

Chicago Fed Letter

Improving Midwest agriculture and the environment

by David B. Oppedahl, senior business economist

On November 20, 2019, the Chicago Fed held a conference to examine environmental issues related to Midwest agriculture, with a particular focus on conservation practices. Experts from academia, the farming and food industries, and policy institutions gathered to discuss how to keep the region's farms economically viable while improving the sustainability of its natural resources.

The goals of the conference included understanding the impacts of agricultural and conservation practices on public health and air, land, and water quality; exploring farming policies that affect natural resources; and examining how environmental considerations may affect the financing and sustainability of agriculture, which has generally been less profitable in recent years. The day began with opening remarks from Rick Mattoon (Federal Reserve Bank of Chicago)—who noted that academic and policy researchers, insurance firms, and credit rating agencies are all increasingly concerned with identifying and measuring the impact of climate change on the economy. He acknowledged that environmentally beneficial practices—many of which are associated with

Most materials presented at the 2019 Agriculture Conference are available online, <https://www.chicagofed.org/events/2019/ag-conference>.

“precision agriculture”¹—may be challenging for some farmers to adopt during this period of lower profits. Still, he said, events like this one could help farmers in the Seventh Federal Reserve District² and elsewhere identify common goals and potential support in the private, public, and nonprofit sectors.

Achieving better environmental outcomes and financial results for Midwest farms

Robert Johansson, chief economist at the U.S. Department of Agriculture (USDA), provided the keynote address, which focused on ways to enhance Midwest farms' financial performance while also reducing their negative effects on the environment. To provide more context for his remarks, he shared that per the USDA's forecast, real net farm income is projected to drift lower over the next decade. Moreover, crop production in 2019 was stressful for farmers on account of tough weather conditions. So, given the difficult economic circumstances facing farmers, why should they care about conservation? First, he answered, cleaner air, land, and water benefit farmers; their crops and livestock; their communities; and those who visit the countryside for recreation and spend money in rural economies. Second, he contended, it is incorrect to assume that farms cannot improve their financial performance while also limiting or reducing their negative environmental impacts. Indeed, he asserted, the farms that increase their productivity with technological innovations over time will also be the ones that minimize such impacts. Johansson pointed out the dramatic increase

in agricultural productivity from 1929 through 2014, as agricultural output almost quadrupled while input usage remained relatively constant. The technological innovations that enabled this remarkable surge in productivity included those that improved farm equipment; irrigation; information collection, analysis, and transmission (including the use of satellite imagery); fertilization; seeds; biotechnology; and farming practices (including the incorporation of robots).

There can be a win–win scenario where agricultural innovations and improved efficiencies lead to enhanced bottom lines for farms, as well as better environmental outcomes.

Johansson explained that the USDA has been playing an important role in boosting conservation investments, which have benefited both farmers and the broader public. He said that many USDA programs have incentivized farmers to adopt conservation practices by offering financial assistance and technical expertise.³ USDA investments

through Farm Bill programs have led to reductions in soil loss and in the runoff of pesticides, fertilizers, and nutrients, as well as livestock manure, while more carbon has been kept in the ground. According to Johansson, some USDA programs have focused on the idling or retirement of farmland due to environmental concerns, but in recent Farm Bills there has been more funding for programs that enable conservation practices to be implemented on active farmland. He said that environmental outcomes in the Midwest should improve over the next few years because USDA spending on conservation has been relatively high in the region's states, especially in Illinois and Iowa. Johansson acknowledged that despite the USDA's efforts to assist farmers to produce more with fewer environmentally unfriendly inputs, many agricultural processes still have harmful effects on the nation's natural resources. Even so, Johansson said he remained optimistic that there can be a win–win scenario where agricultural innovations and improved efficiencies lead to enhanced bottom lines for farms, as well as better environmental outcomes.

