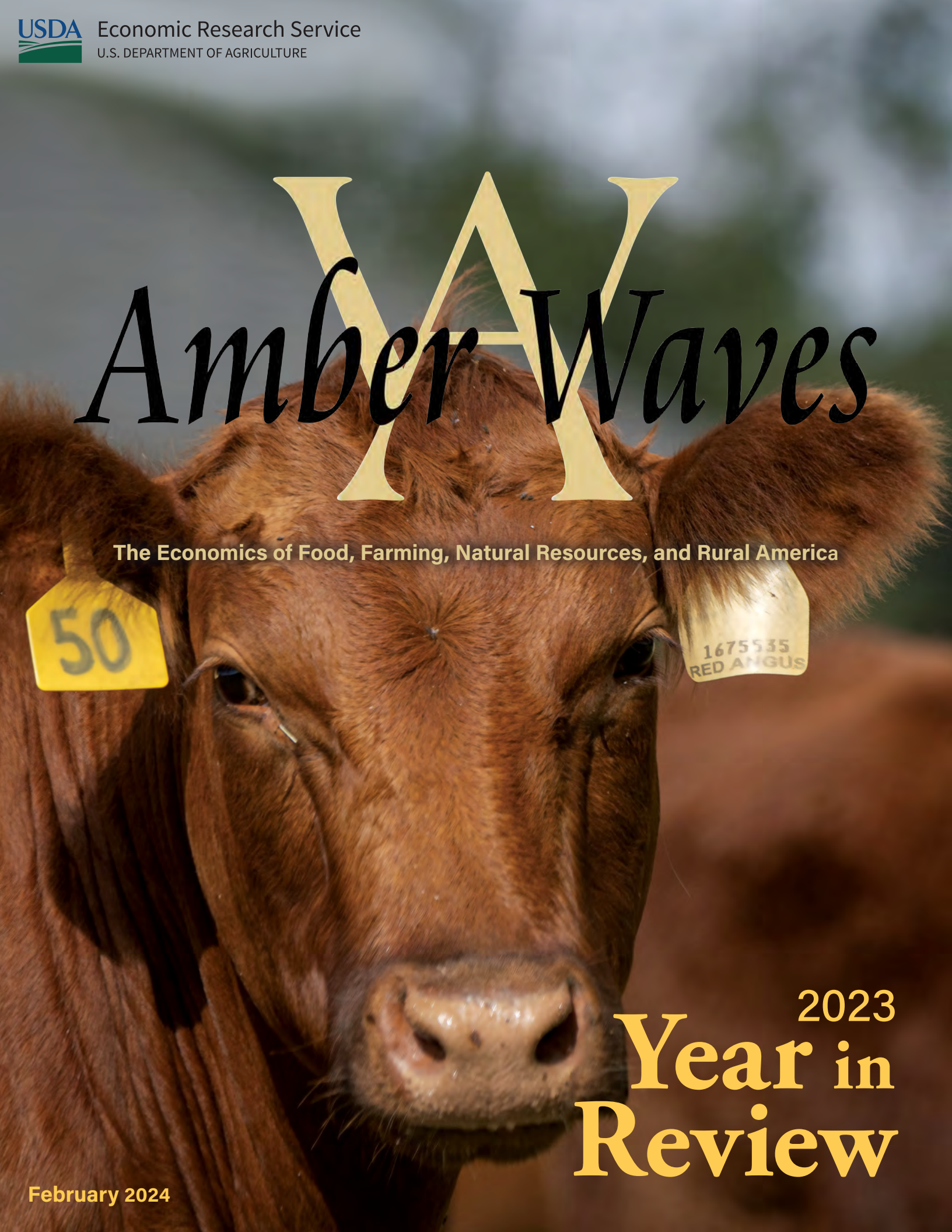
USDA Economic Research Service
U.S. DEPARTMENT OF AGRICULTURE

Amber Waves

The Economics of Food, Farming, Natural Resources, and Rural America



2023 Year in Review

February 2024

Dear Friends and Colleagues:

Last year, we listened to your feedback and brought back something many of you had missed – *Amber Waves* in print! Based on your continued positive responses, we are now making the *Amber Waves* Year in Review an annual tradition.

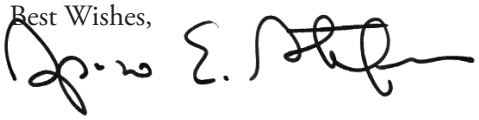
I am pleased to bring you the second annual *Amber Waves* Year in Review, filled with our research on the timeliest issues facing food and agriculture in 2023. I hope you peruse it and use it as a reference throughout the year.

In 2023, *Amber Waves* featured articles that cut across emerging themes and explored the interdependence of our agriculture and food systems. From food price inflation to H-2A jobs to the impact of Russia's invasion of Ukraine on fertilizer markets, *Amber Waves* provided the latest USDA, ERS research in an easy-to-digest format. Articles also tackled topics such as climate change and U.S. *Vibrio* infections, groundwater management, and State animal welfare policies.

This Year in Review provides just a sampling of articles from 2023, so I encourage you to visit ers.usda.gov to explore our latest articles and other topics from years past. Once you have caught up on the latest research, I hope you will visit ERS online to sign up for our email lists for *Amber Waves*, Charts of Note, and more (ers.usda.gov/subscribe).

In 2024, ERS will continue to produce data and research that inform our understanding of emerging issues, and *Amber Waves* will be at the forefront of delivering that research to you. Make sure you subscribe so you don't miss a single article.

Best Wishes,



Spiro Stefanou

ERS Administrator
Economic Research Service
United States Department of Agriculture
ers.usda.gov

CONTENTS

RESOURCE *and* RURAL ECONOMICS

3 Despite Challenges, Research Shows Opportunity To Increase Use of Manure as Fertilizer

9 H-2A Temporary Agricultural Job Certifications Continued To Soar in 2022

12 Groundwater Organizations Promote Aquifer Stewardship for U.S. Agriculture

14 Expanded Intellectual Property Protections for Crop Seeds Increase Innovation and Market Power for Companies

20 Examining Financial Risk Measures on Family and Nonfamily Farms

ECONOMICS *of* FOOD

23 ERS Data Products Show Food-At-Home Price Inflation From Producers to Consumers

28 ERS Refines Forecasting Methods in Food Price Outlook

32 Prevalence of the "Natural" Label Varies by Food Category

36 Children Were Only Age Group Improving Whole-Grain Intakes—School Foods Are a Key Factor

40 U.S. Food and Nutrition Assistance Programs Continued To Respond to Economic and Public Health Conditions in Fiscal Year 2022

46 Climate Change Projected To Increase Costs of U.S. *Vibrio* Infections

MARKETS *and* TRADE

49 Declining Crop Prices, Rising Production and Exports Highlight U.S. Agricultural Projections to 2032

54 Market Opportunities Expanding for Agricultural Trade and Investment in Africa

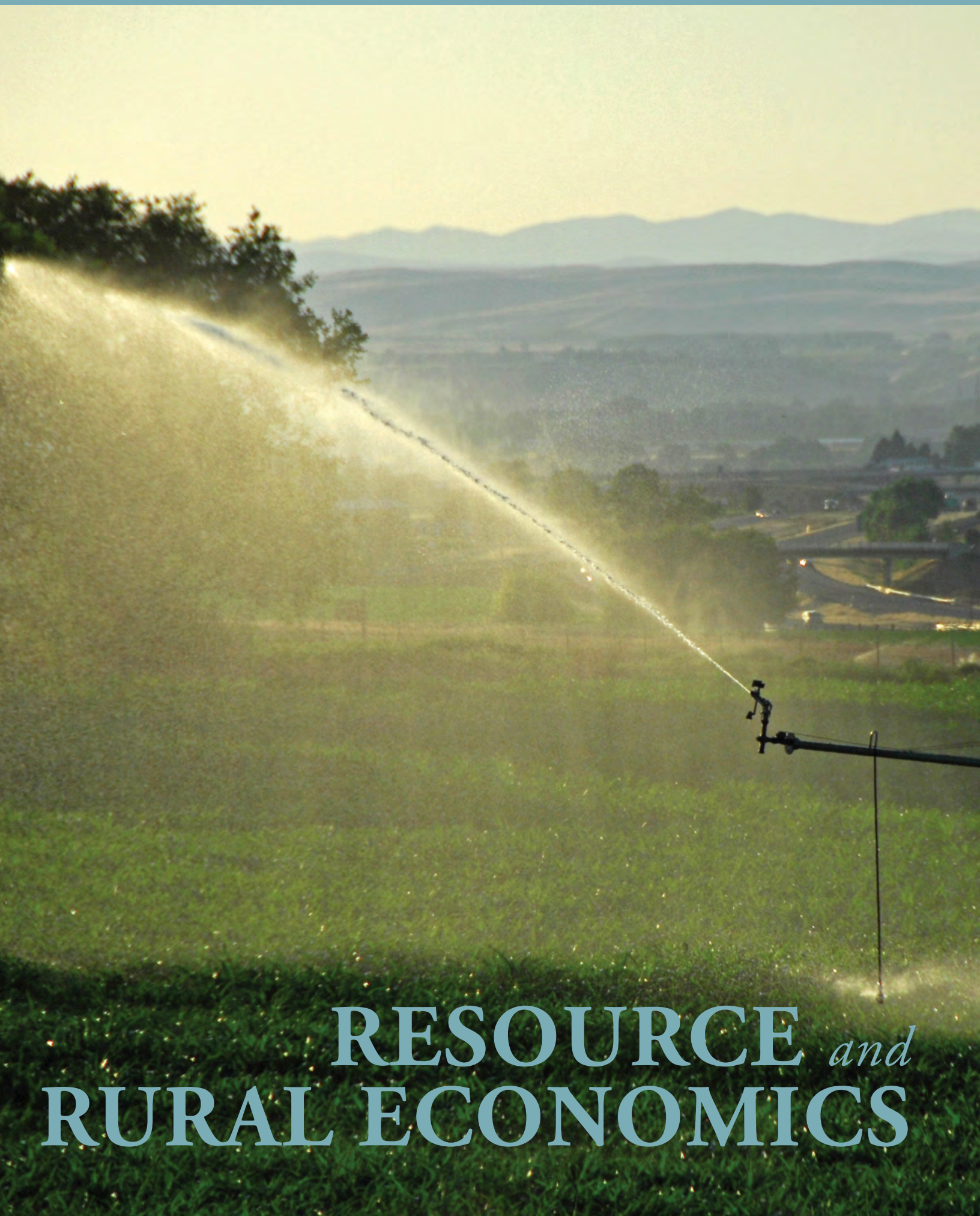
59 Farm Animal Welfare Policies Cover Breeding Sows, Veal Calves, or Laying Hens in 14 U.S. States

63 Fuel Ethanol Use Expanding Globally but Still Concentrated in Few Markets

65 Global Fertilizer Market Challenged by Russia's Invasion of Ukraine

INFOGRAPHIC

34 Farm-to-Plate: U.S. Organic Markets in 2021



RESOURCE *and* RURAL ECONOMICS

APRIL **2023**

Despite Challenges, Research Shows Opportunity To Increase Use of Manure as Fertilizer

BY NIGEL KEY, TENG LIM, RAY MASSEY, AND LAURA MCCANN

HIGHLIGHTS

- The value of manure as a fertilizer depends on where it is located, how expensive it is to transport and apply, and its crop nutrient composition.
- Livestock producers can increase the value of manure by altering their manure storage and handling methods, adjusting animal feed, adding compounds to manure, or by composting or pelletizing manure.
- Farmers can use anaerobic digesters or thermochemical conversion processes to generate renewable energy from manure and produce valuable products such as animal bedding or biodegradable plant pots.

Animal waste, otherwise known as manure, is a valuable source of crop nutrients that can improve physical and biological properties of soil. Manure contains primary macronutrients—namely nitrogen, phosphorus, and potassium—meaning it can substitute for or complement commercial fertilizers. Manure also supplies secondary macronutrients such as calcium, magnesium, and sulfur, as well as micronutrients. In addition, manure provides organic matter and carbon, which makes it useful for improving soil health.

Despite these attributes, there are economic and environmental challenges to expanding the use of manure as a fertilizer. With a low nutrient value-to-mass ratio, manure is more costly to transport, store, and apply than chemical fertilizers. In addition, livestock production tends to be geographically concentrated in the United States, and, in certain regions, animal production generates more manure-supplied nutrients than are needed by nearby cropland. That means farmers often must transport manure longer distances to match its nutrient value with crop needs. Specifically, the nitrogen and phosphorus levels in manure often do not match the nutrient needs of crops, so farmers still must use chemical fertilizers to supplement nutrients from manure. Also, applying enough manure to meet a crop's needs for one nutrient has the potential to create an environmental hazard from the unused nutrients left on the soil. Excess manure nutrients can leave the fields via run-off and degrade water quality, or they can enter the air.

Manure collection and treatment technologies continue to evolve and offer new economic opportunities for some farmers. These technologies can sometimes make it less expensive to transport and apply manure, adjust the nutrient ratio, or support manure's use in pro-

Corn fields lead major U.S. commodities in use of manure as a fertilizer

	Estimated 2020 acres (thousands)			
Commodity	Planted	Manure applied as fertilizer	Manure-applied acreage as share of planted acreage (percent)	Manure-applied acreage as share of total acres using manure (percent)
Corn	90,819	14,822	16.3	78.8
Soybeans	83,084	1,884	2.3	10.0
Wheat	44,349	908	2.0	4.8
Cotton	12,093	505	4.2	2.7
Barley	2,726	137	5.0	0.7
Oats	2,984	358	12.0	1.9
Peanuts	1,664	203	12.2	1.1
Total	237,719	18,818	7.9	100

Note: 2020 planted acreage estimates are from USDA, National Agricultural Statistics Service's Acreage report. 2020 acreages with manure applied as fertilizer are estimated by multiplying 2020 planted acres by the share of crop acres using manure from the USDA's Agricultural Resource Management Survey, Phase II, 2013–19.

Sources: USDA, Economic Research Service (ERS) using data from USDA, National Agricultural Statistics Service's (NASS) Acreage report and ERS and NASS, Agricultural Resource Management Survey Phase II, 2013–19.

ducing energy and other marketable products. In addition to increasing farm revenue, improved manure management has the potential to reduce nutrient pollution in waterways and to lower greenhouse gas emissions and fossil fuel use.

A recent study by USDA, Economic Research Service identified opportunities for increasing the use of manure as a fertilizer. In 2020, farmers applied manure to less than 8 percent of the 237.7 million acres planted to seven major U.S. field crops. About 79 percent of the cropland receiving manure was planted in corn. Although corn received more manure than any other crop, manure was only applied to 16.3 percent of the land planted in corn. In addition to these field crops, hay acreage and grassland also receive manure. ERS research found that in 2006 (the most recent data available), 26 percent of all acreage with manure applied was in hay or grass.

