MICHIGAN STATE UNIVERSITY

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Inside

A new forum for AFRE research

Welcome to *Michigan Ag Economist,* a new publication to get the word out on the work done at Michigan State University's Department of Agricultural, Food, and Resource Economics (AFRE). Our faculty and students continually address key issues and develop insights on Michigan food and agriculture and we want to communicate these through *Michigan Ag Economist*.

The discipline of economics has much to offer. At AFRE, we practice economics that improves lives. As one of the leading departments in the world, we address important and timely policy questions and produce research that addresses practical problems for producers, consumers, and the environment.

Watch for two issues a year where we'll feature some of the latest AFRE research. In this newsletter, you'll find facts and trends in Michigan food and agriculture. You'll also gain a keen understanding of the economic realities that affect Michigan food and agriculture.

We hope you enjoy the research covered within these pages, and as always, we welcome your comments and feedback.

Alan Ker, Editor, Elton R. Smith Chair in Agricultural and Food Policy

Climate change, crop yields, and the implications for crop insurance

Alan Ker, Michigan State University Department of Agricultural, Food, and Resource Economics; and Daniel Shuurman, University of Guelph

Alan Ker

Climate change continues to fuel concern about the future cost of publicly-subsidized crop insurance programs. These programs are designed to protect producers from naturally occurring yield losses and are a key part of domestic agricultural policy in many developed countries. In the U.S., these programs cover a wide range of crops including major grain crops, tree crops, livestock, and specialty crops. In 2022, liabilities for all programs totalled $647 billion, premiums totalled $6.8 billion, and subsidies totalled $4.1 billion.

Although the government sets the premium rates, the policies are delivered by private insurance companies who share in the underwriting gains and losses of the policies they sell. Producers receive a 60% premium subsidy on most insurance products.

Crop insurance payouts to Michigan producers have been roughly $1.80 for every $1 of producer paid premium over the past 20 years for the three main field crops – corn, soybean, and wheat (Figure 1).

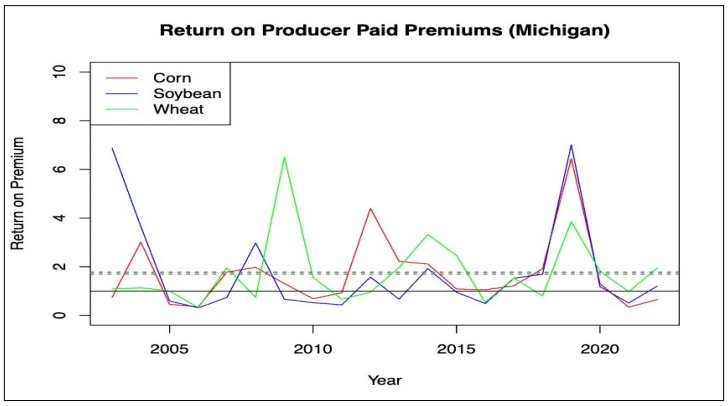


Figure 1. Return on producer paid premiums (Michigan).

Given the size of producer monies, private insurer monies, and public monies involved in the crop insurance program, it's important to understand how a changing climate will affect crop yield distributions and future payouts.

The shape of yields to come

Changes in climate are expected to alter crop yield distributions, and crop losses, in complex ways. To predict the effect of climate change on insurance costs, we must be able to capture the complex relationship between climate, yield, and technology.

Data on Iowa and Michigan non-irrigated corn production, as well as climate was collected and used for the empirical work. Climate data included daily maximum and minimum temperatures, and precipitation. Climate change scenarios from the International Panel on Climate Change were considered.

Mixture modelling and machine learning methods were used to estimate the complex relationship between corn yields and climate. Different models were estimated for each county in Michigan and Iowa. Not surprisingly, we find very different effects in Iowa versus Michigan.

State	Percent Increase in Premium Rates		
	2030	**2040**	**2050**
Michigan	0.0	0.2	0.2
Yield Guarantee (bu/ac)	156.4	172.5	188.5
Iowa	7.5	9.3	7.0
Yield Guarantee (bu/ac)	176.3	191.0	205.2

We find that Michigan premium rates are not expected to rise because of climate change, but Iowa premium rates will increase by 5-10% over the next 25 years. We also find the average yields between Michigan and Iowa will converge over the next 25 years. Iowa will still enjoy a comparative advantage in growing corn, but that advantage is expected to shrink moderately.