Midwest crop farming and the environment

Gary Schnitkey (University of Illinois at Urbana–Champaign) explored past, current, and future concerns regarding Midwest crop farming's effects on the environment. He mentioned that the primary concerns from the past were soil erosion and pesticide runoff—both of which have eased. He then suggested that further carbon release due to tilling farmland, the rate of energy use per unit of farm commodity produced, and agriculture's economic sustainability given its substantial ecological footprint might become much greater concerns in the future. Yet, Schnitkey argued these concerns should take a temporary back seat to the primary concern of the present: nutrient runoff. The runoff of nitrogen and phosphorus—two main nutrients in commercial fertilizers—has contributed to the pollution of large bodies of water, including the Gulf of Mexico and Lake Erie. In particular, the pollution of drinking water resources, such as Lake Erie and the other Great Lakes, poses a public health risk to many communities. For the majority of his talk, Schnitkey focused on nitrogen-management strategies, including reductions in tillage; adjustments to the timing, rate, and form of applied nitrogen; and the use of cover crops,⁴ as well as edge-of-field water treatment technologies (which he contended do not currently offer enough of a return on investment for widespread implementation by farmers). The natural runoff of nitrogen complicates the management situation for crop farmers, but Schnitkey shared that research into these practices has shown that they have merit in reducing nitrogen runoff due to farming. In sum, he concluded that reduced tillage and improved methods for nutrient application could benefit both the environment and the profitability of crop farms.

Emily Bruner (American Farmland Trust) shared some case studies of farms adopting crop production practices that keep soil healthier than more commonly used farming techniques. These case studies were part of a project that she undertook with several colleagues; through their work, they were able to quantify the economic benefits for crop farmers (including overall net cost reductions

and lower operational risks) associated with better managing soil health. According to Bruner, these data are critical information that had been lacking in much of the anecdotal evidence and scientific research supporting the use of these conservation practices. She argued this information has value for not only farmers, but also landlords, retailers, bankers, and others in the agricultural community. The case studies took place on row-crop farms in Illinois, Ohio, and New York (plus an almond orchard in California). In the Illinois example, the farm's net income was boosted through the use of cover crops—which increased the farm's corn and soybean yields by more than enough to offset the cover crops' associated costs—and through nutrient-management techniques and reduced tillage, which lowered costs for running machinery and expenses for nutrients. Overall, across the three row-crop farms, there were improved yields and cost reductions, which led to an average increase of \$42 in net income per acre and an average return on investment of nearly 170%, stated Bruner. These results were driven primarily by lower costs for labor, machinery, fuel, and fertilizers—which more than made up for the additional costs of learning the new conservation practices for all three farms and higher costs for more herbicides for one of them. Bruner said that besides the financial gains, the row-crop farms saw improvements in water quality, as well as reductions in nutrient runoff, sediment losses, and greenhouse gas emissions. Bruner contended that soil, as a living biome, can do more when disturbed less.

Midwest livestock farming and the environment

Next, James Mintert (Purdue University) discussed how the efficiencies gained through improvements in U.S. beef cattle and hog farming reduced the environmental impacts that both would have had otherwise over the past few decades. To begin, he shared that the annual production of beef, pork, and poultry combined grew 70% between 1990 and 2019 in the U.S. Over the same span, annual consumption per capita of red meat and poultry together increased 12% in the U.S., despite a general decline in this measure from 2007 through 2014 coinciding with a recession and higher prices for these products (largely due to increased feed costs for animals). Given that domestic meat production increasingly outstripped domestic meat consumption during this period, Mintert said that U.S. meat exports had clearly become the driver for the industry's growth. According to Mintert, a rise in purchasing power in many foreign nations—enabling better diets for consumers abroad—boosted the demand for U.S. meat products. The U.S. had been a net importer of meat through the late '80s and early '90s, but it became a net exporter starting in 1992. In 2018, about 12% of total beef, pork, and poultry output was shipped outside the U.S., he noted. Given the significant growth in beef and pork production since 1990, some might be concerned that the negative environmental effects from beef cattle and hog farming may have grown proportionally. Yet, Mintert contended that innovations in technology, as well as in cross-breeding and herd management, have helped reduce the environmental impacts these forms of animal agriculture would have had without them. For instance, these innovations for the beef sector increased the output per animal by 23% from 1990 to 2018. Mintert cited research showing that for the beef industry to produce about the same amount in the 2000s as in the late 1970s, it needed just 70% of the animals, 81% of the feedstuffs, 88% of the water, and 67% of the land. Moreover, the use of resources per unit of output changed dramatically for the pork industry, as the breeding herd shrank 9% between 1990 and 2018, although pork production rose over 70%. The environmental impacts of meat production got smaller per unit of output—gains in efficiencies allowed for smaller herds of cattle and hogs, which reduced land use and lessened greenhouse gas emissions. All these developments have the biggest economic and environmental implications for the Great Plains and Midwest states, which have the largest concentrations of beef cattle and hogs. In closing, Mintert asserted that the “ongoing productivity improvements arising from innovation are the foundation of a sustainable food system.”