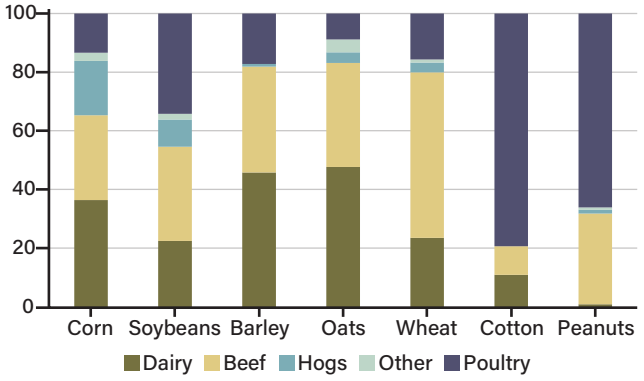
Manure Use Reflects Links Between Regional Mix of Crop and Livestock Production

The extent to which crop farms apply manure depends on location, farm size, commodity mix, production practices, and other characteristics. Manure is expensive to transport, and local animal production largely determines the type of manure applied to regional crops. For example, because most hogs are produced in the Midwest, hog manure is applied predominately to corn and soybeans. Most chickens are raised in the Southeastern United States, so most animal waste applied to crops grown primarily in the South, such as cotton and peanuts, originates from poultry farms.

Beef cattle operations are the source of most manure applied to wheat acreage. Beef cattle are produced mainly in the Great Plains, where most wheat acres are planted. Dairies, located in the Western, Midwestern, and Northeastern United States, supply the largest share of manure applied to corn, barley, and oats.

Animal manure sources reflect regional crop and livestock production

Manure applied (percent)



Source: USDA, Economic Research Service and National Agricultural Statistics Service, Agricultural Resource Management Survey, Phase II, 2013–19.

Nutrient Balance, Price to Transport, and Application Cost Present Challenges to Increasing Value

Several factors increase the costs of using manure as a commercial fertilizer replacement. First, manure has a low nutrient value-to-mass ratio. This is partly because of its water content, which can be up to 90 percent of the total weight. The low quantity of nutrients per ton makes manure application and transportation time-intensive and costly.

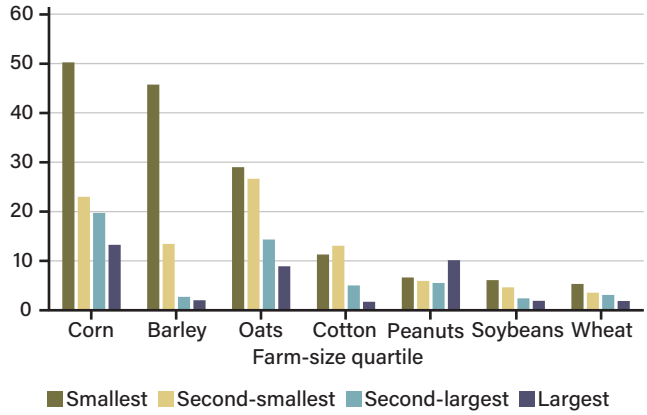
High transportation costs are a particular problem when the local supply of manure exceeds local demand. In recent decades, producers have become increasingly specialized in either crop or livestock production, and livestock production has largely moved from pasture-based to concentrated feeding operations. In some regions, concentrated animal production—where animals are kept in barns or enclosed lots—has resulted in the local supply of manure nutrients exceeding the nutrient needs of local crops. The cost to transport manure creates an incentive to over-apply manure nutrients on nearby land. The application of excess nutrients to the land can have negative implications for water quality and aquatic ecosystems. A local surplus of manure also reduces incentives for farmers to apply and store it in ways that conserve manure's nutrients. Nitrogen is susceptible to evaporation and becomes volatile when manure is stored in lagoons or when it is applied to the soil surface. That can lead to odor, health, and environmental concerns.

In addition, manure has a nitrogen-to-phosphorus ratio that does not align with most crops' nutrient requirements. Applying enough manure to meet a crop's nitrogen needs may lead to an overapplication of phosphorus, resulting in nutrient runoff and leaching and pollution of surface and groundwater. To avoid nutrient pollution from excessive manure application on land, farmers may need to restrict manure applications and apply supplemental nitrogen from commercial fertilizer to meet a crop's nutrient requirements.

The additional labor and time required to apply manure helps to explain why small-scale farmers are generally more likely than large-scale farmers to apply manure to their crops. To study this, ERS researchers sorted the producers of the major field crops into four equal size classes, or quartiles, based on their planted acres for each crop. Half of the corn farmers in the quartile with the fewest acres applied manure, compared with only 13 percent in the quartile with the largest number of acres. Operators of large farms may face labor constraints, and thus prefer commercial fertilizers, which can be applied more precisely and quickly than manure. This pattern may also be partly explained by specialization. Larger crop farms are less likely to integrate animals into their operation, so they are less likely to have manure available for application.

Small-scale farms are more likely to apply manure as a fertilizer

Farms that applied manure (percent)



Note: Producers of the major field crops are sorted into four size classes, or quartiles, based on their planted acres for that crop.

Source: USDA, Economic Research Service and National Agricultural Statistics Service, Agricultural Resource Management Survey, Phase II, 2013–19.

Manure storage systems affect the manure's composition (such as its moisture content), fertilizer value, and potential nonfertilizer uses (such as for energy production or industrial products). They also dictate the equipment a farm needs to manage the manure. Farms with beef cattle and poultry are most likely to use dry storage. Farms with pigs and dairy cows typically store manure as either liquids in lagoons, slurries in pits, or dry manure.

Some storage systems reduce manure's water content. Keeping water out of manure—or storing the manure in a dry form—makes it less expensive to transport. Removing liquid also preserves the manure's nitrogen content and increases its fertilizer value. However, if nearby crops don't need much nitrogen and phosphorus, preserving nitrogen won't neces-

sarily increase manure's value to the farmer. Instead, the higher nitrogen content may require the farmer to transport the manure farther to find land on which to apply it at rates that do not violate Federal or State environmental regulations.

Farms can introduce water-reduction technologies at the manure collection stage or storage stage. Wet-dry feeders in swine production have been shown to reduce water in pig slurry manure and make the slurry a more concentrated source of fertilizer nutrients. Lagoon or pit covers help to conserve nitrogen and prevent rainwater from diluting the manure, as well as reduce odor issues. Solid-liquid separation technologies work by separating manure's nutrient-dense content from the water so both parts can be managed for maximum benefit.

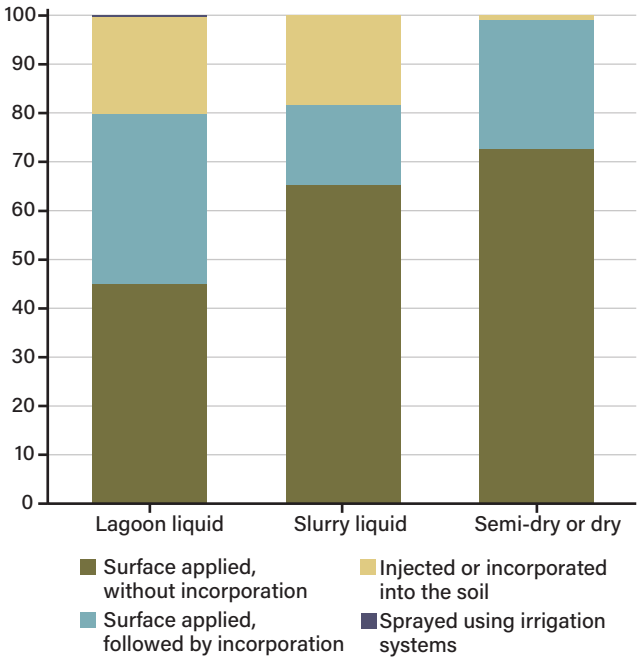
The value of manure as a fertilizer also depends on the *manure application method* used. Injecting manure below the soil surface or incorporating manure shortly after surface application conserves more nutrients and increases the fertilizer value. Surface application without incorporating or applying manure through an irrigation system results in less nutrient retention and lower fertilizer value.

How to decide which application method to use depends in part on the liquid content of the manure, which in turn depends on the animal that produced the manure and the storage system. Poultry and beef feedlot manures are typically dry or semisolid. Almost all dry or semisolid manures are applied through surface applications. On corn fields, less than 30 percent of surface-applied manure is incorporated into the soil.

Lagoon and slurry liquid manure typically comes from swine or dairy farms, where it is common to use water to wash manure out of barns, creating waste with high water content. A greater percent of surface-applied lagoon liquid applications involve incorporation into the soil compared with slurry liquid. For corn, about 20 percent of lagoon and slurry liquid manure is injected or incorporated at application. A small percentage of liquid manure stored in lagoons is sprayed through irrigation systems.

A large share of manure applied to corn fields is not incorporated into the soil

Manure applied to corn fields (percent)



Source: USDA, Economic Research Service and National Agricultural Statistics Service, Agricultural Resource Management Survey, Phase II, 2013–19.

More Than Three-Quarters of Manure Is Applied on the Farm Where it is Produced

According to data from USDA's Agricultural Resource Management Survey (ARMS), 78 percent of applied manure comes from crop and livestock integrated farms. Only 14 percent of applied manure is purchased from other farmers, and 8 percent is obtained for free. There is potential for expanding manure application to cropland. The market for manure as a nutrient source for organic crop production is one source of such expansion. Under National Organic Program standards, manure from conventional animal operations can be used in organic food production. Farms or other agribusinesses may be able to develop other opportunities to market manure as a fertilizer if they can incorporate new ways to process it to compete with chemical fertilizers. Possibilities include:

- **Adjustments to improve nutrient content.** Over the past several decades, it has become increasingly common to supplement feed with distillers dried grains (with solubles), phytase, or synthetic amino acids. These ingredients can change the nutrient content and value of manure. Another option is to add compounds such as nitrogen, alum, acid, biochar, and clay to better match manure nutrients with crop needs and save time and cost in fertilizer application.
- **Composting.** Between 2015 and 2018, only about 4 percent of manure-fertilized farmland received

composted manure. In composting, bacteria stabilize manure's organic matter and nutrients. Composting also reduces the overall volume of manure, bedding, and other organic matter being composted, and it reduces the number of pathogens. Composting improves manure's value as a soil additive and fertilizer and helps to reduce the potential for air and water pollution.

- **Liquid-solids separation.** Technologies exist that remove coarse solids from water-intensive dairy manure systems, separate fine solids for nutrient recovery, and reduce the moisture content in solids to make them more suitable for other processes. Coarse solids can be used to improve soil. The fine solids contain most of the manure nutrients, and these can be developed into valuable fertilizers. Removing water or drying are generally required to prepare manure for value-added processing, including the manufacture of fiber products and energy generation.
- **Pelletizing.** Raw or composted manure can be processed into pellets with a more consistent and denser product. This process conserves manure nutrients, allows for better control of nutrient application, and reduces storage and handling costs. Because pellets are less costly to transport than raw manure, they can make it more economical to redistribute manure nutrients from areas with excess manure nutrients to areas with too few nutrients. Certified organic production is a potential growth market for pelletized manure.

Manure Has Role to Play in Generating Renewable Fuels and Other Coproducts

Some developing technologies obtain value from manure for purposes other than fertilizing crops. In particular, anaerobic digesters linked with livestock production can be used to generate renewable natural gas from manure. An anaerobic digester is an airtight vessel in which bacteria digest, or decompose, organic waste such as manure. Digester coproducts also can be processed into animal bedding or plant substrates. In anaerobic digestion, bacteria generate a biogas containing methane that can be captured and used as a source of energy, thereby reducing greenhouse gas emissions. The anaerobic process turns manure and other organic wastes into a more consistent product, called digestate, and reduces the potential contamination of waterways. On-farm anaerobic digester benefits include odor reduction, air quality improvement, and the supply of digestate as an alternative to chemical fertilizers.

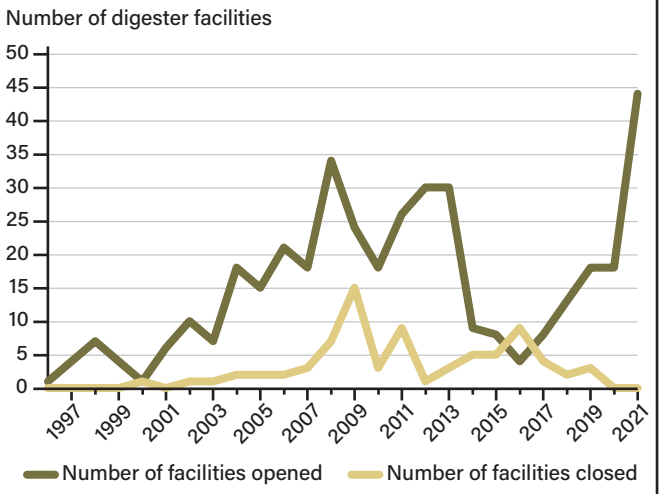
A simple application of the biogas produced by digesters, which requires little to no additional processing, is to burn it onsite to generate heat or electricity for local use or sale. Purifying the biogas creates a product that is comparable to natural gas and can be injected into pipelines and used in large-scale electric power plants or as fuel for vehicles.

The relatively high capital cost of anerobic digesters has limited the use of this technology to larger operations (such as dairies with at least 500 cows). In addition to construction costs, anaerobic digesters require constant maintenance and supervision to maintain the temperatures, consistency, and acidity needed for decomposition. Trained operators must supervise the process to prevent leakage, explosion, asphyxiation, or hydrogen sulfide poisoning. To address the barriers to digester technology, USDA provides cost sharing to farming operations interested in adopting these technologies, including the initial on-farm feasibility study.

The number of on-farm anaerobic digester systems steadily increased during the past several decades, according to tracking provided by AgSTAR, a collaborative program sponsored by the Environmental Protection Agency and USDA. A total of 355 systems were in operation or under construction in 2021. Recent growth in the number of digesters corresponds to the increase in demand for renewable fuel resulting from carbon credit trading and incentive programs. More covered lagoons have been built as their costs have come down. Many of the

newer digester projects are designed to produce compressed natural gas instead of electricity, which would allow for pipeline injection to take advantage of carbon credit-trading programs such as California's Low Carbon Fuel Standard program.

The number of on-farm anaerobic digesters in the United States has increased since 1995



Note: An anaerobic digester is an airtight vessel in which bacteria digest, or decompose, organic waste such as manure.

