to ensure crop yields. The survey asked farmers to indicate their agreement or disagreement with the statement, “Farmers often apply too much fertilizer to ensure yields.” More than half agreed that farmers apply excess fertilizer as yield insurance (figure 2). Twenty-four percent disagreed, and 24 percent were uncertain.



**Figure 2. Response distribution on item, “farmers often apply too much fertilizer to ensure yields,” farmers who planted corn and soybean in 2011**

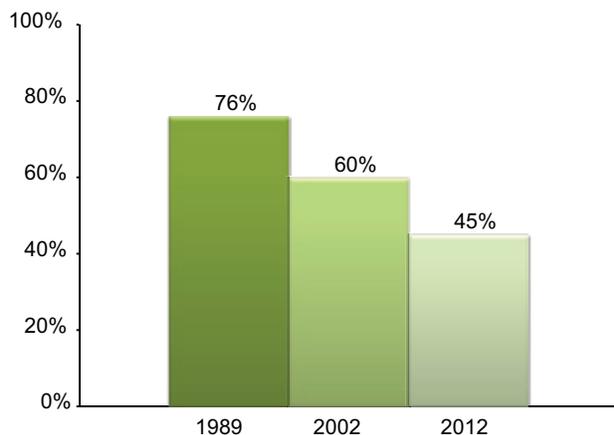
A similar question sought to measure farmers’ beliefs about the appropriateness of fertilizer application rates. The item, which was asked in both 2002 and 2012, asked, “How do you feel about the amount of nitrogen fertilizer most farmers apply to their crops? Do you feel they apply too little, about the right amount, or too much?” In 2012, 75 percent of farmers indicated that farmers apply the appropriate amount of nitrogen fertilizer (figure 3). Twenty-four percent believed that, in general, farmers apply too much, and two percent believed that they apply too little. Between 2002 and 2012 there was a notable increase—from 61 percent to 75 percent—in the proportion of farmers who indicated that fertilizer rates are about right.



**Figure 3. Beliefs about appropriateness of fertilizer rates, 2002 and 2012, farmers who planted corn and soybean in the previous year**

Over the last decades, as use of extended rotations, manure, and similar fertility management practices has declined, farmers have become increasingly dependent on purchased nitrogen fertilizer. Periodically, Farm Poll surveys have asked Iowa farmers to assess whether this dependence is a problem or not by asking them to rate their agreement or disagreement with the statement, “Modern farming relies too heavily on commercial fertilizers.” The proportion of farmers who have agreed with this statement has declined steadily since the question was first posed.

In 1989, 76 percent of farmers believed that agriculture was too dependent on commercial fertilizers (figure 4). By 2002, that number had dropped to 60 percent. In 2012, less than half of farmers agreed that the degree to which they depend on commercial fertilizer is a problem.



**Figure 4. Percent agree or strongly agree, “Modern farming relies too heavily on commercial fertilizers.”**

## Conclusions

The results of the Farm Poll research on nitrogen management point to a number of potential actions to help farmers implement more effective practices and strategies. The following are conclusions and recommendations that can inform further engagement with farmers and agricultural stakeholders as the Nutrient Reduction Strategy is implemented.

**Farmers do not know enough about key practices.** Several of the practices that have the highest potential for reducing the movement of nitrogen into waterways—e.g., nitrification inhibitors, Corn N Rate Calculator, and cover crops—are among the least used practices. Only 11 percent of farmers reported heavy use of nitrification inhibitors, and just two percent reported heavy use of the Corn N Rate Calculator or cover crops. Farmers also reported high levels of unfamiliarity with these and other practices. These results indicate that

lack of knowledge about the existence of and/or capacity to implement such practices is an impediment to widespread use.

**Agribusinesses and other advisors are important information sources.** Most farmers look first to fertilizer dealers or crop consultants for information about nutrient management, especially fertilization rates. Further, about 25 percent of farmers reported that someone else determines their fertilizer rates. These results suggest that outreach efforts should also target advisors to ensure that 1) they understand how to provide effective nutrient management advice and technical assistance, and 2) they encourage farmers to continually improve their nutrient management practices.

**Purposeful application of excess nitrogen fertilizer may be common practice.** Results indicated that more than half of survey participants believe that farmers over-apply fertilizer to ensure yields. At the same time, 75 percent expressed that the amount of fertilizer that Iowa farmers apply is about right. This means that many farmers who believe that farmers use excess fertilizer to ensure yields also believe that the amount applied is “about right.” Considered together with the results showing that the proportion of farmers who believe that farmers are too dependent on commercial fertilizers dropped from 76 percent in 1989 to 45 percent in 2012, these results may reflect a “normalization” of fertilizer use (and overuse) over time as other methods of fertility management such as use of manure and extended crop rotations have declined.

The findings about excess application of N as yield insurance are not altogether unexpected. Although the results are not conclusive, they do support anecdotal evidence that the practice is common. Crop yields depend on having the right amount of nitrogen and other nutrients in the right place at the right time. With variation in weather, soil types, time constraints, and other factors, it can be difficult

to calculate and time application to ensure that the exact amount of nitrogen that plants will need is there when they need it. The perceived economic risks of under-application are high, and these results likely reflect a reality (for at least some farmers) that the practice of “insurance” over-application is simply a part of staying in business.

The Iowa Nutrient Reduction Strategy sets ambitious goals for minimizing leakage of agricultural nutrients into waterways. To reach the reduction targets, individual farmers will have to greatly improve their nutrient management strategies. They will have to learn more about which practices are most effective for their farm operations. They will have

to set nutrient management goals and then implement the right mix of practices to reach those goals.

Farmers (and farmland owners) need more support from advisors. The community of stakeholders who provide production-related products, advice, and technical assistance to farmers must also shoulder responsibility to help their clients set and meet nutrient loss reduction goals. Fertilizer suppliers, in particular, are the advisors that farmers tend to look to first for guidance on nutrient management. It is critical that they be prepared to provide information and technical assistance on the most effective management and structural practices to reduce loss of nitrogen and other nutrients into Iowa waters.

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