Financial implications

When we consider the impact of future climate scenarios on expect yield loss and crop insurance subsidies, there are several key findings.

1. The effect of climate change on expected losses and premium rates will be non-linear over time.
2. The effect of climate change on corn yields will be quite different between Michigan and Iowa.
3. Climate change is not expected to bring into question the financial solvency of crop insurance programs.
4. Premium rates under climate change do not depend solely on temperature changes, but also on the rate of temperature change over time relative to the rate of technological changes over time.
5. Our findings are conditional on historic trends in technological change and adaptation to rising temperatures including improvements in seed genetics, greater precision in fertilizer applications, and higher planting densities. A focus on continued advances in technology is crucial to offset the effects of climate change on crop yields.

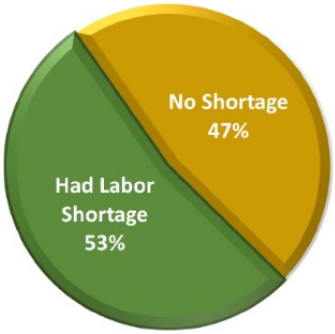
We find that Michigan premium rates for corn are not expected to rise because of climate change, but Iowa premium rates will increase by 5-10% over the next 25 years.

Policy ideas to address agricultural labor issues

Zachariah Rutledge, Michigan State University Department of Agricultural, Food, and Resource Economics

Zachariah Rutledge

Most farm employees in the U. S. were born in Mexico but are settled here. There are a number of factors affecting farm employment across the U.S. and Michigan; farm work is notoriously difficult and tends to pay lower wages than other sectors of the economy. The number of people willing to work on U.S. farms is also declining. As a result, a significant number of farmers report labor shortages. Of 1,300 farmers surveyed in 2020-2021, more than 50% reported having labor shortages.



Farmers have been trying to adapt to this situation, and many have turned to the H-2A visa program to hire legal, foreign-born employees for seasonal labor. H-2A employment is rising (Figure 1) but the program comes with certain mandates, including a minimum wage that is adjusted every year and is always higher than the state of federal minimum wage. While many farm employees have fought for higher pay and better working conditions, farmers claim these higher mandated labor costs are at a tipping point that is causing production changes in Michigan and throughout the U.S.

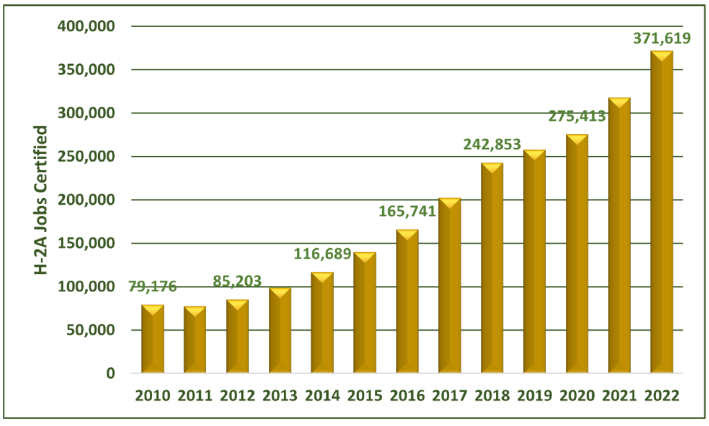


Figure1. H-2A employment is increasing.

Labor issues revolve around several factors – labor availability, rising wages, and competition from foreign producers. There is a rising demand for fruit, vegetable, and horticultural crops (FVH) that are more labor-intensive and in a market where the U.S. is at a comparative disadvantage. The labor supply pressure creates a food security risk from supply chain disruptions and market creep from foreign competition.

If the U.S. is unable to secure a stable labor force for farmers (Figure 2), it must mechanize labor-intensive tasks or reduce the amount of labor-intensive crops produced and increase its dependence on imported foods.