Source: USDA, Economic Research Service using data from the U.S. Environmental Protection Agency's AgSTAR database.

In some cases, the production of renewable fuels from anaerobic digesters results in digester coproducts. These coproducts can be marketed and serve to increase revenue and encourage further adoption of digesters. For example, anaerobically digested and composted manure fiber may be used as a peat moss substitute in greenhouse and nursery production, although challenges remain to meet growers' needs for plant substrates that are standardized, reliable, free of odor and pathogens, and economical. In addition, technologies exist to convert digestate fiber into marketable biopots—biodegradable plant pots that are alternatives to plastic containers used in greenhouses, nurseries, and landscaping markets.

Researchers are developing technologies to extract renewable fuels from manure. These include thermochemical conversion technologies such as combustion, gasification, and pyrolysis (heating without air). While there are advantages of thermochemical conversion, such as destruction of pathogens and pharmaceuticals, the high capital costs of equipment, increased costs to meet air emission limitations, and process inefficiencies are significant barriers to adoption of current thermochemical conversion technologies.

CITATIONS

This article is drawn from ...

Lim, T., Massey, R., McCann, L., Canter, T., Omura, S., Willett, C., Roach, A., Key, N., & Dodson, L. (2023). ***Increasing the value of animal manure for farmers.*** (Report No. AP-109). U.S. Department of Agriculture, Economic Research Service.

You may also be interested in ...

Hellerstein, D., Vilorio, D., Ribaudo, M., Aillery, M., Bigelow, D., Bowman, M., Burns, C., Claassen, R., Crane-Droesch, A., Fooks, J., Greene, C., Hansen, L,, Heisey, P., Hitaj, C., Hoppe, R.A., Key, N., Lynch, L., Malcolm, S., McBride, W.D., Mosheim, R., Nehring, R., Schaible, G., Schimmelpfennig, D., Smith, D., Sneeringer, S., Wade, T., Wallander, S., Wang, S.L., & Wechsler, S.J. (2019). *Agricultural resources and environmental indicators*, 2019. (Report No. EIB-208). U.S. Department of Agriculture, Economic Research Service.

U.S. Department of Agriculture, Economic Research Service. (2023, October 4). ***Farm Practices & Management***. [Topic page].

Wallander, S. (2022, March 7). ***Policy Instruments for Protecting Environmental Quality***. [Topic page]. U.S. Department of Agriculture, Economic Research Service.

Mosheim, R. (2019, October 30). ***Fertilizer Use and Price***. [Topic page]. U.S. Department of Agriculture, Economic Research Service.

Aillery, M., Gollehon, N., Johansson, R., Kaplan, J., Key, N., & Ribaudo, M. (2005). ***Managing manure to improve air and water quality.*** (Report No. ERR-9). U.S. Department of Agriculture, Economic Research Service.

Ribaudo, M., Livingston, M., & Williamson, J. (2012). ***Nitrogen management on U.S. corn acres, 2001–20***. (Report No. EB-20). U.S. Department of Agriculture, Economic Research Service.

Ribaudo, M., Delgado, J., Hansen, L., Livingston, M., Mosheim, R., & Williamson, J. (2011). ***Nitrogen in agricultural systems: Implications for conservation policy.*** (Report No. ERR-127). U.S. Department of Agriculture, Economic Research Service.

Key, N. & Sneeringer, S. (2011) ***Climate change policy and the adoption of methane digesters on livestock operations.*** (Report No. ERR-111). U.S. Department of Agriculture, Economic Research Service.

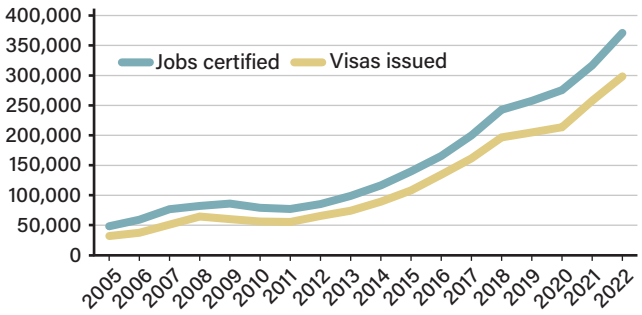
MARCH **2023**

H-2A Temporary Agricultural Job Certifications Continued To Soar in 2022

BY MARCELO CASTILLO

U.S. agricultural employers anticipating a shortage of domestic workers can fill seasonal farm jobs with temporary foreign workers through the H-2A visa program. The U.S. Department of Labor certified around 370,000 temporary jobs in fiscal year (FY) 2022 under the program, more than 7 times the number certified in 2005 and double the amount in 2016. A certified job does not necessarily result in the issuance of a visa; in fact, in recent years only about 80 percent of jobs certified as H-2A have resulted in visas. Under Department of Labor eligibility rules, employers must show that their efforts to recruit U.S. workers were not successful before a job can be certified. They also must pay H-2A workers no less than the Adverse Effect Wage Rate (AEWR), which is set at the region's average hourly wage for crop and livestock workers in the previous year, as measured in USDA's Farm Labor Survey. Even with these restrictions, the H-2A visa program has grown rapidly in recent years as U.S. domestic workers find jobs outside agriculture and fewer newly arrived immigrants seek agriculture jobs.

The number of H-2A jobs certified increased more than sevenfold from fiscal years 2005 to 2022

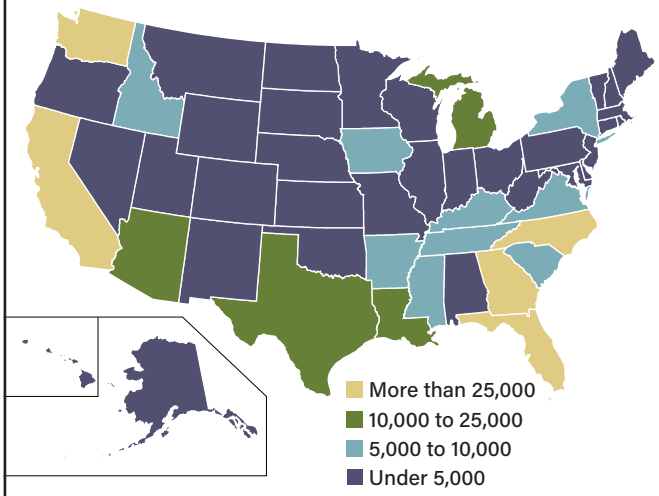


Note: Around 80 percent of H-2A certified jobs result in visas issued to H-2A workers. Some employers do not follow through to hire the workers, and some H-2A workers fill two or more certified jobs.

Source: USDA, Economic Research Service using data from the U.S. Department of Labor and the U.S. Department of State.

H-2A employment is concentrated in States with large and labor-intensive agricultural sectors. In 2022, the top 5 States, each of which had more than 25,000 certified jobs, were: Florida with 14 percent of total H-2A jobs certified, California with 12 percent, Georgia and Washington with around 9 percent each, and North Carolina with 7 percent. These five States accounted for around 51 percent of all H-2A certifications. The level of farm workers in a State does not always correspond with the number of H-2A hires made in that State. For example, Georgia and North Carolina have fewer farmworkers than Texas but hire more H-2A workers. As such, the H-2A share of total farm jobs is higher in Georgia and North Carolina, as well as in most Southeastern States, than in Texas.

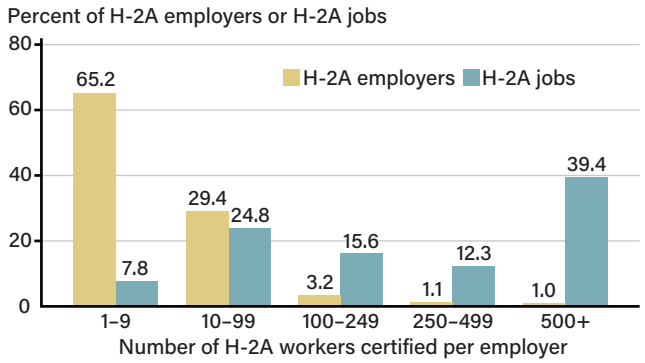
Five States accounted for 51 percent of H-2A certified jobs in fiscal year 2022



Source: USDA, Economic Research Service using data from the U.S. Department of Labor.

H-2A employment also is concentrated by employer size, and a relatively small number of employers sponsor the majority of H-2A workers. The chart to the right shows the share of H-2A employers and jobs certified by size category, defined by the number of H-2A workers certified. The tan bars denote the share of H-2A employers in each size category, and the blue bars show the share of H-2A workers certified to those employers. The top 5.3 percent of H-2A employers—those who employ more than 100 workers—accounted for more than two thirds of all certified jobs in FY 2022. The top 1 percent (the category of the largest employers, which is made up of about 110 employers) received almost 40 percent of all H-2A certifications. However, most employers request relatively few workers. About two-thirds request between 1 and 9 H-2A jobs, accounting for less than 8 percent of the national total.

Within the H-2A program, a relatively small number of employers sponsored the majority of H-2A workers in fiscal year 2022



Note: Percentages do not add to 100 because of rounding.

Source: USDA, Economic Research Service using data from the U.S. Department of Labor.

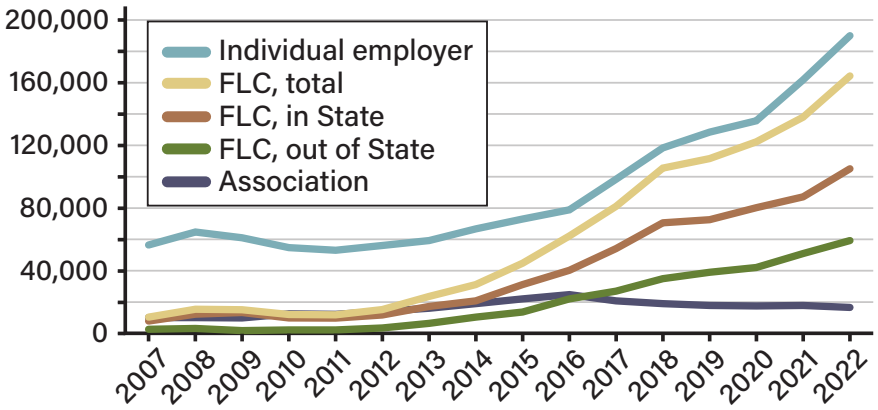
One reason for the concentration of H-2A jobs by employer size is the prevalence of farm labor contractors (FLCs) in the program. Employers eligible to request H-2A workers fall into three main types: individual employers; growers associations; and FLCs, who are brokers who hire farmworkers and lease their services to individual farmers. FLCs often provide H-2A workers to multiple farmers, which partly explains why they tend to be some of the larger employers in the program. In FY 2022, around 51 percent of all H-2A jobs certified were

for employment by individual employers, followed by FLCs with 44 percent and growers associations (and their individual members acting as joint employers) with 5 percent.

The next chart shows that strong FLC participation in the program is a relatively new phenomenon. While individual employers obtained most of the H-2A certifications between 2007 and 2022, the gap between them and FLCs narrowed, and now more than half the recent growth in H-2A certifications comes from FLCs. The FLC share of H-2A jobs increased from 13 percent in FY 2007 to 44 percent in FY 2022.

Hiring of H-2A workers has increased for farm labor contractors (FLCs) and individual employers since 2012

Certified workers



Source: USDA, Economic Research Service using data from the U.S. Department of Labor.

Agricultural employers based in one State may put in a request to employ H-2A workers in a different State. The chart shows that many FLC H-2A jobs are outside the State where the FLC is based. In FY 2022, around 36 percent of FLC H-2A employment was for out-of-State employers and worksites. Florida-based FLCs accounted for around 50 percent of all FLC-sponsored out-of-State H-2A jobs, and California-based FLCs accounted for an additional 14 percent. FLCs based in Florida and California accounted for 40 percent and 24 percent, respectively, of all H-2A jobs sponsored by FLCs.

CITATIONS

This article is drawn from...

Castillo, M., Martin, P., & Rutledge, Z. (2022). ***The H-2A temporary agricultural worker program in 2020*** (Report No. EIB-238). U.S. Department of Agriculture, Economic Research Service.

You may also be interested in ...

Castillo, M., & Simnitt, S. (2023, August 7). ***Farm Labor.*** [Topic page]. U.S. Department of Agriculture, Economic Research Service.

Castillo, M., Simnitt, S., Astill, G., & Minor, T. (2021). ***Examining the growth in seasonal agricultural H-2A labor*** (Report No. EIB-226). U.S. Department of Agriculture, Economic Research Service.

Calvin, L., Martin, P., & Simnitt, S. (2022). ***Adjusting to higher labor costs in selected U.S. fresh fruit and vegetable industries*** (Report No. EIB-235). U.S. Department of Agriculture, Economic Research Service.

May **2023**

Groundwater Organizations Promote Aquifer Stewardship for U.S. Agriculture

BY R. AARON HROZENCIK, NICHOLAS POTTER, AND STEVEN WALLANDER

Almost two-thirds of all irrigated U.S. agricultural acreage relied on groundwater as a primary or secondary source of water in 2018, according to data from USDA's National Agricultural Statistics Service (NASS). The shared nature of many groundwater resources means pumping by one irrigator affects water availability for nearby irrigators. That connectivity led to the creation of groundwater management districts, natural resource districts, groundwater sustainability agencies, and other groundwater management entities. These organizations play a critical role in determining the future of groundwater-based irrigated agriculture, but national data about their functions has only recently become available.

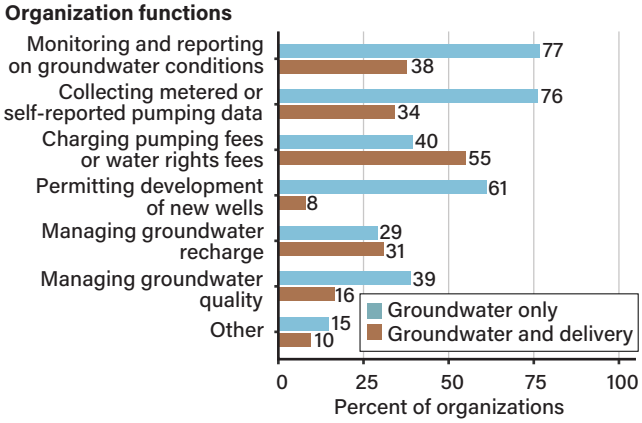
The 2019 Survey of Irrigation Organizations (SIO) is the first nationally representative Federal data collection effort aimed at organizations that deliver water to farms or influence on-farm groundwater withdrawals. Three USDA agencies (Economic Research Service, NASS, and the Office of the Chief Economist) collaborated to develop and implement the survey.

