

America stress-tested its food system, and it mostly held

New ASU research shows US food supply chains bent under pandemic pressure but proved more resilient than they appeared

By Kelly deVos, ASU News
February 18, 2026

In the spring of 2020, Americans watched [grocery store shelves empty](#) in real time. Flour vanished. Meat became scarce and expensive. Potatoes were suddenly everywhere and nowhere. It felt like the country's food production system was unraveling.

But according to new research, that perception wasn't quite right.

"What we really had was an experiment that the country didn't mean to run," [Deniz Berfin Karakoc](#) says.

Karakoc is an assistant professor of industrial engineering in the [School of Computing and Augmented Intelligence](#), part of the [Ira A. Fulton Schools of Engineering](#) at Arizona State University, and a researcher who studies food supply chains.

Between 2018 and 2022, the United States endured a rare pileup of disasters: a trade war with China, catastrophic Midwest floods, the COVID-19 pandemic and widespread drought. Together, they formed something like a national crash test.

In [a new paper](#) published in the peer-reviewed journal [Frontiers in Sustainable Food Systems](#), Karakoc studied which parts of the food system bent under pressure, which snapped and which steadily kept working.

The goal, she says, is not to relive those failures, but to prevent the next crisis from catching the system unprepared.

A system built in layers

To understand what happened, Karakoc and her collaborators, including Megan Konar from the University of Illinois at Urbana-Champaign, started with a deceptively simple question: How does food flow across the country from producers to consumers?

“Food supply chains usually have four steps,” Karakoc says. “It starts with agricultural production — what happens in the field. Then processing, where food is packaged or transformed. Then consumption, where food goes to grocery stores or restaurants. And the fourth step is distribution, which connects every single one through transportation infrastructure.”

That system spans a massive country with deep regional specialization. Florida grows oranges. California produces nuts. The Midwest dominates corn and soybeans. Some regions are built around farming; others around processing plants, ports or rail hubs. Each layer of the food supply chain is vulnerable to different shocks.

“If you’re talking about floods, that’s going to hit production,” Karakoc says. “If you’re talking about trade wars, that impacts urban trade hubs. And a pandemic is a national-level shock that hits processing and service industries especially hard.”

From 2018 to 2022, all those stresses arrived, sometimes overlapping, sometimes back-to-back. To understand what happened inside the system, Karakoc and her collaborators turned to a massive federal freight database that tracks how commodities move between U.S. regions each year. The researchers wanted to know which locations and which steps in the chain proved most fragile and which were surprisingly resilient.

The team calculated how strongly each region was linked to others, balancing both the number of trade partners and the volume of food moving through them. That allowed them to quantify resilience — not just in tons of food, but in the structure of the system itself.

The pandemic didn’t break distribution, but it exposed other weak points

Public memory of the COVID-19 pandemic might be dominated by images of empty shelves. But when the team analyzed national freight data, they found something unexpected. The distribution system itself never fully collapsed.

“Our production was doing relatively good during COVID,” Karakoc says. “We had many farmers actually complaining that their high-quality produce was just rotting in the field.”

[The problem wasn’t a lack of food](#) or a nationwide inability to move it. Trucks and railways kept rolling. What broke down were the steps on either side of transportation, making a functioning distribution system look like it had failed.

Labor shortages meant crops couldn’t be harvested. Processing plants shut down when workers got sick. Even basic steps — washing lettuce, packaging meat — became bottlenecks. At the other end of the chain, consumer behavior added fuel to the fire.

“Panic buying was an issue,” Karakoc says. “The stress that you might not be able to go to the grocery store for a long period of time pushed people to purchase more than necessary, creating an imbalance at the consumption end.”

She points out that this pattern hasn’t gone away. During a recent winter storm in Texas, she watched store shelves empty again, even though forecasts predicted just a few days of snow.

Why cities struggled more than farms

One of the most counterintuitive findings from the research is that cities fared worse than rural areas, with slower and more prolonged recoveries.

“You would think cities have massive infrastructure,” Karakoc says. “But those metropolitan areas are where food processing and food service industries are concentrated.”

During COVID-19, those dense workplaces became liabilities. Close quarters meant outbreaks spread quickly. Plants shut down. Restaurants closed overnight.

“In rural areas, small farms allowed families to actually pick up their own produce from the field,” she says. “That part of the supply chain could still move forward.”

In other words, efficiency became fragility. Urban systems optimized for just-in-time delivery proved less adaptable when labor and demand shifted overnight.

The soybean surprise

The team’s biggest “aha” moment came not from the pandemic, but from geopolitics.

During the [U.S.–China trade war](#), soybean production in the United States remained strong. Farmers kept planting. Yields stayed high. But revenue dropped sharply.

“We realized production volumes were good,” Karakoc says, “but the revenue was low.”

At the same time, demand collapsed from China, and there were few backup markets ready to absorb the supply. Karakoc says there were no effective backup plans in place, leaving producers to sell at reduced prices.

The system recovered within about a year, but the episode exposed a hidden vulnerability. Even when production holds steady, a lack of diversified buyers can ripple through the entire chain.

Looking back, Karakoc says Americans often misidentified what was failing during the pandemic. Day to day, breakdowns in labor, processing and consumer behavior made the system appear fundamentally broken. But at an annual scale, the food system proved far more resilient, absorbing those short-term shocks and rebounding within a year.

That distinction matters, she says, because focusing only on visible, short-term disruptions can lead policymakers to misdiagnose the problem — overcorrecting in some areas while overlooking the structural vulnerabilities that make future crises more likely.

The real risk: 'Too big to fail'

If the last few years taught researchers anything, it’s that some parts of the food system are carrying far too much weight.

“We have to be more careful about the ‘too big to fail’ parts of our food supply chain,” Karakoc says. “In certain aspects, the system is too centralized.”

One example is rail. Karakoc says the nation’s rail infrastructure has become effectively too big to fail for grain distribution. When rail workers [threatened to strike in 2022](#), it triggered widespread concern because a prolonged stoppage would have brought most grain shipments to a halt.

Another is [meat processing](#). During COVID-19, the [shutdown of a handful of massive plants](#) sent shockwaves through the protein supply, hitting low-income consumers especially hard. The disruption underscored how dependent the system has become on a small number of facilities operating at full capacity.

Karakoc’s fix isn’t to scrap the system, but to decentralize it. Identify critical nodes. Reduce reliance on single points of failure. And, above all, use the data the U.S. already collects to inform helpful policies.

“We need to know where our food comes from, what path it follows from farm to fork,” she says. “If you know that before anything happens, you can take better measures to increase resilience.”

Why this research matters

Research is the invisible hand that powers America’s progress. It unlocks discoveries and creates opportunity. It develops new technologies and new ways of doing things.

Learn more about ASU discoveries that are contributing to changing the world and making America the world’s leading economic power at researchmatters.asu.edu.

This story originally appeared on [ASU News](#).

Main image



An illustration shows the four steps of the U.S. agri-food system: agricultural production, food processing, distribution and, finally, consumption. Deniz Berfin Karakoc, an assistant professor of industrial engineering in the School of Computing and Augmented Intelligence, part of the Ira A. Fulton Schools of Engineering at Arizona State University, has released new research that analyzes the food supply chain from 2018 to 2022, when the COVID-19 pandemic, trade issues and more placed unprecedented stressors on critical systems. Graphic generated by Erika Gronek/ASU using Adobe Firefly and Google Gemini

Text image(s)



Karakoc poses with an illustration from a recent academic paper. She and collaborators hope their emerging research can be used to better protect food distribution from future shocks and disruptions. Photo by Erika Gronek/ASU