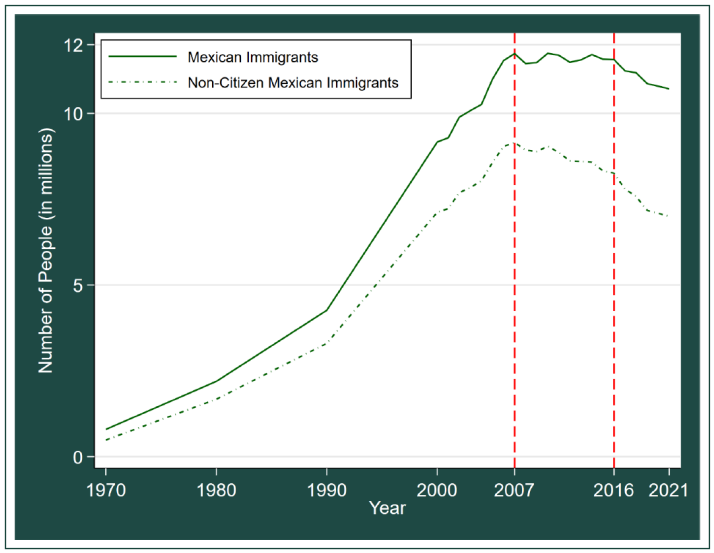


Figure 2. The Mexican-born U.S. population is declining.

Farm labor policy options

There are three types of policies that could help secure an adequate workforce for domestic agricultural production: migration, compensation, and technology.

1. Increase legal, permanent migration opportunities.

- Immigrant employees tend to be hard workers often willing to work for less than U.S.-born employees
- It can be difficult to vet good workers from those with other motivations
- Increased immigration may cause harm to individuals already settled in the U.S.

2. Address issues with the temporary H-2A visa program.

- H-2A employees are very motived to earn as much as they can while in the U.S. – working hard and working overtime hours

- H-2A employees tend to be paid more than U.S.-based employees
- The H-2A program is subject to increased regulatory scrutiny

3. Incentivize farm labor supply.

- Subsidize labor or create labor tax offsets where employees could earn sufficient wages but employers do not bear the full costs
- Mandate benefits for health insurance to improve employee welfare and commitment to work. There is the question who would pay, employer or the government.

Market or policy solutions are needed to maintain U.S. agricultural production. These may include ways to incentivize farm labor and mechanize labor-intensive tasks.

Policy pros and cons at a glance

	Pros	Cons
Increase permanent legal migration	Foreign-born employees are physically fit, highly productive, and have low reservation wages	Vetting process is difficult and there is a negative impact on incumbent employees
Increase H-2A employment	Highly productive, hardworking employees willing to work over time	Vetting process is difficult, higher labor costs required for housing
Subsidies and tax credit compensation	Raises wages and offsets employer expenses	Distorts labor market and involves taxpayer money
Benefit mandates	Improves employee welfare	Extra cost burden for employer

The bottom line on labor

Labor supply issues for the U.S. agricultural sector are threatening the agricultural production capacity of the U.S., reducing economic welfare for domestic producers, and exposing the U.S. to food security risks. Market and/or policy solutions are needed for the U.S. to maintain its level of agricultural production. These may include incentivizing employees and mechanizing labor-intensive tasks.

Fewer people want to do farm work

- Better education and job opportunities for Mexican nationals
- Tighter border security
- More settled migrant families

Tracking the transition to cage-free eggs

Vincenzina Caputo, Michigan State University Department of Agricultural, Food, and Resource Economics

Vincenzina Caputo

As the second largest egg producer in the world, the U.S. is in the midst of transitioning to cage-free egg production. To date, 10 states have existing or impending legislation to ban conventional cage egg production. Many large retailers, including Walmart and Kroger, have voluntarily pledged to sell 100% cage-free eggs in the next few years.

The transition from conventional housing to cage free is a dynamic topic with many divergent interests at play. Currently, approximately 66% of laying hens are housed in conventional cages and 34% are in cage-free systems. To meet new policy/retailer goals would require an estimated 70% of egg facilities to be cage free – systems that have higher costs than conventional that are generally passed down to the consumers.

To gain new insights into the effect of cage-free mandates on the U.S. egg market, AFRE was asked to conduct market research with producers and consumers by the Food Industry Association, the United Egg Producers (UEP) and the United Egg Association (UEA). There were two key objectives:

- Evaluate producer attitudes, concerns, and willingness to adopt cage-free production
- Assess consumer preferences for cage-free eggs and purchasing behavior under different marketing conditions

Producer point of view

Individual interviews and online surveys were conducted with egg producers to evaluate the cost of cage-free systems and identify barriers and opportunities to adoption of cage free.