According to SIO data, there were 735 groundwater organizations in the United States in 2019. Of these, 601 report delivering water to irrigated farms and ranches in addition to engaging in groundwater management ("groundwater and delivery"). The remaining 134 organizations focus solely on managing groundwater resources ("groundwater only").

Groundwater-only organizations often promote groundwater stewardship by monitoring groundwater conditions, collecting pumping data, and issuing permits for well development. More than 75 percent of groundwater-only organizations monitor groundwater conditions or collect pumping data, but 38 percent of groundwater and delivery organizations engage in these activities. Sixty-one percent of groundwater-only organizations issue permits for well development, but less than 10 percent of groundwater and delivery organizations are involved in well-permitting.

Groundwater organizations that also engage in water delivery are more likely to charge pumping or water rights fees compared with organizations that focus solely on groundwater management. The majority (55 percent) of groundwater and delivery organizations report charging pumping fees. A relatively smaller share (40 percent) of groundwater-only organizations uses pumping or water rights fees to support groundwater management objectives.

Groundwater-only organizations and those also engaged in water delivery each focus on different aspects of groundwater management



Note: Groundwater only represents the 134 organizations that in 2019 only managed on-farm groundwater. Groundwater and delivery refers to the 601 organizations that managed on-farm groundwater use and delivered water to farms. Groundwater organizations can engage in more than one activity to influence on-farm groundwater use, so percentages will not add to 100.

Source: USDA, Economic Research Service using data from the USDA 2019 Survey of Irrigation Organizations.

More than 75 percent of groundwater-only organizations monitor groundwater conditions or collect pumping data.

CITATIONS

This article is drawn from ...

Hrozencik, A.R., Gardner, G., Potter, N., & Wallander, S. (2023). ***Irrigation organizations: groundwater management.*** (Report No. EB-34). U.S. Department of Agriculture, Economic Research Service.

You may also be interested in ...

Hrozencik, A. (2022, May 6). ***Irrigation and water use.*** [Topic page]. U.S. Department of Agriculture, Economic Research Service.

Wallander, S., Hrozencik, A., & Aillery, M. (2022). ***Irrigation organizations: Drought planning and response*** (Report No. EB-33). U.S. Department of Agriculture, Economic Research Service.

Hrozencik, A., Wallander, S., & Aillery, M. (2021). ***Irrigation organizations: Water storage and delivery infrastructure*** (Report No. EB-32). U.S. Department of Agriculture, Economic Research Service.

Hrozencik, A. & Aillery, M. (2021). ***Trends in U.S. irrigated agriculture: Increasing resilience under water supply scarcity*** (Report No. EIB-229). U.S. Department of Agriculture, Economic Research Service.

Marshall, E., Aillery, M., Malcolm, S., & Williams, R. (2015). ***Climate change, water scarcity, and adaptation in the U.S. fieldcrop sector*** (Report No. ERR-201). U.S. Department of Agriculture, Economic Research Service.

Wallander, S., Aillery, M., Hellerstein, D ., & Hand, M.S. (2013). ***The role of conservation programs in drought risk adaptation*** (Report No. ERR-148). U.S. Department of Agriculture, Economic Research Service.

Wallander, S., Hrozencik, A., & Aillery, M. (2022, February 22). Some irrigation organizations rely on formal drought plans. ***Amber Waves***, U.S. Department of Agriculture, Economic Research Service.

Hrozencik, A., Wallander, S., & Aillery, M. (2021, November 8). Irrigation organizations use conveyance infrastructure to deliver water to irrigated farms and ranches. ***Amber Waves***, U.S. Department of Agriculture, Economic Research Service.

AUGUST **2023**

Expanded Intellectual Property Protections for Crop Seeds Increase Innovation and Market Power for Companies

BY KEITH FUGLIE AND JAMES M. MACDONALD

HIGHLIGHTS

- The U.S. crop seed sector has undergone significant structural change, spurred in part by expansions of intellectual property rights protections and innovations in biotechnology.
- Market concentration—measured by the share of industry sales held by the largest firms—is high in many seed markets. In 2018–20, two seed companies (Bayer and Corteva) accounted for 72 percent of planted corn acres and 66 percent of planted soybean acres in the United States.
- Stimulated by the prospect of being able to raise seed prices and earn higher revenues, seed companies increased their research and development (R&D) spending and accelerated the development of new crop varieties.
- Between 1990 and 2020, prices paid by farmers for crop seed increased an average of 170 percent, and seed prices for crops grown predominantly with genetically modified (GM) traits rose 463 percent. That compares with a 56-percent increase in commodity output prices.

In recent decades, the U.S. crop seed industry has become more concentrated, with fewer and larger firms dominating seed supply. Expanded intellectual property rights combined with structural changes in the seed industry spurred seed and biotechnology companies to increase research and development (R&D) spending that resulted in a series of innovations to crop agriculture. At the same time, seed prices have risen substantially, especially for genetically modified varieties, reflecting the value of improved seed varieties and gains in market power for top seed companies.

Expanded Intellectual Property Rights Spurred Structural Changes

Crop breeding is the science of changing plant genetics to adapt to evolving nutritional, environmental, and market needs. Before 1970, most crop breeding was done in the public sector. Private seed companies were mostly engaged in multiplying seed and distributing new varieties developed by public institutions. Farmers often saved a portion of their harvest for use as seed in subsequent seasons, periodically buying new seed to reestablish purity and quality or to adopt an improved variety. Some farmers and seed companies specialized in the production of "bin-run seed," which is grain taken from their own crop harvest, cleaned of impurities, and perhaps treated with pesticides. They would sell the bin-run seed to other farmers for planting. But this practice left private seed companies with little financial incentive to conduct crop R&D. In selling improved seed to farmers, they also transferred the ability to reproduce the new technology. At that time, seed companies had no legal mechanism to restrict unlicensed use of their innovations.

Hybrid seed was an exception. Hybrid seed does not reproduce true-to-form, meaning it does not perform similarly across generations. To maintain yield, farmers repurchase hybrid seed each season from the seed companies that control the parental lines. The parental lines of the hybrids can be held as trade secrets—an exclusion mechanism that provides an incentive for private investment in breeding for crops where hybrid seed technology is viable. Corn was the first crop to be grown using commercial hybrid seed, and almost all corn acreage today is grown from hybrid seed, but most crops continue to be grown using self-pollinated or clonal seed rather than hybrid seed and thus reproduce true-to-form.

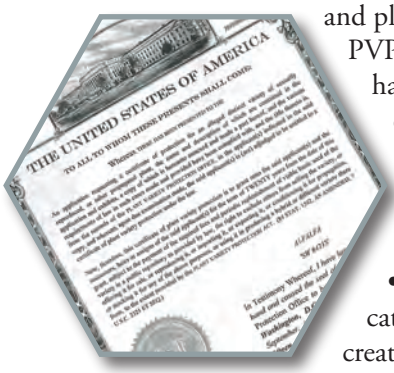
The 1970 Plant Variety Protection Act (PVPA) aimed to encourage seed companies to improve crop varieties beyond hybrids. Under the act, breeders could obtain a Plant Variety Protection certificate (PVPC) to protect their intellectual property rights for new varieties. Farmers were still allowed to save seed of varieties protected with the certificates, but they (and other seed companies) could no longer sell bin-run seed to other farmers except under license from the breeding company that owned the certificate. However, other seed companies and breeders could freely use protected varieties as parent material in their own breeding programs. Those protections did stimulate some private R&D, but it was uneven across crops. For example, private varieties of soybeans gradually replaced public varieties, but that was not the case for wheat and small grains.

Advances in biotechnology provided a new means of improving crops by allowing genes with specific, inheritable traits to be transferred to distant crop varieties. This is the process that creates genetically modified (GM) varieties. However, development of GM varieties is expensive and risky, and without stronger intellectual property protection other than what was offered by the PVPA, there was limited incentive for the private sector to invest in that technology. In 1980, the Supreme Court ruled in *Diamond v. Chakrabarty* that biotechnology innovations could be patented, and in 1985, a complementary decision (*Ex parte Hibberd*) included GM traits in crops in that ruling. Utility patents—usually the go-to patents for inventors—offer stronger intellectual property protection to seed breeders than the 1970 law because farmers cannot legally save patented crops or crop traits as seed and other companies cannot use them in breeding programs except under license from the patent owner. In 2001, in *JEM Ag Supply v. Pioneer Hi-Bred*, the Supreme Court extended patent protection to include plants, so new crop varieties were protected just as biotechnology and GM traits. Since that decision, companies have used patents as well as PVPCs to protect their intellectual property rights in new crop varieties (GM and non-GM), including for inbred parent lines used to produce hybrid seed.

Three types of intellectual property rights are now available for new plant varieties in the United States:

- **Plant Variety Protection certificates.** Created by Congress in 1970 and issued by USDA, they protect new varieties of seed crops, as well as potatoes. They include exemptions that allow breeders to use the varieties as parent material for breeding other varieties and farmers to save the varieties' seeds for their own subsequent plantings.

- **Utility patents.** Issued by the U.S. Patent and Trademark Office (USPTO), they can be used to protect new varieties of seed crops and plant traits. Unlike the PVPA certificates, they do not have breeder or farmer-use exemptions. Utility patents and PVPA certificates may be issued for the same crop variety.



- **Plant patents.** A special category of USPTO patents created in 1930, they protect asexual, or self-propagating, plants other than potatoes. They are used mainly for flowers, ornamentals, and some tree crops.

Timeline of actions that established intellectual property rights for new plant varieties and traits

1930 — Plant Patent Act
- Establishes special patent category—plant patents—for new varieties of asexually reproduced, or self-propagated, plants such as flowers and ornamentals.

1970 — Plant Variety Protection Act
- Establishes plant breeder rights for new varieties of seed-propagated field crops. Contains exemptions that let farmers save their own seed and other plant breeders use the seed in breeding other varieties.

1980 — *Diamond v. Chakrabarty*
- U.S. Supreme Court rules biotechnology innovations are patentable. Applies to utility patents issued by U.S. Patent and Trademark Office.

1985 — *Ex parte Hibberd*
- Supreme Court extends 1980 decision to also apply to genetically modified (GM) traits in crops. No exemptions for farmers or researchers to reuse seeds with GM traits.

1994 — Amendment to Plant Variety Protection Act
- Extends plant breeders rights to include potatoes.

2001 — *JEM Ag Supply v Pioneer Hi-Bred*
- Supreme Court rules utility patent protection can be used for plants as well as for biotechnology and GM traits.

Source: USDA, Economic Research Service.

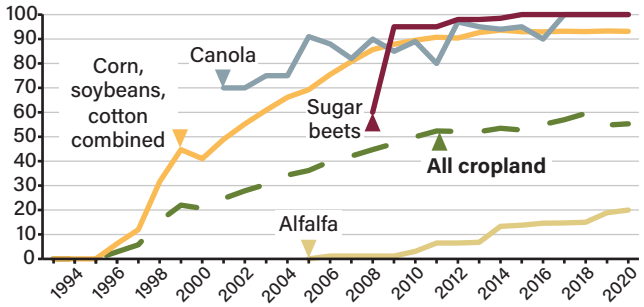
Each type of intellectual property right lasts 20 years from the date of application.

The opportunities created by expanded intellectual property rights gave private companies the incentive they needed to invest in seed-biotechnology R&D. In addition, companies with promising GM traits acquired or merged with companies that had assets in seed genetics and marketing and sales networks.

GM varieties of corn, soybeans, and cotton were introduced in the United States in 1996 and within a few years became the dominant seed choice among farmers. Later, GM varieties were widely adopted for canola and sugar beets, and their use has begun to spread in alfalfa plantings, as well as some fruits and vegetables. By 2020, about 55 percent of the total U.S. harvested cropland was grown with varieties having at least one GM trait. The most prevalent GM traits are herbicide tolerance and insect resistance.

Genetically modified (GM) seeds have been adopted on more than half of U.S. cropland

Percent of area planted to GM crops



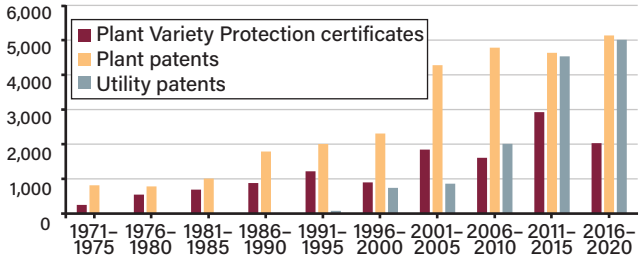
Note: **All cropland** includes area planted to all field crops; area harvested of hay, sugarcane, tobacco, and commercial vegetables; and area in fruit and nut-bearing trees.

Source: USDA, Economic Research Service using data from the International Service for the Acquisition of Agri-Biotech Applications and USDA, National Agricultural Statistics Service.

The increase in private R&D not only led to the commercialization of GM crops but also accelerated the pace of crop technology development overall. From 2016 to 2020, a total of 5,137 plant patents, 5,010 utility patents, and 2,028 PVPCs were issued for new crop varieties, more than double the rate of a decade earlier. Farmers also appear to be turning over their varieties more frequently, with the average commercial life of a newly introduced hybrid falling from around 4 to 5 years in 1997 to fewer than 3 years by 2009.

Issuances of intellectual property rights for new crop varieties increased from 1971 to 2020

Number issued



Note: **Plant Variety Protection certificates** are issued by USDA, Agricultural Marketing Service as part of the 1970 Plant Variety Protection Act. They protect new varieties of seed crops and potatoes but contain exemptions for farmers and other seed breeders to reuse the new seed varieties. **Plant patents** are issued by the U.S. Patent and Trade Office specifically for self-propagating plants (other than potatoes) such as flowers, ornamentals, and some tree crops. **Utility patents** include patents issued for new crop varieties, cultivated plants, hybrids, inbreds, and breeding lines. The patents do not contain exemptions for reuse by farmers and other seed breeders.

Source: USDA, Economic Research Service using patent data from the U.S. Patent and Trademark Office and Plant Variety Protection certificate data from the USDA, Agricultural Marketing Service.

Seed Markets Involve Complex Interactions Among Industry Groups

Seed markets involve not only developers and retailers of crop varieties but also suppliers of improved parent lines,

seed treatments, biotech (GM) traits, and services. A company may provide one or more product or service and sell or license them to or from other firms. Companies that sell their proprietary seed varieties to farmers often have licensed technologies from other companies to produce the seed. For example, Monsanto was an early developer of biotech traits for corn, soybeans, and cotton. It incorporated traits into its own crop varieties and licensed the traits to other seed companies to use in their own varieties. Firms with large patent portfolios have entered into cross-licensing agreements to acquire one another's technologies. Through cross-licensing agreements, firms may be able to significantly reduce or even avoid paying royalties or licensing fees.

