

Over-application of Fertilizer on Iowa's Farm Fields – Although Fertilizer is Expensive, Farmers are Indeed Wasting It

Members of the environmental community have been clamoring for improvements in Iowa's water quality. Swimmers have been greeted with warnings of bacteria and toxins on the beaches at Iowa's state parks as well as green smelly water; the bacteria and toxins result from too many nutrients in the lake. Surface water – rivers and streams – are carrying high loads of nutrients, as shown in water tests. All the while, Iowa has made very little progress in implementing the Nutrient Reduction Strategy.

One of the great concerns is the over-application of fertilizer being applied to farm fields. All indications are that farmers are not adhering to the Iowa State University fertilization guidelines. Members of the environmental community have not been and are not being quiet about this.

As things of this nature go, we would expect pushback from some members of the farming community. And indeed, we did see the pushback. It started out with simple comments such as “fertilizer is expensive, therefore farmers wouldn't waste fertilizer” and “most farmers are doing things the right way”. The language from leaders in the farming community, particularly Farm Bureau, is starting to change. Now they are suggesting that the Iowa State fertilization guidelines need to be changed. Before we dig into that, let's get some background on this issue.



Application of nitrogen fertilizer on a no-till field. Photo courtesy USDA NRCS, Lynn Betts

Background

In 2006, Dr. John Sawyer, a researcher at Iowa State, joined with researchers at the University of Illinois, University of Minnesota, University of Wisconsin – Madison, Purdue University, and Ohio State University, to develop tools to aid farmers in determining the ideal levels of fertilizer to apply to corn fields, called the Maximum Return to Nitrogen (MRTN).¹ The result is a Corn Nitrogen Rate Calculator which considers the region where the fields are located and soil characteristics, the price of corn, and the price of fertilizer. The calculator takes into consideration the results of field trials run across the Corn Belt states.² Using the calculator, the farmer can purchase the proper amount of fertilizer without wasting it.³ Wasted fertilizer washes off of farm fields and into our waterbodies, where it becomes a pollutant.

Although fertilizer is expensive, farmers are indeed wasting it

¹ John Sawyer, Emerson Nafziger, Gyles Randall, Larry Bundy, George Rehm, Brad Joern, “Concepts and Rational for Regional Nitrogen Rates Guidelines for Corn”, Iowa State University Extension, April 2006

² The calculator has been updated since it was first released, according to Professor Antonio Mallarino. See Erin Jordan, “Farm Bureau: Fertilizer guidance ‘flawed’”, *Cedar Rapids Gazette*, September 19, 2021

³ The calculator can be found at <http://cnrc.agron.iastate.edu/>

There is on-the-ground evidence that although fertilizer is expensive, farmers are indeed wasting it. According to Iowa State Professor Antonio Mallarino, “many farmers don’t follow ISU’s fertilizer recommendations, with some using too little and others using too much.”⁴ Mallarino is a professor of nutrient management research and extension.

The Iowa Nutrient Research and Education Council surveyed farmers in 2017, 2018, and 2019 and found that they were applying fertilizer at rates more than 30 pounds greater than recommended by the MRTN calculator. The Iowa Nutrient Research and Education Council is an industry group whose members are commodity groups, fertilizer companies, and crop advisors.⁵

Professor Carrie Loboski, University of Wisconsin-Madison stated, “. . . what we know from other research we’ve done, if there’s over-application of N (nitrogen) to the point you’re not making money off that application anymore, that’s detrimental to water resources and to the environment in general.”⁶

Research led by Dr. Chris Jones found that farmers in the Floyd River watershed were applying fertilizer at more than double the MRTN rates. Farmers in the North Raccoon River were applying at rates of 140% the recommended rates.⁷ Both of these rivers are highly polluted with nutrients.

In other words, an over-application of nitrogen fertilizer results in polluted lakes, rivers, and streams.