We engaged with 29 UEP members representing 30% of U.S. egg production with representation from the Midwest, northeast, south, and west. On average, 38% of participants have cage-free operations.

Key producer findings

1. The transition from convention to cage-free housing has huge implications to the cost structure of the egg layer business. Average cage-free costs are at least 8-19% higher than conventional.
2. Barriers to cage-free systems are perceived to be higher than their benefits. Most producers view conventional housing as superior in food affordability, production efficiency, and environmental impact, relative to cage-free production.
3. Egg producers are skeptical that the industry can meet all existing retailer pledges by 2026 based on the challenges associated with the cage-free transition.

Consumers on cage free

An online survey was used to evaluate consumer preferences for various egg products, including cage free. We also simulated consumer demand under various market conditions – purchasing decisions at various price points, and label implications (conventional, cage free, free range, pasture raised, and organic).

Key consumer findings

1. Segments of consumers are willing to pay significant premiums for cage-free eggs, but the largest segment (representing 55% of consumers) is motivated by price and does not discriminate between cage and cage-free eggs.
2. Removing the conventional option for consumers would increase the share of consumers choosing not to buy eggs by 20 percentage points.
3. Consumers do not expect a full conversion to cage-free egg systems by 2026. On average, they expect a 10-percentage point increase in cage-free laying hens from now to January 2026.

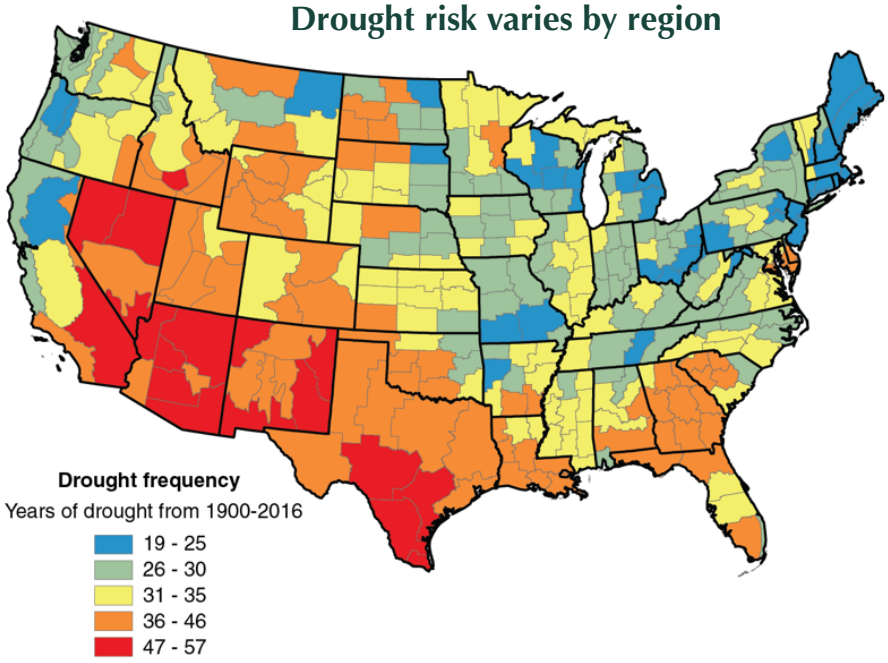
Decision making strategies for investing in irrigation

Molly Sears, Michigan State University Department of Agricultural, Food, and Resource Economics

Molly Sears

Climatic shifts and changing weather patterns put crops across the U.S at regular risk of drought. Historically, irrigation has primarily been adopted in areas that are more severely drought prone and/or have arid or sandy soils. But as drought occurs regularly in wetter locations, investments in irrigation have dramatically increased in the eastern part of the U.S. over the last 25 years.

Drought risk varies by region



Note: Drought frequency is the number of years when at least one summer month (June, July, or August) had moderate or worse drought (PMDI ≤ -2.00).
Source: USDA, Economic Research Service using historical data by climate district from National Oceanic and Atmospheric Administration's Palmer Modified Drought Index (PMDI).

There are several factors that affect the decision to invest in irrigation technology – some are within a farmer's control, and some are not. Understanding how frequently drought occurs – and how big the risk/reward trade-offs are – can affect the decision to invest.