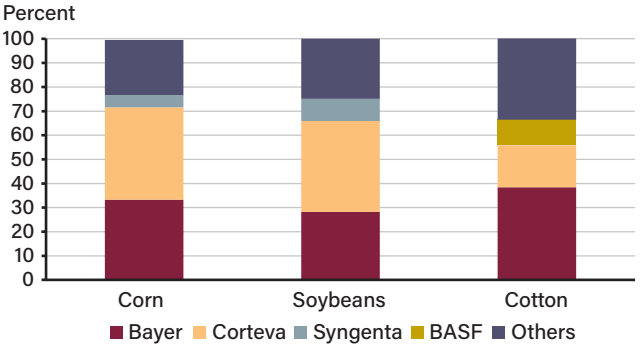
GM traits can be sold or licensed separately from seed and incorporated into multiple varieties and crops. Markets for those traits are thought to be highly concentrated, though available public information is limited. Licensing and cross-licensing of GM traits are common, and a single variety may have multiple GM traits licensed from multiple companies. While some of the early patents for GM traits have expired or are soon expiring, it is not clear whether generic versions of these traits will become available for commercial use.

To use a GM trait in crop production, regulatory approval must be secured and maintained by the trait developer in each country where the seed is grown. Countries also may require regulatory approval for the intended use (food or animal feed) of imported crops containing GM traits. The patent holder or licensee usually bears the cost of maintaining regulatory approvals. If the approvals lapse, those traits can no longer be used in commercial varieties or in the crops sold for commercial use in those countries.

Market concentration is likely to be high for crop seed for which GM traits are popular (such as canola, sugar beets, and alfalfa) and is probably lower in markets where conventional seed varieties dominate and where public-sector varieties and farmer-saved seed continue to be widely used (such as for wheat and other small grains, peanuts, and dry beans). The market for vegetable seeds appears to be dominated by private-sector varieties but is diverse across species. Large seed-chemical companies such as Bayer and Syngenta have significant investments in proprietary vegetable seeds, but midsized companies (including several Dutch companies) also have a significant presence in U.S. and global seed markets for specific vegetables.

As seen in the next chart, two companies—Corteva and Bayer—accounted for more than half of the retail seed market sales of corn, soybeans, and cotton in 2018–20.

Two companies accounted for more than half of corn, soybean, and cotton seed sales in 2018–20



Source: USDA, Economic Research Service (ERS) using data from RAND Journal of Economics (2019) based on proprietary GfK Kynetec data (2000–11) and Farm Journal (2012–17); USDA, Agricultural Marketing Service, Cotton Varieties Planted, Annual Bulletin.

Spate of Mergers Reduces "Big Six" Seed Companies to "Big Four"

In 2015, six firms dominated global markets for seeds and agricultural chemicals: BASF, Bayer, Dow Chemical, DuPont, Monsanto, and Syngenta. Sometimes referred to as the "Big Six," these firms produced and sold pesticides (primarily herbicides, insecticides, and fungicides), seed treatments (seed coatings to protect against insects or fungi), crop seeds, and seed traits. Then ChemChina, a state-owned Chinese company, acquired Syngenta; Dow Chemical and Dupont merged and spun off their combined agricultural businesses into a firm called Corteva; and Bayer acquired Monsanto. The transactions reduced the "Big Six" to a "Big Four" and eliminated two of the three U.S. firms.

Antitrust regulatory authorities reviewed the mergers in the firms' two biggest markets, the United States and the European Union (EU), as well as in Australia, Brazil, Canada, China, India, and South Africa. Focusing on the economic repercussions of market power, the reviews and their resolutions concentrated on whether the mergers' resulting reduction in competition could lead to higher production costs for farmers and reduced R&D spending and, therefore, lead to less innovation.

The United States and European Union investigations of the Dow Chemical-DuPont and Bayer-Monsanto mergers focused on their likely effect on innovation, especially in several highly concentrated markets for traits, seeds, and pesticides. The antitrust agencies argued that with fewer competitors,

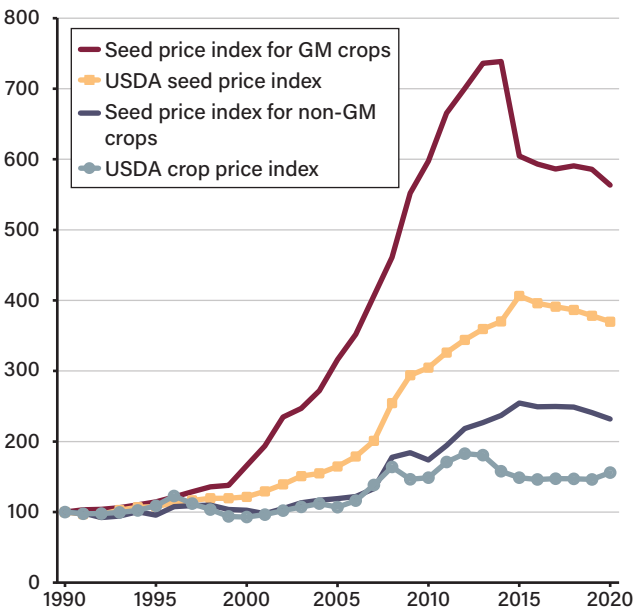
new innovations would compete with existing products instead of diverting business from rival firms. In those cases, a firm would be less likely to invest in research to develop innovations. The U.S. and EU regulators in particular focused on several pesticide markets in the Dow-DuPont merger. In the Bayer-Monsanto merger, agencies expressed concerns with several GM seed and trait markets, five vegetable seed markets, and markets for certain seed treatments and herbicides. In each case, the merging firms were active or potential competitors and faced few or no other rivals.

Enforcement agencies approved the mergers, but with stipulations: The merged companies had to divest some businesses to other firms to maintain competitive rivalry in the markets identified as problematic. DuPont was required to sell part of its pesticide business, including R&D assets, to FMC Corp., a firm already active in agrichemicals. DuPont also sold its Brazilian corn seed business to meet the antitrust objections of the Brazilian enforcement agency. Bayer sold seed, seed trait, seed treatment, and pesticide businesses to BASF, a "Big Six" firm that had dealt primarily with pesticides but had a limited seed business.

Seed Price Increases Reflect Value of Improved Traits, New Market Power for Companies

With U.S. seed markets concentrated among fewer companies, and with expanded protections of individual property rights, seed prices have risen, especially for seed with GM varieties. Between 1990 and 2020, the average price farmers paid for seed rose 270 percent, compared with commodity price inflation of 56 percent. For crops planted predominantly with GM seed (corn, soybeans, and cotton), average seed prices were 463 percent higher in 2020 than 30 years earlier and at their peak in 2012 were 600 percent above 1990 levels. Despite their higher cost, GM crop varieties brought significant productivity gains to farmers. Yields increased, and farmers were able to cut production costs as genetic traits reduced the need for other inputs. For example, GM traits that made crops resistant to insects meant farmers could apply less insecticide.

Crop seed prices have risen faster than commodity prices, especially for genetically modified (GM) seed



Note: The **seed price index for GM crops** is the average of seed price indexes for corn, soybeans, and cotton. The **seed price index for non-GM crops** is the average of seed price indexes for wheat, barley, oats, sorghum, rice, flaxseed, potatoes, and peanuts.

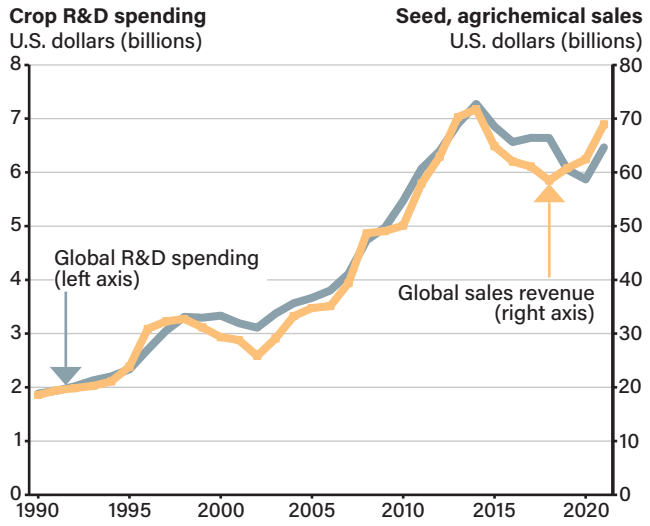
Source: USDA, Economic Research Service using data from USDA, National Agricultural Statistics Service.

One factor in the seed cost increase was the expanded market power of seed companies. Patents (and to a lesser extent PVPCs) offer owners of intellectual property a legal monopoly over the use of their inventions. For inventions with market value, intellectual property rights give firms the ability to set prices for the products that contain their inventions. The profits earned are a return for R&D investments and other costs to commercialize the invention. In addition, moving from a system in which privately owned inventions replace publicly financed inventions provided to users at nominal cost also affects who pays for, and who benefits from, technological change in agriculture. Inventions by private firms are financed by the price premiums they can charge users. Historically, public institutions like the USDA or land grant universities provided their inventions freely to users, but now, like their private counterparts, they may obtain patent rights and charge licensing fees for commercial use of their innovations.

The market power provided by expanded intellectual property protection and market concentration has allowed seed companies to spend more on crop R&D, accelerate the rate of new variety introductions with higher productivity potential, and charge higher prices reflecting the value of improved seeds. Coinciding with the introduction of GM varieties, total R&D spending on crop improvement by the seven largest seed companies (including their legacy companies) increased

from less than $2 billion in 1990 to more than $7 billion by 2014, closely tracking increases in company revenues from seed and agrichemical sales. These companies have invested about 10 percent of their agricultural revenues in R&D.

Major companies' spending on crop research and development (R&D) tracks their seed and agrichemical sales revenue



Note: Chart shows combined R&D spending and sales revenue of the world's seven largest seed companies: Bayer, Corteva, Syngenta, BASF, Limagrain, KWS, and Rijk Zwaan, as well as 25 legacy companies that have merged with or been acquired by these firms since 1990. **R&D spending** reflects that of the firms' agricultural business segments. **Revenue** includes sales of seed, agrichemicals, and other crop improvement products and services.

Source: USDA, Economic Research Service using data from company financial reports.

A firm's ability to exercise market power also may be affected by the concentration levels in an industry. Economic theory suggests that some degree of market power leads to private R&D investment. However, too much market concentration may reduce competition and take away firms' incentive to innovate. The cost of R&D and regulatory requirements might deter firms from entering the field, further limiting competition and new sources of innovation.

Antitrust agencies have focused more heavily on innovation concerns in the last two decades; these concerns have become an important feature in a growing number of cases across the economy and in agribusiness. However, not much empirical evidence exists on the effect of competition on research investments and innovation—and, specifically, on how many rivals are necessary to spur innovation. This issue will remain an important question for antitrust policy and economic research.

CITATIONS

This article is drawn from...

MacDonald, J.M.., Dong, X., & Fuglie, K.O. (2023). ***Concentration and competition in U.S. agribusiness*** (Report No. EIB-256). U.S. Department of Agriculture, Economic Research Service.

You may also be interested in ...

Ciliberto, F., Moschini, G. & Perry, E. (2019). Valuing product innovation: Genetically engineered varieties in U.S. corn and soybeans. ***RAND Journal of Economics, 50***, 615–644.

Fuglie, K., Ballenger, N., Rubenstein, K.D., Klotz, C., Ollinger, M., Reilly, J., Vasavada, U., Yee, J. (1996). ***Agricultural research and development: Public and private investments under alternative markets and institutions*** (Report No. AER-735). U.S. Department of Agriculture, Economic Research Service.

Fuglie, K., Heisey, P., King, J., Pray, C.E., Rubenstein, K.D., Schimmelpfennig, D., Wang, S.L., & Karmarkar-Deshmukh, R. (2011). ***Research investments and market structure in the food processing, agricultural input, and biofuel industries worldwide*** (Report No. ERR-130). U.S. Department of Agriculture, Economic Research Service.

MacDonald, J.M. (2017, April 3). Mergers and competition in seed and agricultural chemical markets. ***Amber Waves***, U.S. Department of Agriculture, Economic Research Service.

MacDonald, J.M. (2019, February 15). Mergers in seeds and agricultural chemicals: What happened? ***Amber Waves***, U.S. Department of Agriculture, Economic Research Service.

JUNE **2023**

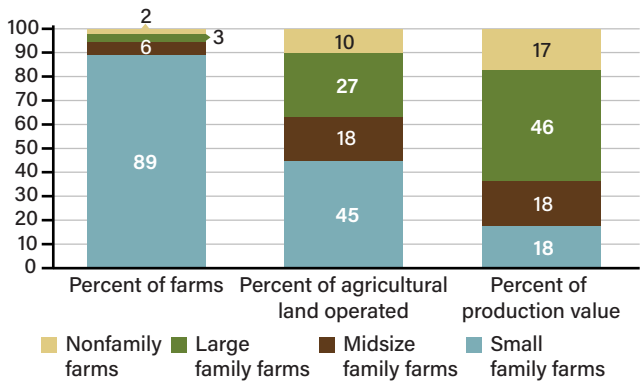
Examining Financial Risk Measures on Family and Nonfamily Farms

BY CHRISTINE WHITT, NOAH MILLER, AND RYAN OLVER

The Agricultural Resource Management Survey (ARMS) provides data on two measures of financial performance: the operating profit margin (the share of gross income that is profit) and the current ratio (the ratio of short-term assets to short-term debt). Researchers use these data to gain a sense of risk faced by different types of farms.

USDA, Economic Research Service classifies farms according to their ownership type (family or nonfamily) and their size (small, midsize, or large) as measured by gross cash farm income (GCFI). A family farm is any farm in which an operator and their relatives own more than half the business' assets. In 2021, 98 percent of the 2 million U.S. farms were family owned and operated. Additionally, 89 percent were classified as small farms, meaning their GCFI was less than $350,000. Small family farms operated 45 percent of U.S. farmland but accounted for only 18 percent of production by value. Large family farms operated 27 percent of U.S. farmland and accounted for 46 percent of production value. Large farms are those with GCFI of $1 million or greater, and those with GCFI above $5 million are categorized as very large farms. Midsize farms, with GCFI between $350,000 and $999,999, operated 18 percent of farm acreage and accounted for 18 percent of production value.

