Midwest Farmers Experience Toll of Climate Change on Food Supply

SARA SHIPLEY HILES, MA

It's not news to Midwestern farmers that the weather is getting weird. Last spring was more like winter through the end of April, as late snow delayed planting by several weeks, followed by a blazing hot May. It was dry during the growing season, when farmers would have liked rain, and wet again through a cold fall that delayed the harvest. Some farmers couldn't bring in their crops until mid-December, weeks behind schedule.

"It was a very trying crop season," said Brian Martin, who farms 1,500 acres with his family in mid-Missouri. "We didn't get the rainfall when we needed it."

"The weather's become more extreme. No two years are alike," agreed Taylor Moreland, owner of Moreland Seed and Soil in Centralia, Mo. The two men share a warehouse where they store seed to sell to surrounding farms.

Farmers across the Midwest are seeing the impact of climate change — and more changes are coming that threaten to rearrange the economy, landscape and food supply of the region. Already, the Midwest is warmer, wetter and more humid, with increased nighttime temperatures and more downpours in spring and winter, according to the Fourth National Climate Assessment, a federal state-of-the-climate report released in November 2018.[1] The report, which involved 13 federal agencies, predicts that changes in precipitation, along with rising temperatures by mid-century, will reduce Midwest agricultural productivity to levels of the 1980s without major technological advances. The report's chapter on the Midwest details major shifts to agriculture that have developed over the last few decades:

- Increased spring and winter rainfall and more intense rain events have caused erosion, flooding and a reduction in workable field days.
- Warmer winters and higher humidity have led to more pests and pathogens.
- Daytime temperatures haven't gone up as much as in some parts of the country, but nights are warmer on average, which stresses both plants and animals.

The report predicts that temperature trends will accelerate, with summer heat in the Midwest increasing more than in any other region of the United States. For example, the annual five-day maximum temperature in northern Minnesota

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Larry Moore

is projected to climb from a historical average of 88 degrees to 95 degrees by mid-century under the higher emission scenario. Southern Missouri would go from 97 degrees to 103.

Jim Angel, the recently retired Illinois state climatologist and lead author for the report's Midwest chapter, said that the region has largely escaped scorching heat so far, but that isn't expected to continue. "The key part will be hotter summertime temperatures," said Angel, who was based at the University of Illinois at Urbana-Champaign. "That's the part that really has me worried."

Extremely hot summers could push crops past optimal growing temperatures into the "reproductive failure" zone, the report warns. This is bad news for corn and soybeans, which take up 75 percent of arable land in the Midwest. Corn is especially heat-sensitive, with its developmental phases strictly following temperature cues. "If you know what the temperatures are, you can predict what stage the corn plant will be at," Angel said. A spike in temperature at the wrong time can result in lower yields. Warmer evening temperatures also take a toll on corn plants, which need to cool off at night for optimal production.

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— JIM ANGEL

Hot, humid conditions also affect livestock: animals tend to eat less and produce less milk, meat or eggs. The report estimated that the dairy, beef, swine and poultry industries lost more than $1.6 billion to heat stress in the year 2000. "At minimum, you get less weight gain," said Dennis Todey, director of the U.S. Department of Agriculture's Midwest Climate Hub in Ames, Iowa, and a co-author of the National Climate Assessment's Midwest chapter. "At the far end, there are episodes of mortality, especially when you have extreme conditions or it persists over several days."

Of course, humans are susceptible to heat waves too. Farmers and farm hands who are outdoors in hotter temperatures are subject to more heat stroke, heat exhaustion and heart attacks. "Right now, there's a lot of rural areas in the Midwest where you're a long way from any kind of medical facility," Angel said. "With heat stroke, if you are 40 minutes away from a hospital, that's a big difference."

FARMERS FEEL THE STRESS

Midwestern farmers already are feeling the heat. Ethan Miller works with landowners in central Missouri as the district manager for the Boone County Soil and Water Conservation District. He and his family raise row crops, hay and livestock in Boone, Audrain and Callaway counties. Following the widespread drought of 2012, which caused extreme shortages of hay to feed livestock, last summer's drought was the last straw for some in the cattle business. "All around there were guys who liquidated their entire herds," he said in early January. "We did see quite a few sold off this year."

Miller himself stopped raising corn after a drought in 2007. "Corn takes a lot more in inputs: seed, nitrogen," he said. He has switched to mostly soybeans and wheat interspersed with sorghum and red clover. His family rotates livestock on different pastures and leases grazing land, which has helped keep his farm productive.

For fruit farmers, warmer winters can lead to peril. Michigan experienced a total failure of the tart cherry crop in 2012 after a cold snap followed an unseasonably warm spring, and apple crops in the Midwest failed in 2007 and 2012 under similar patterns, Angel said. "If you've had a mild winter, apple trees start to break dormancy, buds start to swell, and eventually they will flower if it gets warm enough, but then they're extremely vulnerable to frost," he said.

Plant diseases and mold are increasing, like the bacterial spot outbreak that has plagued Illinois pumpkin crops. Farmers are spraying fungicides more often, and that costs money. They're installing more drainage tiles in their fields to manage runoff from extreme rainfall events. "Yields over time, it's true they're going up, but the cost of keeping those yields high is also going up," Angel said.

A CHANGING CLIMATE PATTERN

University of Missouri Extension State Climatologist Pat Guinan said Missouri has been warming since the late 1990s, and 2012 stands as the warmest year on record. The date of the last spring freeze is about a week earlier on average over the past 20 years, and the first fall freeze occurs a week later, adding about two weeks to the growing season. Most notably: "We're in an unprece-

dented wet period," Guinan said, and that means more rain and more flooding. Despite periods of drought, Missouri has seen a 37 percent increase in 3-inch rainfall events in the past 20 years, he said.