Defining drought risk

All regions are likely to experience drought conditions on a regular basis, and the relative risk determines what the optimal strategies are for any given farm to mitigate farm losses.

- In high drought-risk regions, farms may experience a severe, extreme or exceptional drought once **every 2-3 years**.
- In low drought-risk regions, farms may encounter a severe, extreme or exceptional drought once **every 5-6 years**.

Drought vulnerability falls into two areas – those outside of a farmer's control and those within their control. Factors outside a farmer's control include weather, availability of ground/surface water, or soil moisture storage capacity. In contrast, factors impacting drought that farmers can control include irrigation, stewardship to promote water-holding capacity, crop choice, and insurance.

What about water rights?

Before investing in irrigation, it's important to understand the landscape of water rights and water sharing structures. Water rights affect a farmer's ability to gain and maintain access to water. In the western U.S., most farmers use a form of appropriation doctrine that establishes a priority order for surface water rights. This doctrine gives permit holders the right to divert a specified amount of water for an approved, beneficial use. This "first in time, first in right" structure was designed to clearly allocate water in the face of scarcity but can also lead to equity issues: new water rights holders are the least likely to obtain an adequate supply of water under drought conditions.

In contrast, the riparian rights structure – in place in much of the eastern U.S. – requires anyone with land adjacent to surface water to have equal access. While all landowners have equal rights to water, in times of water scarcity, allocating water across users can require significant legal coordination.

Before investing in irrigation, it's critical to know if a steady supply of water is available. In Michigan, surface water is governed by riparian rights.

However, all water users (both surface and groundwater) who are planning to install systems with the capacity to withdraw 100,000 gallons/day (70 gallons/minute) are required to make an annual report on water use. This policy applies to surface and groundwater withdrawals. Water users are also required to register with Michigan Department of Environment, Great

Lakes, and Energy using the **Water Withdrawal Assessment Tool** (www.egle.state.mi.us/wwat) – a screening program that predicts whether a large quantity withdrawal is likely to cause an adverse impact.

There are several factors that affect the decision to invest in irrigation technology – some are within a farmer's control, and some are not. Understanding how frequently drought occurs – and how big the risk/reward trade-offs are – can affect the decision to invest.

How do we value irrigation?

There are two types of benefits that farmers realize from irrigation – internal or private benefits and external benefits.

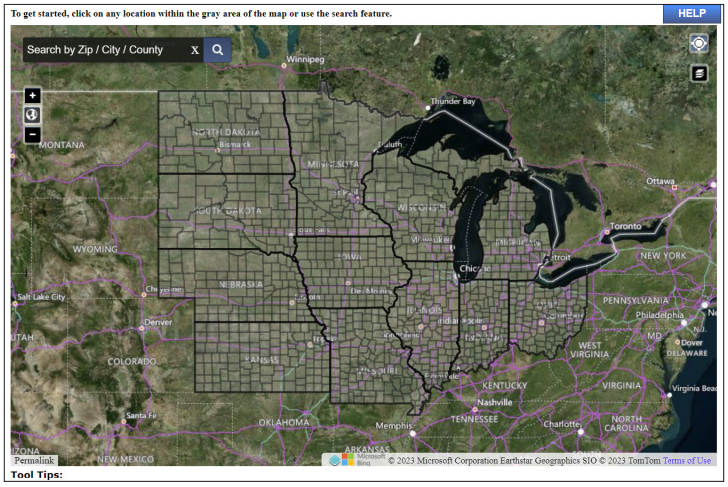
Internal benefits

- Increased crop yields
- Reduced risk from adverse weather (freeze risk, high temperatures, low precipitation)

External benefits

- Crop diversification
- Increased business for irrigation dealers, food processors, and agricultural employees

Irrigation investment calculator



To help farmers pencil out the internal benefits of investing in irrigation, the **irrigation investment calculator** (https://hprcc.unl.edu/agroclimate/iic.php) was created as part of the Useful to Usable (https://mygeohub.org/groups/u2u) project. The online tool is location specific and calculates net present value over the life of an irrigation investment, accounting for variability in crop yields and the probability of adverse weather. While the tool is valuable in assessing the net present value of an irrigation investment decision over the lifetime of a system, the initial design cannot accommodate complicated crop rotations and default values were related to just corn and soybeans. Together with colleagues Sungmin Cheu, Lyndon Kelley, Jon LaPorte, and Younsuk Dong, we are assessing the value of irrigation to Michigan agriculture, partially based on results from an updated version of this tool that incorporates other crop rotations.