Small family farms accounted for 89 percent of all U.S. farms but 18 percent of the production value in 2021



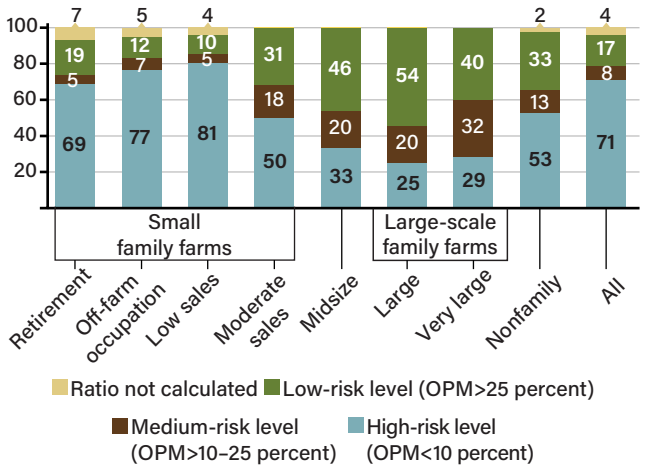
Note: **Land operated** = owned land plus leased land minus land leased to others. Numbers may not add to 100 percent because of rounding.

Source: USDA, Economic Research Service (ERS) using USDA, National Agricultural Statistics Service and ERS 2021 Agricultural Resource Management Survey data.

Nonfamily farms include (but are not limited to) those operated by partnerships of unrelated partners, nonfamily corporations, and farms with a hired manager unrelated to the owners. The share of nonfamily farms remained at 2 percent between 2020 and 2021, although their share of production value increased from 13 to 17 percent. Twenty-one percent were also classified as "large," and those accounted for 93 percent of the total value of production for nonfamily farms. An operating profit margin under 10 percent indicates

higher risk of financial problems, while margins above 25 percent are considered low risk, and margins between 10 and 25 percent are moderate risk. In 2021, most small family farms were classified as high risk, while midsize, large, and very large farms generally reported higher margins and lower risk. However, many farms categorized as small farms—including retirement farms, off-farm occupation farms, and low-sales farms (the categories of which are determined by the occupation of the principal operator)—also earn most of their income from off-farm sources, which is not reflected in operating profit margin. During the Coronavirus (COVID-19) pandemic, the proportion of low-risk farms increased from 2020 to 2021 (from 14 percent to 17 percent) across all categories except retirement farms.

Large family farms were most likely to have operating profit margins (OPMs) in the low-risk level in 2021

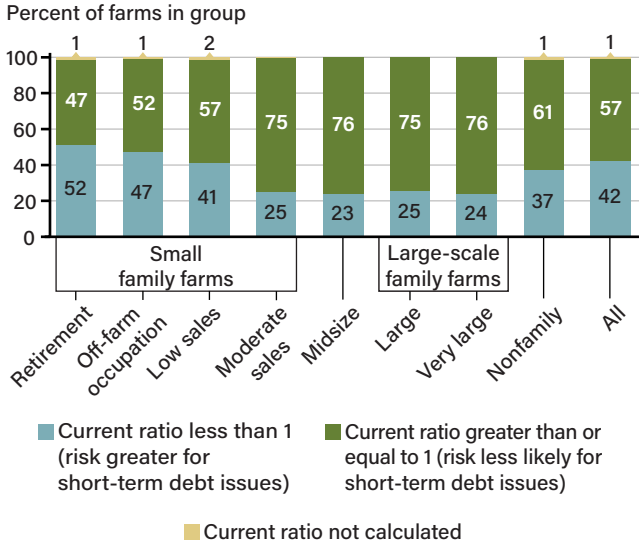


Note: **Operating profit margin (OPM)** = 100 multiplied by (net farm income plus interest paid, minus charges for unpaid labor and management) divided by gross farm income. OPM ratios are not calculated for operations with zero or negative gross farm income. Sums may not add to 100 percent because of rounding.

Source: USDA, Economic Research Service (ERS) using USDA, National Agricultural Statistics Service and ERS 2021 Agricultural Resource Management Survey data.

Another measure of financial performance is the current ratio, which indicates whether an operation has enough assets to convert into cash to meet debt obligations that need to be paid off within a year. A current ratio less than 1 suggests the farm is unable to fulfill its current debt by selling its current assets. Based on this measure, 57 percent of all farms do not have a short-term liquidity issue, even though 71 percent had an OPM in the high-risk zone. In 2021, about 25 percent of all farms categorized as "moderate sales" or larger had a current ratio less than 1, and about half of the retirement and off-farm occupation categories fell below this value. However, like the OPM measure, the current ratio does not account for off-farm household income, which many of these farms could use to fulfill short-term farm debt obligations.

Short-term debt obligations varied by farm size in 2021



Note: **Current ratio** equals current assets divided by current debt. **Current assets** consist of cash and other assets expected to be converted to cash within a year and include the value of crop inventory, livestock inventory, inputs for crops planted but not harvested, purchased inputs, and all other current assets. **Current debt** is any obligation for borrowed money payable on demand or within a period of 1 year. Current debt is the sum of accrued interest, accounts payable, current portion of term debt, and short-term financial debt. Sums may not add to 100 percent because of rounding. For farms that have no current debt, the current ratio cannot be calculated.

Source: USDA, Economic Research Service (ERS) using USDA, National Agricultural Statistics Service and ERS 2021 Agricultural Resource Management Survey data.

CITATIONS

This article is drawn from...

Whitt, C., Miller, N., & Olver, R. (2022). *America's farms and ranches at a glance: 2022 edition* (Report No. EIB-247). U.S. Department of Agriculture, Economic Research Service.

You may also be interested in ...

Whitt, C. (2023, February 7). ***Farm Household Well-being.*** [Topic page]. U.S. Department of Agriculture, Economic Research Service.

Tsiboe, F., & Turner, D. (2023, May 3). ***Risk Management—Data***. [Topic page]. U.S. Department of Agriculture, Economic Research Service.

Economics *of* Food

JULY **2023**

ERS Data Products Show Food-At-Home Price Inflation From Producers to Consumers

BY MEGAN SWEITZER, MATTHEW MACLACHLAN, WILSON SINCLAIR, ALEXANDER STEVENS, HAYDEN STEWART, JAMES CHANDLER ZACHARY, AND ELIANA ZEBALLOS

As a basic necessity, food is a major component of household spending, representing 12.4 percent of U.S. household expenditures in 2021, behind housing (33.8 percent) and transportation (16.4 percent). Food price growth, or food inflation, affects all household budgets and can disproportionately impact the financial health as well as the food and nutrition security of lower income consumers. Lower income households spent a greater share of their income (30.6 percent) on food in 2021 than the national average. Moreover, rising food prices can force households to shift spending from other budget categories to allow them to buy enough food.

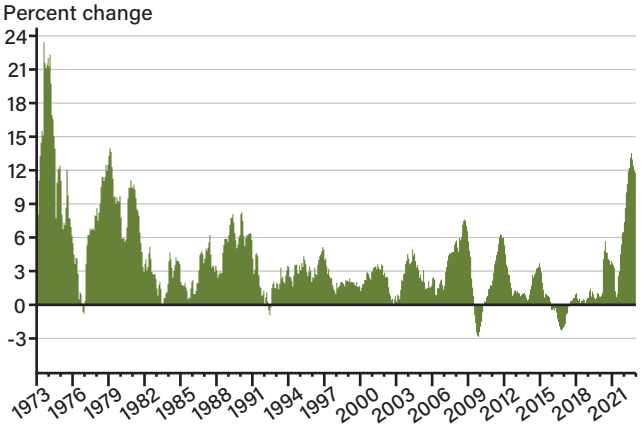
HIGHLIGHTS

- U.S. food prices increased from 2020 to 2022 and recorded the largest annual growth rate since the 1970s in 2022. Price inflation was particularly high for food at home.
- U.S. consumers spent more on food at home in 2022 compared with 2019, even after adjusting for inflation.
- Retail food prices respond to changes in input costs from industries along the food supply chain.

The USDA, Economic Research Service (ERS) maintains a suite of data products related to food markets and prices that can shed light on food price changes and impacts. One of those data products, the Food Price Outlook, shows that U.S. food prices grew rapidly and with increased volatility from 2020 through 2022, driven by economy-wide inflationary pressures as well as changes in food supply and demand. Food consumption patterns shifted markedly after the onset of the Coronavirus (COVID-19) pandemic. Other shocks to the food supply chain, including an outbreak of highly pathogenic avian influenza and Russia's war against Ukraine, compounded inflationary pressures in the food processing and retail sectors. Prices for food at home (FAH), or groceries, rose by 3.5 percent in 2020 and 2021. These increases outpaced the average 2.0-percent growth rate from 2000 to 2019. FAH prices then grew by 11.4 percent in 2022. Year-over-year FAH price increases peaked in August 2022, at 13.5 percent higher than in August 2021, the largest such increase since March 1979.

Food-at-home prices in 2022 grew at the fastest rate in more than four decades

Percent change



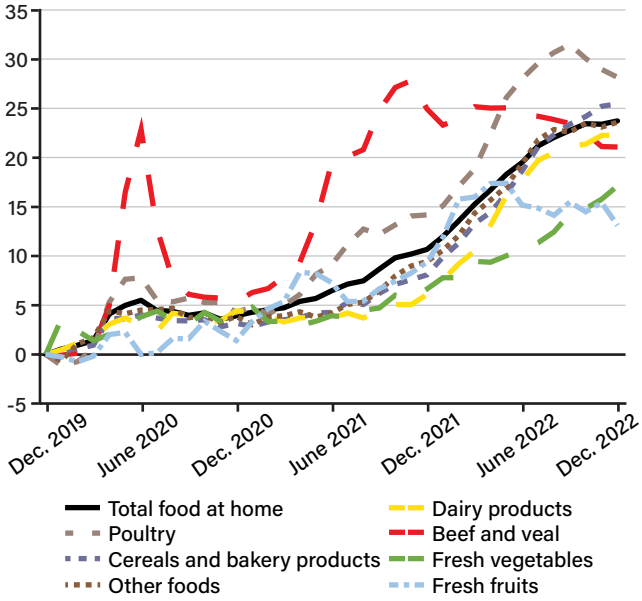
Note: Chart shows monthly year-over-year percent changes in the food-at-home Consumer Price Index, 1973–2022.
Source: USDA, Economic Research Service, using data from the U.S. Bureau of Labor Statistics' Consumer Price Index.

From 2020 through 2022, prices for some types of food purchased for home consumption increased faster than others, reflecting changes in production costs, levels of processing, industry concentration, and consumers' willingness to pay. In the first half of 2020, beef, veal, and pork prices grew most rapidly as packinghouses struggled with labor disruptions from COVID-19 infections and risk of infections. Meat, poultry, and fish prices continued to grow faster than most other categories through 2021.

Prices for more processed foods grew consistently throughout 2022. These food categories included fats and oils (such as butter and cooking oils), other meats (such as hotdogs and cold cuts), cereals and bakery products, dairy products, processed fruits and vegetables, and nonalcoholic beverages. Meats, poultry, and fish prices grew more slowly in 2022, with beef and veal prices falling from their peak in November 2021. Prices for fresh fruits and vegetables also increased over this period but lagged growth in other categories.

Prices grew for all food-at-home categories, 2020–22

Percent change since December 2019



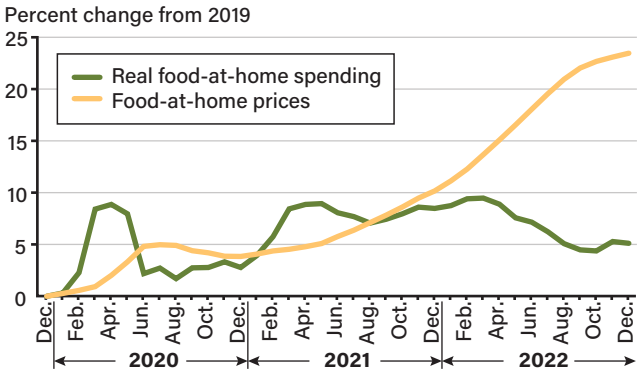
Note: **Other foods** include soups, frozen and freeze-dried prepared foods, snacks, sauces and condiments, and baby food, among others.
Source: USDA, Economic Research Service, using data from the U.S. Bureau of Labor Statistics' Consumer Price Index.

Consumers Adjust Spending in Response to Food Price Changes

When food prices rise, spending on food typically rises as well. However, these expenditures may rise more, or less, than the rate of inflation because households may respond to higher prices by buying less food, limiting purchases of discretionary items, or choosing less expensive alternatives. By adjusting food spending data for inflation, researchers remove the effects of price changes and are able to capture "real" changes in consumption.

Without adjusting for inflation, food prices and spending rose considerably from 2020–22. The ERS Food Expenditure Series data product shows that inflation-adjusted, or real, FAH spending also increased in 2020 and the first half of 2021, driven largely by pandemic-related restaurant restrictions and health concerns that shifted consumer spending from food away from home (FAFH) to FAH. However, as FAH prices and nominal (not inflation-adjusted) average monthly FAH spending rose by 11.4 percent and 9.8 percent in 2022, respectively, real spending on FAH trended downward, falling 1.4 percent from 2021. Even so, food spending remained above 2019 levels throughout the year.

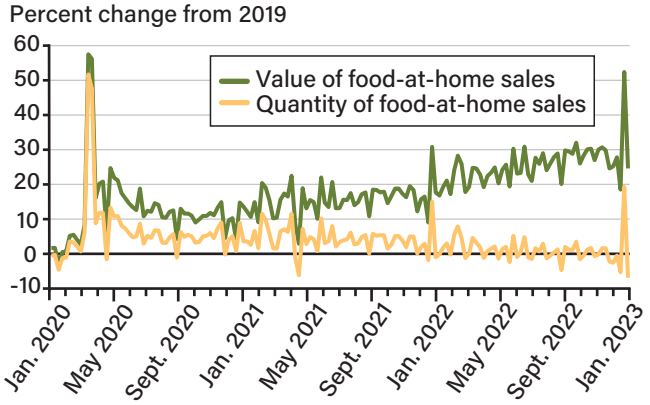
Rising food prices since mid-2021 have correlated with a downward trend in inflation-adjusted food-at-home spending



Note: Percent changes in real, or inflation-adjusted, spending and prices are calculated using 2019 as the base year and displayed as a 3-month moving average. These estimates are for sales only and exclude food furnished, donated, home-produced, and served at educational institutions.

Source: USDA, Economic Research Service, using data from its Food Expenditure Series data product and the U.S. Bureau of Labor Statistics' Consumer Price Index for food at home.

