



Challenges and opportunities for nitrogen management

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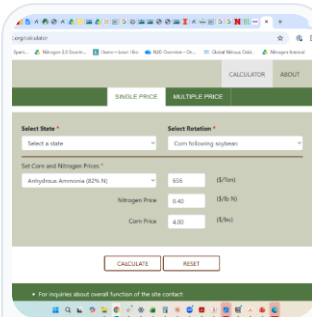
What tools do farmers use for nutrient management?



Experience



Trusted
relationships



N rate
calculators

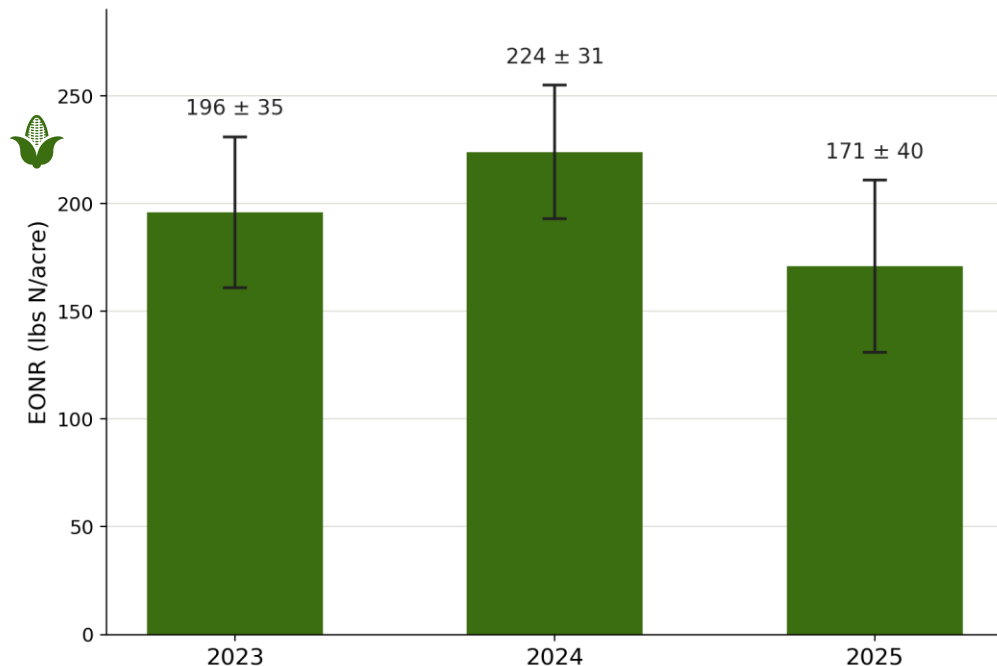


Soil testing



Specialized
equipment

Challenge: the “right” nitrogen rate varies widely from year to year



Over just 3 years the Economically Optimal N Rate (EONR) for trials in the Iowa Nitrogen Initiative differed by 53 lbs./acre