What's on the horizon?

We can expect to see more irrigation and more volatile rainy seasons with more drought, rainfall and likely more pest pressure. There may be more legal issues related to water use in Michigan, especially under drought conditions. With increased irrigation, we can expect to see more specialty crops grown in the region on higher value irrigated acres.

Our team will continue to assess how irrigation has changed crop choices and profitability in the Great Lakes region over time, evaluating changes in crops produced, and resulting changes in yields and profits for farmers switching to new crops or maintaining old ones. Importantly, we will assess these changes across time and space, looking at how regions adapt differently, and how variation in weather conditions affect the results.

Quick numbers of U.S. irrigation

- 58 million total irrigated acres (Michigan had approximately 700,000 acres in 2017)
- 42% of U.S. freshwater withdrawals were from irrigated agriculture (in 2015)
- As of 2017, only 20% of land is irrigated, but 54% of total U.S. crops sales were from irrigated acres

Building resilience in local food systems

Brent Ross, Michigan State University Department of Agricultural, Food, and Resource Economics

Brent Ross

The Covid-19 pandemic brought new challenges to the agri-food supply chain. From panic buying to a dramatic shift in market demand, inventory shortages, and capacity constraints including labor and packaging. Add to that, other shocks and disruptions in the U.S. Midwest over the last several years caused by extreme weather, livestock and poultry disease outbreaks, and geopolitical conflicts.

When multiple and concurrent events shock various parts of the food supply chain, the economic, environmental, and social costs are amplified. Covid in particular impacted many of the agri-food supply chains in Michigan, including pork, dairy, blueberry, and tart cherry. The impacts were felt throughout these supply chains from farm supply, consumer demand and processing capacity.

The impact of extreme shocks on the food supply chain signals the need for adaptation and mitigation strategies. However, identifying effective strategies is complex. Here's why.

- The correlation between shock events can vary the intensity of the disruption.
- The effect of the impact (positive or negative) on the supply chain can vary over time and space.
- The nature of the impact can be affected by factors such as market concentration, supply chain structure, geographical concentration of product, and consumer behavior, among others.

New investment to enhance sustainability

To build greater resiliency for local and regional food systems, Michigan State University has received a $10 million grant to enhance the sustainability of the agricultural system. The five-year project has several goals.

- **Assess the impacts** of historical and projected shocks to the national agri-food system
- **Develop alternative** mitigation and adaptation strategies
- Use **AI-enabled** decision support system to help stakeholders better prepare for and respond to multiple shocks
- Create novel education programs and materials for K-postsecondary students to **enhance workforce development**
- **Safeguard** food access, food equity, nutrition security, and productivity

The project team includes a multidisciplinary group from nine public and private institutions covering agricultural economics, climate change and sustainability, food science and nutrition, education, supply chain management, and computer science and engineering.

There are nine overall objectives to build local and regional food systems that are resilient to multiple shocks. The approach is to develop an innovative framework to address the food and nutritional security needs of underrepresented, underserved, and vulnerable communities. Project deliverables will cover four key areas – research, education, extension, and integration.

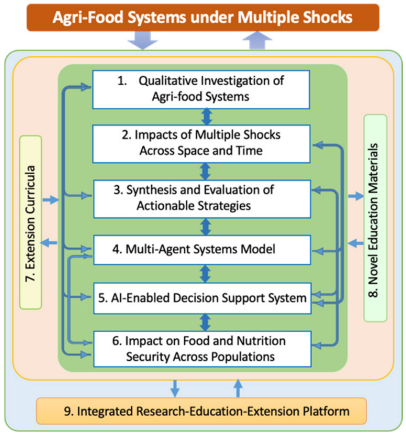


Figure 1. Overall project objectives to address agri-food systems under multiple shocks.

Timeline of shocks and disruptions in U.S. Midwest

- January 2018: U.S-China tariff war
- August 2018: African swine fever
- Spring 2019: severe rainfalls and flooding
- March 2020: COVID-19 pandemic
- August 2020: Derecho wind storm
- February 2020: Ukraine-Russia conflict and avian influenza outbreak

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