Trends in weekly food-at-home sales by value and quantity began to diverge in early 2022



Note: Chart shows percentage changes in sales (dollar and quantity) from the equivalent week in 2019. The chart uses data from USDA, Economic Research Service's Weekly Retail Food Sales data product, which is subject to revision based on periodic adjustments in methodology underlying the proprietary data from Circana (formerly Information Resources, Inc. [IRI]).

Source: USDA, Economic Research Service Weekly Retail Food Sales data product using proprietary retail scanner data from Circana (formerly Information Resources, Inc. [IRI]).

Changes in consumer behavior and demand likely led to the increase in real food spending in 2022 compared with 2019. For instance, U.S. consumers may have chosen more expensive products, such as precut vegetables and fruits, organic products, prepared dishes, and imported out-of-season foods. They may also have bought more groceries than they did in 2019. The ERS Weekly Retail Food Sales data product shows that increases in the quantity of FAH purchases by U.S. households were broad-based in 2020, as retail sales units rose across all major categories. Overall, the FAH sales quantities in 2022 declined from 2020 and 2021 but remained slightly higher than 2019. Consumers continued to buy more beverages, fruits, vegetables, and other foods than in 2019, but smaller amounts of sugar and sweeteners, dairy, meats, eggs, nuts, and commercially prepared items. However, unit quantity sales do not capture if consumers made changes in response to rising prices such as switching to more economical products or buying larger package sizes.

Although households shifted spending from FAFH to FAH early in the pandemic, households maintained higher real spending and purchased slightly larger quantities of FAH in 2022 even as real FAFH spending exceeded prepandemic levels and resumed its growth trend from the previous decade.

ERS' Food Dollar Series shows contribution to retail food prices of 12 industry groups along food supply chain.

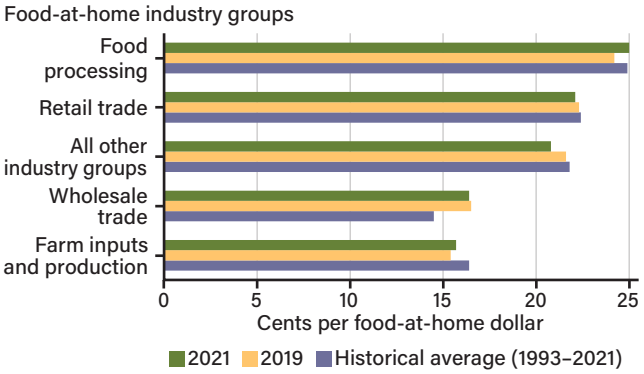
Industries Along the Food Supply Chain Impact Retail Food Prices

Many supply-side factors contribute to retail food costs and influence food price changes. Retail food prices include the many costs associated with transforming agricultural commodities into food products. Farmers typically hire workers and bear the cost of inputs such as land, seeds, fertilizer, and machinery. Raw agricultural commodities then are processed, packaged, and transported. Services along the supply chain, such as retail and wholesale trade and advertising, ensure the timely and efficient distribution of products.

The ERS Food Dollar Series data product estimates the relative contribution to retail food prices of 12 industry groups in the food supply chain: agribusiness; farm production; food processing; packaging; transportation services; energy; wholesale trade; retail trade; food services; finance and insurance; advertising; and legal and accounting services. The industries that contribute the highest shares of costs are relatively consistent across years, although shifts occur in their relative contributions. Food processing stands out as the most expensive step along the food-at-home production process. Firms responsible for processing agricultural commodities into foods accounted for 24.2 percent and 25 percent of total food-at-home costs in 2019 and 2021, respectively. Costs for processing increased after the pandemic's onset as packinghouses and other types of facilities struggled to stay open and staffed. Costs for wholesaling and retailing together represented 38.8 percent of total costs in 2019 and 38.5 percent in 2021.

Agribusiness and farm production accounted for 15.7 percent of overall food-at-home production costs in 2021, an increase from 2019 but below the historic average of 16.4 percent. These two industry groups represent the share of production costs associated with farm commodity production, excluding on-farm costs paid to other industry groups. Intermediate steps such as packaging and transportation, as well as industries elsewhere along the production process, including finance and insurance, advertising, and legal and accounting, also contribute to total food-at-home production costs.

Food-at-home costs are distributed among industries along the food supply chain



Note: **All other industry groups** include transportation, packaging, advertising, energy, finance and insurance, food services, and legal and accounting.
Source: USDA, Economic Research Service, Food Dollar Series data product.

Because food processing, wholesaling, and retailing costs generally account for a larger share of food prices than farm inputs (agribusiness) and production, the relationship between retail food prices and what farmers receive for their commodities can be theoretically and statistically weak. The ERS Price Spreads from Farm to Consumer data product measures the difference between a food's retail price and the value of the agricultural commodities used to produce it. For products that require less processing, such as Cheddar cheese and all-purpose white flour, farmers tend to receive a higher share of what consumers pay than in the case of more highly processed foods such as bread.

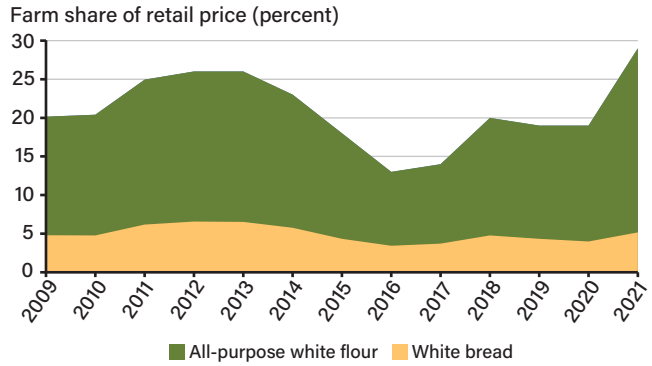
Retail prices for minimally processed foods also tend to move more closely with farm-level prices though still not in tandem. In theory, an increase in the value of the farm commodities in a food would increase retail prices by the same amount if all businesses along the supply chain passed the cost increase through to retail. In practice, as was the case for Cheddar cheese in 2022, marketers do not typically do so.

U.S. dairy product exports increased in 2022, buoying milk demand. Growth in milk supply was comparatively small. U.S. dairy farmers facing high costs for inputs including cows, feed, and fertilizer managed to increase their output by less than one-tenth of 1 percent in 2022, leaving milk

processors and dairy product manufacturers to compete for limited supply. The farm price of milk hit an all-time high of $27.20 per hundred pounds in May 2022 ($8.10 higher than in May 2021). The farm value of the milk components in Cheddar cheese rose 31 percent in 2022, from $1.57 per pound to $2.06 per pound. Retail Cheddar cheese prices, meanwhile, rose a comparatively modest 6 percent, from $5.44 per pound to $5.76.

More highly processed products have even less of a connection between their farm and retail prices. The farm share for wheat producers of white bread has been around 5 percent in recent years, but the farm share for all-purpose white flour has exceeded 20 percent. The retail cost of both products might increase with the farm price of wheat. However, as payments to wheat growers represent a much smaller share of bread's retail price, wheat price shocks have much less potential to be passed through to retail bread prices. For example, farm-level wheat prices rose 44.5 percent in 2021, but retail-level cereals and bakery products increased 2.3 percent. In 2022, however, prices for farm-level wheat grew 31.0 percent, and retail prices for cereals and bakery products rose 13.0 percent.

Farmers' share of retail prices typically is smaller for more processed products



Source: USDA, Economic Research Service, Price Spreads from Farm to Consumer data product.

A Look Ahead to 2023

U.S. food prices grew volatile after the onset of the COVID-19 pandemic and increased rapidly in 2022 as economic conditions and consumer demand changed and external factors weighed on the food supply chain. U.S. households, which shifted spending patterns early in the pandemic, continued to buy higher quantities and different types of FAH in 2022 compared with 2019. Consumers responded to food price increases in 2022 with less real (inflation-adjusted) FAH spending in 2022 than in 2021 and 2020, but higher food prices still led to an increase in nominal (not adjusted for inflation) food-at-home expenditures. The ERS Food Price Outlook forecasts that food prices will grow more slowly in 2023 than in 2022 but remain above historical average rates. Higher food prices will continue to affect consumer budgets in 2023.

CITATIONS

This article is drawn from ...

Baker, Q., & Zachary, J.C. (2023). ***Food dollar series.*** [Data product] U.S. Department of Agriculture, Economic Research Service.

Zeballos, E., & Sinclair, W. (2023). ***Food expenditure series.*** [Data product] U.S. Department of Agriculture, Economic Research Service.

Sweitzer, M. (2023). ***Food price outlook.*** [Data product] U.S. Department of Agriculture, Economic Research Service.

Stewart, H., & Hyman, J. (2023). ***Price spreads from farm to consumer.*** [Data product] U.S. Department of Agriculture, Economic Research Service.

McLaughlin, P.W. & Stevens, A. (2023). ***Weekly retail food sales.*** [Data product] U.S. Department of Agriculture, Economic Research Service.

You may also be interested in ...

Chelius, C., & MacLachlan, M. (2021, March 1). Retail food price inflation in 2020 outpaced historical average by 75 percent. ***Amber Waves***, U.S. Department of Agriculture, Economic Research Service.

Zeballos, E., & Sinclair, W. (2021, October 4). Food spending by U.S. consumers fell almost 8 percent in 2020. ***Amber Waves***, U.S. Department of Agriculture, Economic Research Service.

Okrent, A., Elitzak, H., Park, T., & Rehkamp, S. (2018). ***Measuring the value of the U.S. food system: Revisions to the food expenditure series***. (Report No. TB-1948). U.S. Department of Agriculture, Economic Research Service.

MacLachlan, M., Chelius, C., & Short, G. (2022). ***Time-series methods for forecasting and modeling uncertainty in the Food Price Outlook.*** (Report No. TB-1957). U.S. Department of Agriculture, Economic Research Service.

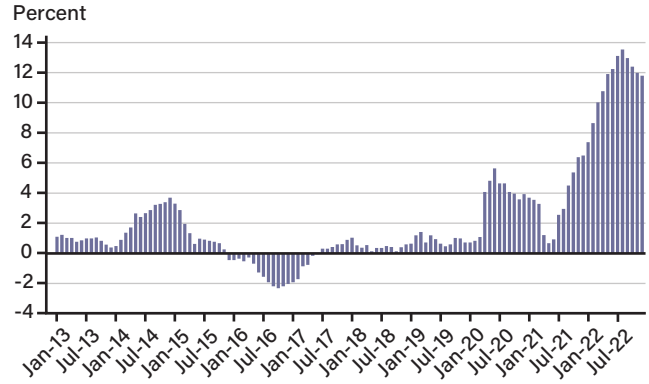
FEBRUARY **2023**

ERS Refines Forecasting Methods in Food Price Outlook

BY MEGAN SWEITZER, MATTHEW MACLACHLAN, AND GIANNA SHORT

The USDA, Economic Research Service's (ERS) Food Price Outlook (FPO) provides forecasts of annual food price changes up to 18 months in the future. Once a month, the FPO forecasts the annual percentage change in prices for the current year and, beginning in July each year, for the following year. ERS has forecasted food prices for decades and periodically updates and improves the forecasting methods. In 2022, researchers at ERS developed a method to forecast food price changes more accurately while better representing the level of uncertainty in forecasts.

Food-at-home prices experienced year-over-year increases as high as 13.5 percent in August 2022



Source: USDA, Economic Research Service using U.S. Bureau of Labor Statistics Consumer Price Index data from 2013 to 2022.

Food prices have increased more rapidly in recent years, with shocks to the food supply chain from events such as the Coronavirus (COVID-19) pandemic, a highly pathogenic avian influenza outbreak, and the conflict in Ukraine. Food-at-home prices rose 3.5 percent in 2020 and 2021 and 11.4 percent in 2022. The historical annual average is 2.0 percent from 2002 to 2021. Recent price increases tied to unprecedented world events highlight the importance of periodic reviews of, and improvements to, forecasting methods over time.

There are many ways to track food price changes over time. The FPO forecasts annual percent price change by averaging prices in the 12 months of a calendar year and comparing them with past or future annual average prices. For example, forecasts for 2023 developed in 2022 are based on an average of predictions for all 12 months of 2023 compared with 2022. As the months progress and new price data become available, the forecasts incorporate that new price change information. Once actual price data from 2023 start to become available in February 2023, the FPO will base the forecast for the year on a combination of observed and forecast data. Therefore, forecasts developed earlier in the year will be more uncertain than forecasts developed later in the year.

Historically, FPO forecasts have used 1-percent forecast ranges for retail food categories (such as prices are predicted to increase between 2 and 3 percent) and 3-percent ranges for farm and wholesale food categories. The FPO had reported forecasts using these uniform ranges no matter how far into the future the forecast covered, whether it was 1 month or 18 months. The new method developed by ERS presents food price forecasts as a midpoint and a prediction interval (similar to a forecast range). The intervals vary in size based on the level of uncertainty about the forecast. In addition, while the legacy method used uniform forecast ranges across

New method of reporting forecasts offers varying ranges for food categories, taking levels of uncertainty into account

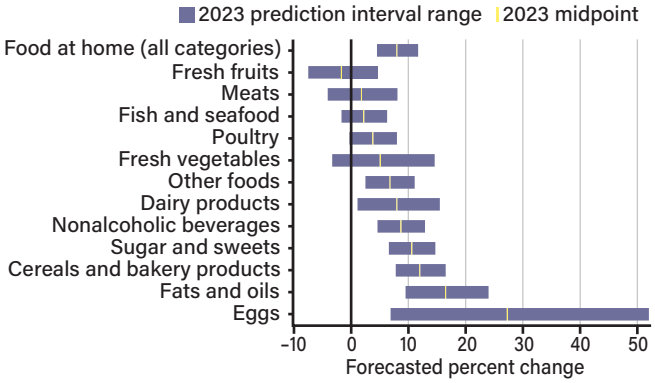
Consumer Price Index item	2023 forecast range of percentage change		
	Lower	Mid	Upper
All food	4.2	7.1	10.1
Food away from home	6.7	8.2	9.7
Food at home	4.5	8.0	11.7
Meats, poultry, and fish	-3.6	1.8	7.7
Meats	-4.1	1.8	8.1
Beef and veal	-10.4	-1.8	8.0
Pork	-10.3	-3.0	5.1
Other meats	7.1	12.8	18.7
Poultry	-0.3	3.8	8.0
Fish and seafood	-1.7	2.2	6.3
Eggs	6.9	27.3	52.0
Dairy products	1.1	8.0	15.5
Fats and oils	9.5	16.5	24.0
Fruits and vegetables	-2.6	2.0	7.1
Fresh fruits and vegetables	-4.6	1.0	7.0
Fresh fruits	-7.5	-1.7	4.5
Fresh vegetables	-3.3	5.1	14.6
Processed fruits and vegetables	4.1	9.6	15.3
Sugar and sweets	6.6	10.6	14.7
Cereals and bakery products	7.8	12.0	16.5
Nonalcoholic beverages	4.6	8.7	12.9
Other foods	2.5	6.8	11.1

Note: Forecast using data through December 2022.