Our opposition’s message is changing

As reported by Erin Jordan of the Cedar Rapids Gazette, on July 26, 2021, an Iowa Farm Bureau podcast introduced new framing for dealing with the over-application of fertilizer on Iowa’s farm fields. Participants in the podcast were the moderator, Andrew Wheeler who is the public relations manager for Iowa Farm Bureau Federation, and Rick Robinson, the Conservation and Natural Resources Policy Advisor for the Iowa Farm Bureau. Wheeler began discussing the Maximum Return to Nitrogen and posed the question “Why is that particular tool and that logic in general, why is that flawed and what’s a better, maybe more informed way of looking at this issue of nitrogen that in our soil, both naturally and what’s being applied?”⁸ Wheeler continued with “Many soil scientists say that the long-standing MRTN rate calculator, which estimates the economic return to nitrogen application rates with different nitrogen sources and corn prices, really doesn’t account for weather and soil variability or changes and improvements in genetics and management that we’ve seen over time. That kind of information has not been updated in the MRTN.”⁹



Cultivating corn. Photo by Lynn Betts, USDA NRCS

Research does not indicate the calculator should be changed

⁴ Erin Jordan, “Farm Bureau: Fertilizer guidance ‘flawed’”, *Cedar Rapids Gazette*, September 19, 2021

⁵ Erin Jordan, “Farm Bureau: Fertilizer guidance ‘flawed’”, *Cedar Rapids Gazette*, September 19, 2021

⁶ Erin Jordan, “Farm Bureau: Fertilizer guidance ‘flawed’”, *Cedar Rapids Gazette*, September 19, 2021

⁷ Chris Jones, Philip W. Gassman, Keith E. Schilling, “The Urgent Need to Address Nutrient Imbalance Problems in Iowa’s High-Density Livestock Regions”, *Agricultural Policy Review*, Iowa State University, Fall, 2019, page 6

⁸ Erin Jordan, “Farm Bureau: Fertilizer guidance ‘flawed’”, *Cedar Rapids Gazette*, September 19, 2021

⁹ Erin Jordan, “Farm Bureau: Fertilizer guidance ‘flawed’”, *Cedar Rapids Gazette*, September 19, 2021

When Erin Jordan of the Gazette asked Farm Bureau's Andrew Wheeler for the names of the scientists who think the ISU recommendations need to be updated, she did not get a response.¹⁰

Contrary to the messaging by the Iowa Farm Bureau, the recommendations for fertilizer have been updated recently.¹¹

Further, Iowa State Professor Antonio Mallarino stated that farmers can use other tools to adjust the rates that are recommended, such as using the data from soil samples taken on the farm in late spring or using remote sensing through a drone or satellite imaging.¹²

Professor Antonio Mallarino indicated that "he is open to other ideas for nitrogen fertilizer recommendations – once these ideas are proven through years of research, like the MRTN."¹³ He stated "When they show something else works better, we will adopt it. Until then, we will use this."¹⁴

DNR needs to change its manure application rates to comply with science

The study led by Dr. Chris Jones makes it clear that one of the big problems with nutrients in Iowa's waterbodies results from the Department of Natural Resources (DNR) allowing manure from confinements to be over-applied, by using an out-of-date yield-goal strategy.¹⁵

Large confinements must file manure management plans, which include the application fields and the application rates. The DNR uses the computation of 1.2 pounds of nitrogen per bushel of expected corn production.

The problem comes into play when the manure management plans allow an application rate in excess what is recommended by the Maximum Return To Nitrogen calculator. By allowing the excess amounts of manure and its component nitrogen to be applied to fields, the result will be that the excess will run off the fields and into Iowa's lakes, rivers, and streams.

The yield-based strategy was introduced in the 1960's and 1970's based on work by George Stanford.¹⁶ Farmers would estimate the yield of corn, in bushels per acre, from a field and then apply nitrogen fertilizer at the rate, in pounds per acre, of 1.2 times the expected yield.¹⁷ The methodology was widely used until 2005.