Matt Krueger (Wisconsin Land+Water) spoke about the economic and environmental impacts of Wisconsin's dairy sector, highlighting the risks to the state's natural resources and rural communities posed by concentrated animal feeding operations (CAFOs), or large-scale industrial animal farms.

Among the approximately 8,000 dairy farms in Wisconsin in 2018, 312 of them were CAFOs. While the number of Wisconsin dairies had shrunk by roughly half since 2004, the number of CAFOs had more than doubled since 2005. Meanwhile, the size of the dairy herd (around 1.25 million cows) remained fairly steady between 2004 and 2018, as small dairy farms shuttered and large operations multiplied. Krueger said that while the dairy industry is a key economic driver for Wisconsin, this sector was under pressure between 2015 and 2019 as milk prices stayed below the state's average break-even price over this period. This partly explains why so many small dairy operations closed during this time. In addition, the pollution of surface water and groundwater due to dairy production harmed human health, tourism, and home values—all of which led to greater public scrutiny of the dairy sector's practices. In particular, hosting more CAFOs created problems for Wisconsin as the state's cropland nutrient runoff potential increased, the amount of manure in storage rose, and the resiliency of farmland to withstand extreme weather fell, according to Krueger. He acknowledged that the state's water quality was not the sole fault of dairy farming, but emphasized this sector has played a critical role in its decline. Krueger contended there are opportunities for the agriculture sector to lead the way through transparent, verifiable, and marketable farmland-stewardship initiatives to improve environmental outcomes. Financial capital has been available to dairy farms to expand their operations, as evidenced by the rising number of CAFOs. But he argued there should be greater provision of financial capital for more Wisconsin farms to transition to new ownership or management, to have a more diversified set of products, and to modernize their operations to reduce their negative effects on the state's natural resources.

Farmland ownership and environmental impacts

Alejandro Plastina and Wendiam Sawadgo (Iowa State University) pointed out that absentee or nonoperator farmland ownership and short-term rental arrangements for agricultural land may hinder the implementation of conservation practices. They began their presentation by citing data showing that 53% of Iowa farmland was rented out by landowners and 37% was operated by landowners in 2017. Most farmland leases are short-term contracts; therefore, most farmland tenants are unlikely to want to invest in practices that provide primarily longer-term gains. Moreover, Plastina and Sawadgo mentioned that many landlords do not live in the area near their farmland—which may make them less willing to implement conservation practices. Of these practices, using cover crops has been one of the more critical ones for improving soil health, as well as preventing soil erosion and water runoff, Plastina and Sawadgo contended. Between 2012 and 2017, the percentages of cropland devoted to cover crops increased in most midwestern states, yet the use of cover crops remained small relative to the total area of cropland. In 2017, cover crop percentages for Seventh District states ranged from 3% in Illinois to 9% in Michigan. Iowa State University conducted a survey to analyze how conservation practices varied by ownership type for Iowa farmland. According to this survey, just 4% of Iowa farmland had cover crops in 2017. Notably, 6% of full-time owner-operators employed cover crops, while only 3% of part-time owner-operators and 4% of owners who never farmed their land used them. Plastina and Sawadgo showed that cover crops were used least on farmland owned by someone living outside Iowa for the entire year. One of the main reasons cited for not employing cover crops was the high associated cost in money and time.

Kevin Mahalko (GrassWorks Inc.) talked about running his family's small dairy and beef operation in Wisconsin using grass-fed and organic production methods. Mahalko listed the five fundamentals of the 100% grass-fed dairying that he adheres to on his farm: a majority of a herd's feeding must be on pastures during the grazing season (which can get extended with supplemental hay); no fed grain; mandatory checks for animal health; no antibiotics, growth hormones, or genetically modified organisms (GMOs); and yearly on-farm inspections to ensure compliance with 100% grass-fed dairying standards. While using organic production methods generally yields less milk, the prices for organic milk have been higher and more stable than those for regular milk—which makes using such techniques financially viable, he argued. For the kind of pasture-based farming he does, he said that one key goal is to build up rich soil with lots of organic matter; about two-thirds of this

would come from the roots of various prairie flora, he noted. According to Mahalko, research shows that dairy farms using pastures to feed their herds are often better at preventing soil runoff, managing animal waste, and sequestering greenhouse gases in soil than dairy farms using animal containment facilities for feeding. Finally, he discussed the Dairy Grazing Apprenticeship (DGA) program—for which he's served as an educator and mentor. The DGA was established to develop national standards for training in managed grazing dairy production; provide training to the next generation of grass-fed dairy farmers through instruction and work experiences; and offer them pathways to farm ownership.