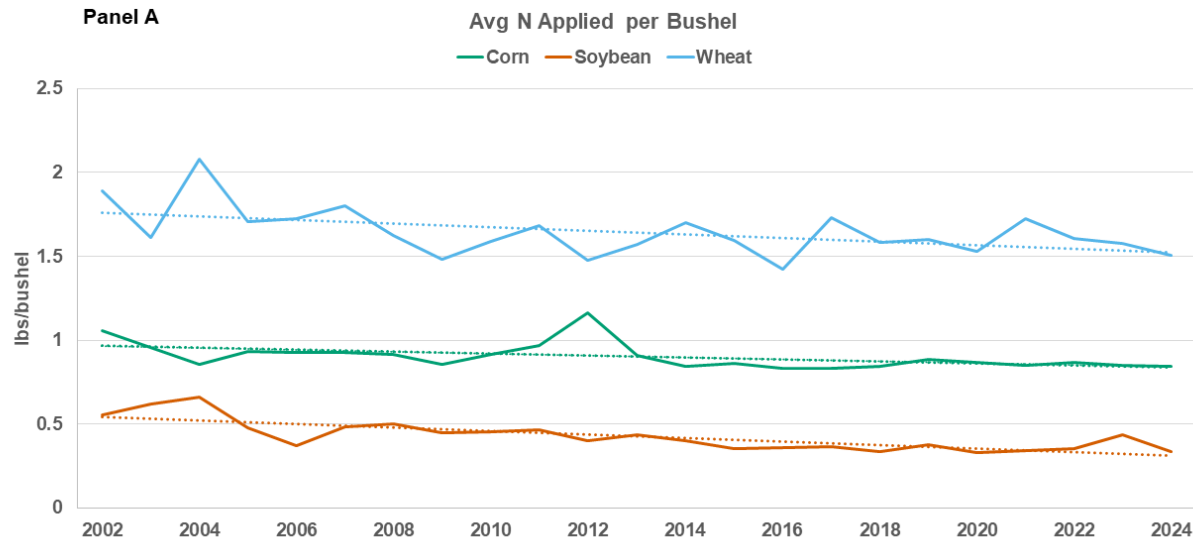
Most of this variability is due to **weather** which means that **a farmer doesn't know ahead of time how much N to apply**

Better data, models, and decision tools can reduce this uncertainty!

Source: Iowa Nitrogen Initiative trial data: <https://n-fact.ag/>
Ranges represent variability in the EONR across fields.

Fertilizer Use Efficiency has increased

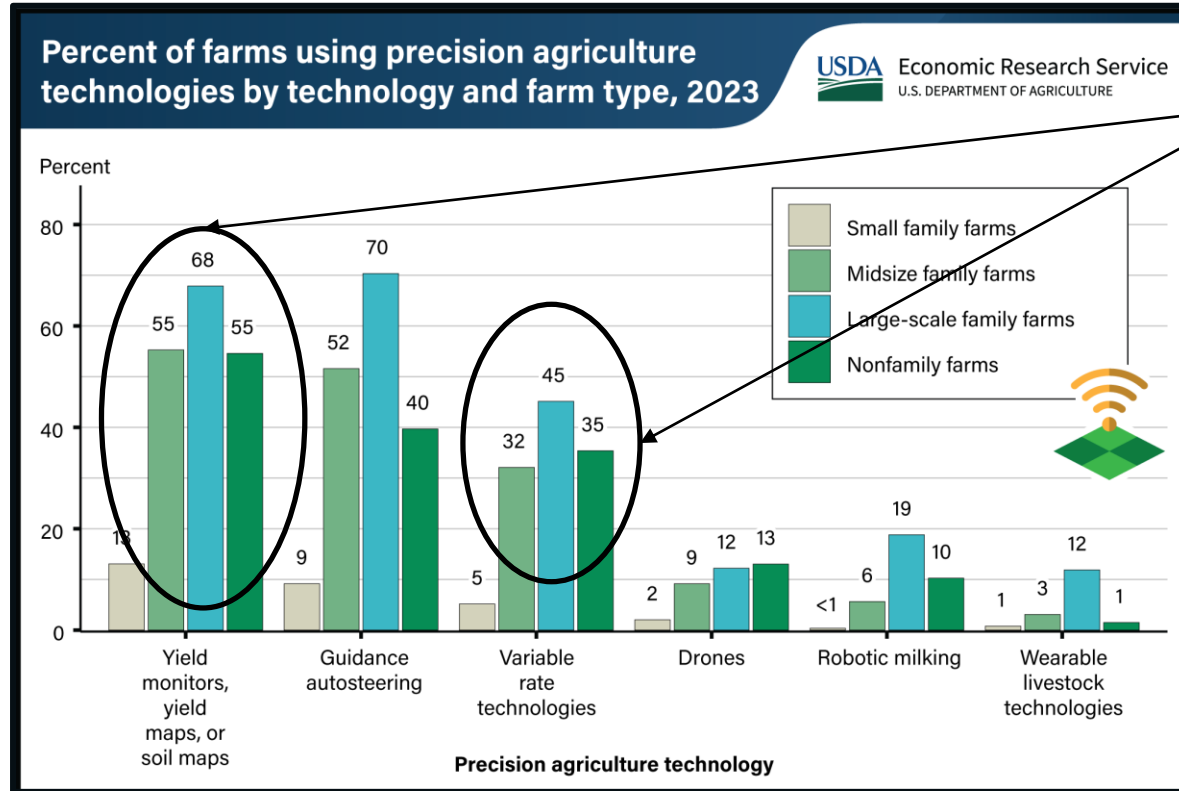
Figure 3. Estimated Fertilizer Use Efficiency (lbs/bushel) by Nutrient Type and Crop, 2002-2024



