

Keeping America's cereal bowl full

ASU researcher charts the best routes for our grains?

By Kelly deVos, ASU News
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If breakfast is the most important meal of the day, then cereal grains are America's morning MVPs.

Corn, wheat, rice, oats, barley and rye aren't just pantry staples. They're the backbone of our diets, the fuel in our lunch boxes and the crunchy, golden heart of a thousand cereal ads. But before they ever meet your spoon, these grains take epic road trips, river cruises and cross-country train rides.

The journey from field to bowl is anything but simple.

Every year, billions of tons of cereal grains crisscross the United States, moving from farms in the Midwest to ports to processing plants to kitchen tables in every state. Along the way, they rely on a complex transportation network of highways, railways and waterways.

That network faces big challenges: how to keep costs low so cereal stays affordable, how to reduce carbon emissions so breakfast is sustainable and how to make the system resilient enough to handle unexpected shocks, like floods, droughts or even a bridge collapse.

That's where [Deniz Berfin Karakoc](#) comes in. She 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.

In a [new paper](#) in [Environmental Science & Technology](#), a peer-reviewed scientific journal published by the American Chemical Society since 1967, Karakoc and her collaborator Megan Konar, a researcher at the University of Illinois Urbana-Champaign, are asking a critical question.

How can we make sure America's cereal bowl is always full, no matter what?

Crunching the numbers on cost, carbon and crunch-resistance

Karakoc and Konar's study looks at how our current cereal grain transportation patterns stack up against optimized scenarios that prioritize three different goals: cost-efficiency, sustainability and adaptability.

Think of it like designing the perfect cereal mix.

Cost-efficiency is the generic corn flakes that keep your grocery bill in check. Sustainability is the organic, low-carbon muesli that's good for the planet. Adaptability is that hearty granola that stays crunchy no matter how long it sits in milk, ready to withstand whatever the morning throws at it.

The researchers analyzed U.S. freight data for seven cereal grains, breaking down how much traveled by truck, train or barge, and then used a multi-objective optimization model to see what would happen if you tried to maximize one goal at a time.

The results?

If you only care about cost, waterways win. They're like buying in bulk at the warehouse store. Grain can move cheaply by barge down the Mississippi River, but only certain regions can use that route. Railways are a strong runner-up: efficient, able to haul huge quantities long distances, but still limited by track locations and capacity.

If you care most about sustainability, waterways also perform well, followed by railways. Both produce far fewer carbon emissions per ton-mile than trucks.

But if you want maximum adaptability, highways take the crown. Trucks can go almost anywhere, reroute around closed bridges and deliver directly to more destinations. The trade-off? They're the most expensive and the biggest carbon emitters.

Real-world grain movement, the study found, is a blend. It's a bit like mixing corn flakes with a handful of granola and a sprinkle of rice puffs. In practice, America's cereal supply leans toward adaptability, ensuring food keeps moving even when one route is blocked.

Why your breakfast depends on this work

If you've ever poured the last of the milk over your cereal only to realize there's nothing left in the box, you know the mild panic of an empty bowl. Now imagine that happening on a national scale — not just for cereal, but for bread, pasta, tortillas and every other grain-based food.

That's the scenario resilient transportation networks aim to prevent.

Why this research matters

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Karakoc's current study is more than a snapshot of how grain moves today. It's a blueprint for how to make that movement stronger, smarter and more sustainable. By pinpointing which routes and transportation modes are used most and which could be used more, her team's findings can guide infrastructure investments and national programs that keep costs low, emissions down and grain flowing even when disaster strikes.

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While the current study focuses on broad, nationwide freight patterns, future research will incorporate more detailed, real-time data to capture how transportation systems respond in the moment.

The next phase of the work will dive deeper, simulating scenarios like extreme weather events, harvest peaks or sudden infrastructure failures to test rerouting strategies. The team then hopes to expand their models to other staples facing food security risks.

Their goal is to build a supply chain that can weather whatever the future serves.

And for Karakoc, that balance isn't just an industrial engineering challenge; it's a social mission. With [28 million Americans reporting food insufficiency](#) in recent surveys, she sees transportation resilience as a cornerstone of food security.

"Food is essential, and we should be able to trace it from farm to fork," she says.

Or maybe from field to spoon. Because keeping America's cereal bowl full means making sure the journey from golden field to golden flakes is one we can count on, come rain, shine or milk spill.

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

Main image



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 co-authored a groundbreaking study on how to keep the supply chain for America's cereal grains moving. Photo by Erika Gronek/ASU