As in the rest of the Midwest, the wetter Missouri climate has prevented farmers from getting into their fields to plant in the spring and to harvest in the fall. Heavy rains erode soil and wash nutrients downstream, where they feed the lifeless "dead zone" in the Gulf of Mexico. The sun evaporates some of this extra moisture, and abundant row crops pump even more water into the atmosphere. This process suppresses the maximum temperature and elevates the minimum temperature, Guinan said. In effect, the Midwest has created its own climate feedback loop.

But that doesn't mean droughts won't come, Guinan said. In fact, last year's midsummer drought hit the state hard. "2018 was crazy. I don't want to repeat it," Guinan said. "It was very difficult and challenging for farmers. We had our second coldest April, followed by the hottest May on record. We've never seen anything like that in Missouri."

Changes in precipitation and temperature are redrawing the map of Midwestern agriculture. Todey said that following droughts, some livestock operations in Texas and Oklahoma moved to Iowa. "That's starting to put a stretch on water resources," he said. "The Midwest has always been viewed as an area with ample water, but if we have to grow more food, we have to think about that."

Meanwhile, the National Climate Assessment predicts that Midwest temperatures will warm to the point that certain crops may not be profitable. "What happens when the climate changes enough that it becomes too difficult to grow corn and beans in the region?" Todey asked. "We'll run into that. It won't happen tomorrow, but we need to start giving producers some other thoughts."

TECHNOLOGY VERSUS CLIMATE CHANGE

The "corn belt," a swath of the central U.S. where corn is a major crop, already has shifted northward to include the Dakotas, said Nathan Fields, vice president for production and sustainability at the National Corn Growers Association. He said that the federal report documents what farmers see on the ground: increased weather variability, more wet or dry stretches, warmer evenings. Despite these challenges, crop yields have continued to rise on average as farmers and technology have adapted, Fields said.

Fields predicted it will be possible to keep growing corn in the same areas, but it may require changes, such as planting at different times and using seeds designed for the climate. Seed companies have poured research into new varieties that can better withstand heat, drought or even standing water.

But some experts worry that the climate is changing so quickly that agricultural technology might not be able to keep up. "Technology can get us part of the way, but it doesn't look like it will be able to get us all the way," Todey said.

Cornell University economist Ariel Ortiz-Bobea, PhD, has done several studies on how climate change affects the productivity of U.S. agriculture. One study found corn yields would have to increase dramatically — on the order of a second "genetic revolution" — in order to offset climate change impacts under a scenario where emissions continue to rise through the 21st century.[2] Another study examining total agriculture productivity nationwide found that the Midwest has become especially sensitive to climate shocks because the region has specialized in rain-fed row crops, and those crops are increasingly vulnerable to extreme weather.[3]

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Ortiz-Bobea described technology as increasing productivity while climate change decreases it. "You have two forces going in opposite directions," he said. Human ingenuity can develop technology to adapt to climate change, he said, but the rate of development and adoption might not keep up. "It's like a headwind," he said.

Ortiz-Bobea said the dominance of corn and soybeans leaves the Midwest at risk, and he suggested diversifying. "Let's broaden the discussion about improving the resilience of the ag sector," he said.

THE PROBLEM AND THE SOLUTION

U.S. farms contributed $137 billion to the U.S. economy in 2015 and provided about 2.6 million jobs, according to USDA data. Agriculture also makes up about 9 percent of all greenhouse gas emissions in the United States, the fifth-largest

segment following transportation, electricity generation, industry, and commercial and residential uses, according to U.S. Environmental Protection Agency estimates.[4] Farms release greenhouse gases from fertilizer application, cattle digestion, manure management, burning crop residues and other practices.

On the other hand, as the National Climate Assessment points out, agriculture is one of the few sectors that has the potential to offset emissions by capturing carbon from the atmosphere and storing it in soil, plants and trees. Carbon sequestration is a trendy term describing what some farmers call good old-fashioned conservation. Not all farmers like to talk about climate change, but they're already adapting to it.

"Some of the things that are better for soils are the same things that are better for the climate," Todey said. Those practices including tilling the soil less or not at all, planting cover crops such as clover or winter rye, and leaving more crop residue on the fields. This creates rich soil that's more biodiverse, more stable and better able to hold moisture. It also holds more carbon — so much so that a study by Climate Central found the widespread use of cover crops across Missouri farms could offset the carbon pollution of all the cars owned by St. Louis and Kansas City residents.[5]

Miller, the Soil and Water Conservation District manager, preaches the benefits of conservation practices for both farm finances and the environment. "Soil health is a movement," he said. "It all works together, and it's just getting guys to see that."

Martin, the farmer based in Centralia, participates in the Soil Health Partnership, a National Corn Growers Association initiative that has enrolled 140 farms in 14 states in field research. "I'm 100 percent no-till and always have been," Martin said proudly, steering his truck along fields bristling with stubble from the previous corn harvest. He also plants cover crops and applies only as much as fertilizer as is needed. "To me, it's like what Grandpa said: We're stewards of the land. We're here to make it better than we found it for the next generation."

SARA SHIPLEY HILES is a freelance journalist and an associate professor at the University of Missouri School of Journalism in Columbia.

NOTES

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JOURNAL OF THE CATHOLIC HEALTH ASSOCIATION OF THE UNITED STATES www.chausa.org

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Reprinted from *Health Progress*, March-April 2019