How to fund conservation efforts in the farming sector

The conference concluded with a panel on financing conservation efforts within the farming industry. The panel was moderated by David B. Oppedahl (Federal Reserve Bank of Chicago) and featured Maria Lemke (The Nature Conservancy), Clay Mitchell (Fall Line Capital), Ben Spitzley (GreenStone Farm Credit Services), and Noah B. Yosif (Independent Community Bankers of America). The panelists were in agreement that there has been some progress in funding conservation methods in recent years, yet a few of them voiced concerns about whether certain conservation practices could be scaled up to adequately address the farm sector's negative effects on the environment without being prohibitively expensive for most farmers. Lemke discussed research projects exploring the use of conservation techniques in a heavily farmed Illinois watershed. In that area, the use of winter cover crops, timing changes for nitrogen application (in the spring rather than in the fall), and man-made wetlands showed promise in lowering water runoff and nitrogen losses. Private-public cost-sharing agreements (e.g., between farmers and federal government agencies) enabled the implementation of many of these techniques, as well as some of the research on their effectiveness that Lemke cited. Mitchell shared his perspective as a farmer who became a venture capitalist, as he laid out the analytical tools to maximize financial and environmental returns on investments in both technology and farmland. From Mitchell's experience, landlords can promote conservation practices through incentivizing and enforcing them in lease agreements, as well as sharing best practices with tenants. According to Spitzley, despite the dairy sector's challenges, dairy farmers could still get loans with workable terms to invest in an array of farming technology and infrastructure yielding better environmental results—e.g., modernized housing for cows, more-tailored animal feeding, manure-management systems (to avoid spillage and runoff), and digesters (to turn manure into energy and bedding for cows). That said, Spitzley contended that the consolidation of livestock operations (often into CAFOs) will continue, given the current economics of livestock agriculture and consumers' rising demand for food. Yosif presented research on the correlation between agricultural lending by community banks (which he defined as banks with under \$50 billion in assets) and adverse weather patterns (which he attributed to climate change). Yosif examined community bank lending during a time when FEMA (Federal Emergency Management Agency) disaster declarations due to extreme weather events were on the rise (2005–18). His research found that over this period, agriculture-related lending by community banks rose a lot when disaster declarations were made—likely to support farmers' recovery efforts. Additionally, his study showed a small positive correlation in lending by community banks and grants awarded to conduct sustainable agricultural research. Yosif said his view was that sustainability research provides additional opportunities for bankers to team up with farmers to develop new strategies that benefit both the environment and their bottom lines.

Conclusion

Increases in agricultural productivity have allowed for greater output of food over the past few decades and have reduced the negative impacts on the environment per unit of food produced. Even so, the implementation of additional conservation practices could benefit the Midwest's crop and livestock farms, as well as nearby communities and the countryside. Many conference participants agreed that the region's farming sector and natural environment can both be improved in

the years ahead by funding research on sustainable agricultural practices; implementing proven methods more widely; and finding new ways of financing the use of such techniques while helping to keep farms solvent.

Notes

¹ Precision agriculture involves the use of technologies (such as the Global Positioning System and sensors) to raise crop yields while decreasing the amounts of traditional inputs (e.g., land, water, fertilizers, herbicides, and insecticides) necessary to produce crops (and livestock). Further details are available online, <https://nifa.usda.gov/program/precision-geospatial-sensor-technologies-programs>.

² The Seventh Federal Reserve District comprises parts of five midwestern states—all of Iowa and most of Illinois, Indiana, Michigan, and Wisconsin.

³ Details on many of the USDA's conservation programs are available online, <https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/>.

⁴ Cover crops are plants used to protect the soil between the harvest and planting of primary crops. The use of cover crops can slow erosion and improve soil health. Their use can also improve primary crop yields, in part by suppressing weeds and controlling pests and diseases.

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