Swine in a concentrated animal feeding operation (CAFO). Photo by USDA NRCS, Jeff Vanuga

¹⁰ Erin Jordan, "Farm Bureau: Fertilizer guidance 'flawed'", *Cedar Rapids Gazette*, September 19, 2021

¹¹ Erin Jordan, "Farm Bureau: Fertilizer guidance 'flawed'", *Cedar Rapids Gazette*, September 19, 2021

¹² Erin Jordan, "Farm Bureau: Fertilizer guidance 'flawed'", *Cedar Rapids Gazette*, September 19, 2021

¹³ Erin Jordan, "Farm Bureau: Fertilizer guidance 'flawed'", *Cedar Rapids Gazette*, September 19, 2021

¹⁴ Erin Jordan, "Farm Bureau: Fertilizer guidance 'flawed'", *Cedar Rapids Gazette*, September 19, 2021

¹⁵ Chris Jones, Philip W. Gassman, Keith E. Schilling, "The Urgent Need to Address Nutrient Imbalance Problems in Iowa's High-Density Livestock Regions", *Agricultural Policy Review*, Iowa State University, Fall, 2019, page 9

¹⁶ Divina Gracia P. Rodriguez, David S. Bullock, Maria A. Boerngen, "The Origins, Implications, and Consequences of Yield-Based Nitrogen Fertilizer Management", *Agronomy Journal*, Volume III, Issue 2, page 725

¹⁷ Divina Gracia P. Rodriguez, David S. Bullock, Maria A. Boerngen, "The Origins, Implications, and Consequences of Yield-Based Nitrogen Fertilizer Management", *Agronomy Journal*, Volume III, Issue 2, page 725

A study of the yield-goal strategy lead by Divina Gracia P. Rodriguez concluded “Beginning in the mid-1990’s, empirical research started to show the yield-based rules-of-thumb in general are not a useful guide to fertilizer management.” Further, the authors indicate that “We show that Stanford’s derivation of his “1.2 Rule” was based on very little data, questionable data omissions, and negligible and faulty statistical analysis.”¹⁸ The researchers continued, “To a great extent, the use of the yield-based algorithms resulted neither from their scholarly origin nor their demonstrated scientific legitimacy, but rather simply from the need of agricultural scientists and extension personnel to provide something in the way of fertilizer management advice.”¹⁹ They concluded, “Our conclusion is that yield-based N fertilizer management algorithms were rules of thumb, and may well have provided better N management advice than would have come from fertilizer producers in the absence of university research. The issue lies with the certainty with which they were often presented to the public, and the lack of inquiry into their empirical origins. It appears that for 50 yr there has been too much trust in and too little verification of Stanford’s work.”²⁰

The Maximum Return To Nitrogen is the improved means of determining the amount of nitrogen to apply to farm fields. With that in mind, the Department of Natural Resources needs to come into compliance with the science and needs to change the application rates used in manure management plans.



Ears of corn. Photo by Lynn Betts, USDA NRCS

Conclusion: Claims that we need to change the calculator are gas-lighting

In 2022, the Iowa legislature appropriated one million dollars to perform field tests with the goal of modifying the calculator to allow more dynamic modeling which would account for variability in the weather, the environment, and management. The results are expected in early 2024.²¹

Obviously the pressure the environmental community is placing on the regulators to reduce the amount of nutrients in Iowa’s waterbodies is hitting a nerve in the opposition. So their response is to deflect the criticism and to falsely blame the MRTN calculator for being out-of-date.

We don’t need to change the calculator; farmers just need to follow what the calculator determines as the Maximum Return to Nitrogen. We also want the Department of Natural Resources to modify their formulas to reduce the amount of manure from confinements that is applied to crop fields so that it is not over-applied.

We want real solutions to reducing nutrients and we do not want solutions that will increase the amount of fertilizer that is recommended to be placed on crop fields.

¹⁸ Divina Gracia P. Rodriguez, David S. Bullock, Maria A. Boerngen, “The Origins, Implications, and Consequences of Yield-Based Nitrogen Fertilizer Management”, *Agronomy Journal*, Volume III, Issue 2, page 725

¹⁹ Divina Gracia P. Rodriguez, David S. Bullock, Maria A. Boerngen, “The Origins, Implications, and Consequences of Yield-Based Nitrogen Fertilizer Management”, *Agronomy Journal*, Volume III, Issue 2, page 733

²⁰ Divina Gracia P. Rodriguez, David S. Bullock, Maria A. Boerngen, “The Origins, Implications, and Consequences of Yield-Based Nitrogen Fertilizer Management”, *Agronomy Journal*, Volume III, Issue 2, page 734

²¹ Erin Jordan, “ISU doing field trials to study fertilizer rates”, *Cedar Rapids Gazette*, August 13, 2023