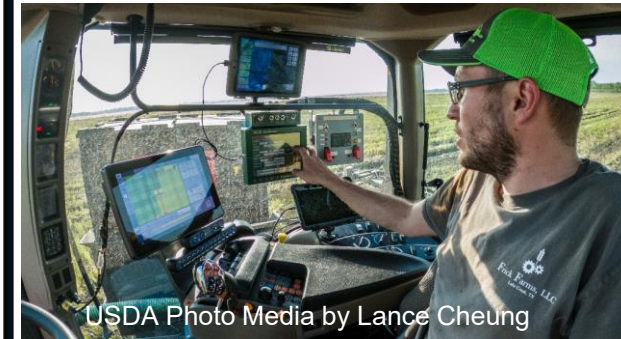
However....roughly $\frac{1}{4}$ of nitrogen inputs to cropland are still lost as pollution to air (nitrous oxide) and water (nitrate)

Monaco, H., N. Paulson and G. Schnitkey. "[Trends in Fertilizer Use and Efficiency in the U.S.](#)" *farmdoc daily* (15):98, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, May 29, 2025

Precision Ag use has increased – but plenty of room to grow



Increasing use of precision agricultural technologies and yield/soil mapping make it easier to vary fertilizer rates within and across fields



Still, **more than half of farms do not use variable rate technologies** for nutrient management

Source: USDA, Economic Research Service (ERS) using USDA, National Agricultural Statistics Service and ERS 2023 Agricultural Resource Management Survey (ARMS) data

Emerging innovations can help reduce N losses

Development of new crop varieties could improve nitrogen use efficiency, and reduce fertilizer inputs and nitrogen losses

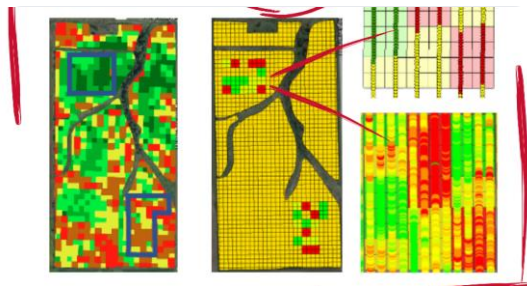
Changing livestock diets to feed more digestible N directly to animals can reduce the amount of N lost in manure

Improved manure recycling could allow manure to substitute for 6% of fertilizer demand with existing technology & another 22% with technological innovations ([Wang et al., 2026](#))

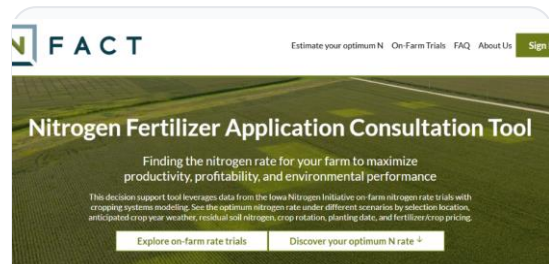


Better data, models, and tools to support the innovation process

The more we understand about the system – the better we understand its agronomic, economic, and environmental performance.



Coordinated, on-farm research networks



Improved models and decision-support tools



Trialing of new innovations to improve NUE, reduce nitrogen losses, and measure outcomes (MMRV)

Innovations and tools need to deliver value to the farmer in order to be adopted

Thank you