Source: USDA, Economic Research Service.

all food categories, the updated method allows the size of the prediction interval to vary for different food categories based on available information and the difficulty of accurate predictions for each food category.

ERS' Food Price Outlook forecasts now include midpoints and are reported in intervals that vary by food category

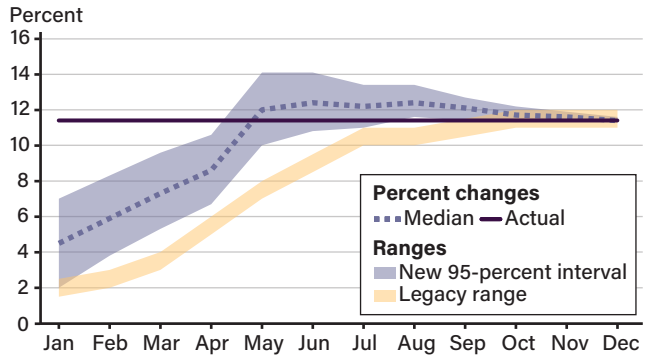


Note: Forecasts shown are for 2023 based on data through December 2022.
Source: USDA, Economic Research Service Food Price Outlook.

Prediction Intervals Illustrate Uncertainty in Price Forecasts

Using the updated method, prediction intervals start out wider at the beginning of the year and narrow as forecasts incorporate more months of observed data and the forecast period shortens. Researchers applied the updated forecasting method to previous years to test how it compared with the legacy method. The accompanying charts illustrate the differences in the two methods, showing how they forecast food-at-home prices in 2022. The blue band represents the new prediction interval at a 95-percent confidence level, and the dashed line is the midpoint of the interval. The yellow band is the legacy forecast range method. The solid line is the actual change in prices for that year.

As new information became known, the 2022 forecast for food-at-home prices converged with the actual percent change by the end of the year

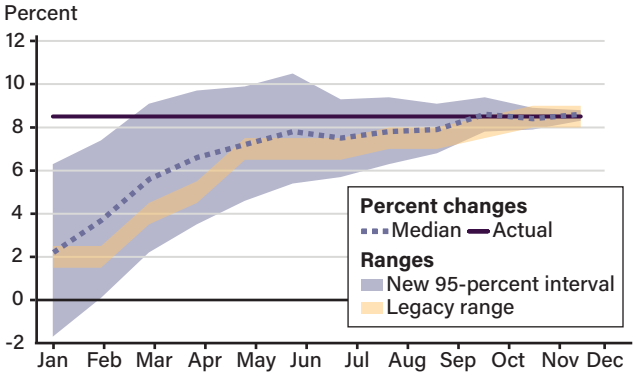


Source: USDA, Economic Research Service using data from its Food Price Outlook data product and the U.S. Bureau of Labor Statistics' Consumer Price Index.

Across food categories and years, the updated method captures the actual percent change in prices more frequently. When using the legacy method from 2011 to 2020, about 16 percent of the forecast ranges developed a year in advance included the actual percent change in retail food prices. With the new approach for the same years, about 86 percent of prediction intervals contained the actual percent change in retail food prices using a 95-percent prediction interval.

Seasonality, long-term trends, and volatility differ across food categories, and the updated methods account for these differences in the predictions. For example, fruits and vegetables often experience large price changes and can be difficult to forecast. Between 2011 and 2020, two of the legacy forecast ranges for fruits and vegetables developed a year in advance included the actual annual change in prices, compared to all years for the new method. The new method incorporates that high degree of uncertainty into the forecast ranges. In 2022, fruits and vegetables had a wide prediction interval at the beginning of the year, and the interval contained the actual percent change beginning in March, despite high volatility in prices in 2022.

The 2022 retail fruits and vegetables price prediction interval contained the actual percent change beginning in March



Source: USDA, Economic Research Service using data from its Food Price Outlook data product and the U.S. Bureau of Labor Statistics' Consumer Price Index.

In part, the prediction intervals capture the actual change in prices more frequently because they can begin with a wider range early in the year. The width reflects the distance between past predictions and actual changes in food prices. The new methods and wider prediction intervals of the updated FPO reflect a more informative and credible measure of uncertainty compared with the legacy forecast methods and ranges that were more precise but predicted the actual change in prices less often.

CITATIONS

This article is drawn from...

MacLachlan, M., Chelius,C. & Short, G. (2022). ***Time-series methods for forecasting and modeling uncertainty in the food price outlook.*** (Report No. TB-1957). U.S. Department of Agriculture, Economic Research Service.

Sweitzer, M. (2022). ***Food price outlook.*** [Data product]. U.S. Department of Agriculture, Economic Research Service.

AUGUST **2023**

Prevalence of the "Natural" Label Varies by Food Category

BY FRED KUCHLER AND MEGAN SWEITZER

U.S. food suppliers use packaging labels to make claims that highlight production-process attributes some consumers want, often charging a higher price for those products than for products without label claims. Some suppliers use the "natural" claim or similar labels such as "all natural," "100 percent natural," or "made with natural ingredients." Regulatory agencies treat the "natural" claim as meaning nothing artificial was added during processing and the product was minimally processed, so food suppliers can use it at a relatively low cost. Regulatory agencies' policies regarding the "natural" label do not address human health, the use of synthetic pesticides, genetically modified organisms, hormones, or antibiotics in crop and livestock production. The size and scope of the market for food carrying a "natural" claim had not been previously explored in depth as have other food labels such as chicken raised without antibiotics, USDA organic, seafood ecolabels, grass-feed beef, and many more including non-genetically engineered.

USDA, Economic Research Service recently released a report that examined the overall size of the market for food labeled "natural" in 2018, the latest available data at the time. Researchers documented the frequency with which suppliers used a "natural" label and how "natural" label use varied throughout the food supply. Estimates were based on Circana's (formerly Information Resources, Inc. [IRI]) 2018 InfoScan retail scanner data and Label Insight data.

There are several ways to quantify the frequency of label use. Across all foods, those whose packaging labeled them as "natural" accounted for 16.3 percent of retail food expenditures, 16.9 percent of all items purchased (unit sales), and 11 percent of Universal Product Codes (barcodes, or UPCs) in stores in 2018. Total expenditures for foods labeled "natural" were larger than total spending for foods labeled USDA Organic.

"Natural" claims are not distributed uniformly across food categories. Dairy had the highest frequency of "natural" claims in 2018 with 27.7 percent of retail spending on dairy products for foods with "natural" labels. In addition, "natural" labels were on 32.3 percent of dairy unit items and 21.3 percent of UPCs in stores.

"Natural" labels were found predominantly on processed products and less so on fruits and vegetables, which usually meet the test of being minimally processed. Digging deeper into the food groupings shows where consumers are more likely to encounter the "natural" label. For example, products labeled "natural" made up 95.6 percent of retail spending on vitamins and supplements, compared with 0.5 percent of expenditures for potatoes. Vitamins and supplements are included in the "Other foods" category.

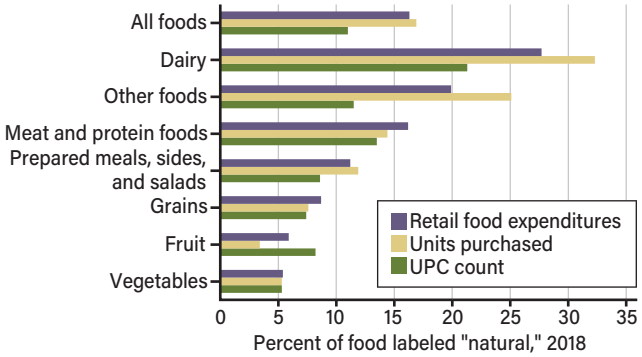
Numerous studies have concluded that most consumers do not understand differences in meanings of label claims. Many equate the "natural" label on food with healthier food choices and production practices that indicate environmental stewardship and attention to animal welfare. Misinterpretation of labels can cost both consumers and producers. For example, a consumer may pay extra for

a product labeled "natural," erroneously believing that the product offers a health benefit. The consumer does not receive the health benefit, and producers supplying the health benefit lose a sale.

The landscape of food label claims is complex for many reasons, but these data help reveal the relative size and scope of the market for foods labeled "natural" for informed decision-making and future research.

About 16 percent of retail food expenditures in 2018 were for products labeled "natural"

Major food groups



Note: **Other foods** include fats and oils; sauces and condiments; beverages; desserts and sweets; breakfast cereal; savory snacks; vitamins and supplements; baby food; and infant formula. **UPC** = universal product code, used to track products in stores.

Source: USDA, Economic Research Service calculations using Circana's (formerly Information Resources Inc. [IRI]) 2018 InfoScan retail scanner data and Label Insight data.

CITATIONS

This article is drawn from ...

Kuchler, F., Sweitzer, M., & Chelius, C. (2023). ***The prevalence of the "natural" claim on food product packaging***. (Report No. EB-35). U.S. Department of Agriculture, Economic Research Service.

You may also be interested in ...

Restrepo, B.J. (2022, February 4). ***Consumer information and labeling***. [Topic page]. U.S. Department of Agriculture, Economic Research Service.

Restrepo, B.J. (2022, February 4). ***Food labeling***. [Topic page]. U.S. Department of Agriculture, Economic Research Service.

Kuchler, F., Greene, C., Bowman, M., Marshall, K.K., Bovay, J., & Lynch, L. (2017). ***Beyond nutrition and organic labels—30 years of experience with intervening in food labels***. (Report No. ERR-239). U.S. Department of Agriculture, Economic Research Service.

USDA Economic Research Service
U.S. DEPARTMENT OF AGRICULTURE

farm to plate

U.S. Organic Markets in 2021

Blueberries, milk, and lettuce illustrate the journey of organic agriculture from farm to plate.

USDA Contribution

USDA began regulating organic agriculture in the early 2000s with the creation of the National Organic Program, which develops and enforces national standards for organically produced products sold in the United States. To help organic farmers, USDA provides cost-sharing assistance to producers obtaining or renewing organic certification, financial help through the Environmental Quality Incentives Program (EQIP), crop insurance options that better reflect prices producers receive, farm and business loans, market promotion, and research.

Farms

$223.6 million Blueberries

$275.6 million Lettuce

$1.6 billion Milk

Trade

Exports

$20.5 million Blueberries

$1.9 million Milk

$78.1 million Lettuce

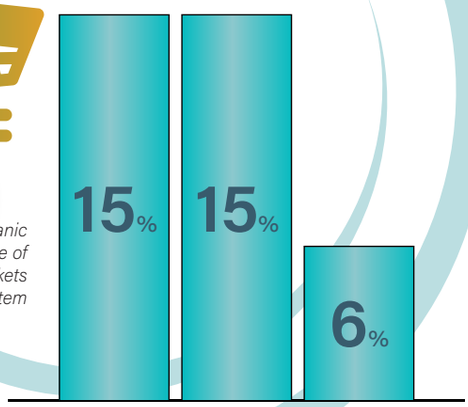
$415.2 million Blueberries

Imports

Consumers

Retail market shares

Organic sales share of total U.S. markets for each item



Summary

Consumer demand for organically produced foods has driven an expansion in U.S. organic production. In the past decade U.S. organic retail sales increased by an average of 8 percent per year. In 2021, organic retail sales were estimated to be more than $52 billion, about 5.5 percent of all retail food sales. U.S. farms and ranches sold nearly $11 billion in organic products in 2021. Imports also are helping to meet consumer demand. Organic milk, lettuce, and blueberries are just part of the story. Learn more at ers.usda.gov.

From USDA, Economic Research Service: Carlson, A., Greene, C., Raszap Skorbiansky, S., Hitaj, C., Ha, K.A., Cavigelli, M., Ferrier, P., & McBride, W.D. (2023). *U.S. organic production, markets, consumers, and policy, 2000–21.* (Report No. ERR-315). U.S. Department of Agriculture, Economic Research Service.

Source: USDA, Economic Research Service (ERS) using various data sources. For Farms data, USDA, National Agricultural Statistics Service's Organic Survey, 2021. For Trade data, U.S. Department of Commerce. For Consumers data, Nutrition Business Journal and ERS estimated market shares using data from OmniMarket Core Outlets (formerly InfoScan) acquired from Circana (formerly Information Resources, Inc. or IRI). Findings cannot be attributed to Circana. Data for all categories are from 2021. Milk in Farms data is milk from cows produced by certified operations. Milk in Trade data includes milk and cream, not concentrated nor sweetened, of a fat content, by weight, exceeding 1% but not exceeding 6%, certified organic. Milk in Consumers data includes whole, reduced-fat (2%), low-fat (1%), and skim (no-fat), both flavored and unflavored. Blueberries include cultivated and wild. Lettuce includes all lettuce varieties and does not include other greens such as cabbage, kale, and spinach.

SEPTEMBER **2023**

Children Were Only Age Group Improving Whole-Grain Intakes—School Foods Are a Key Factor

BY JOANNE GUTHRIE, BIING-HWAN LIN, AND TRAVIS A. SMITH

HIGHLIGHTS

- Between 1977–1978 and 2017–2018, whole-grain intake remained far below that of refined grains despite 2005 Federal recommendations that half of grains consumed be whole grains.
- Adults 65 years and above consistently consumed more whole-grain-dense diets from 1994–2018 than younger adults and children.
- Only children's diets were more whole-grain dense in 2013–2018 than in 1994–2010. This improvement coincided with implementation of updated school meal nutrition standards that required regular inclusion of whole-grain-rich foods.

Since 2005, the Federal Dietary Guidelines for Americans (DGA) have recommended that people eat at least half of their grain intake in the form of whole grains. Whole grains contain all parts of the grain kernel; the process of refining grains removes some portions that contain vitamins, minerals, and dietary fiber. In the United States, most refined grains are enriched with some vitamins (thiamin, riboflavin, niacin, and folic acid) and iron that are added at federally specified levels. Nevertheless, the DGA recommend whole grains as important sources of under-consumed nutrients such as zinc, magnesium, and dietary fiber. They also cite evidence of a relationship between whole-grain consumption among adults and reduced risk of some chronic health problems. Among children and adolescents, there is evidence of a reduced risk of obesity in adolescence and of cardiovascular disease in adulthood, although the expert committee that advised the Federal Government on the DGA judged that evidence to be limited.

Researchers at USDA, Economic Research Service and the University of Georgia used national food consumption survey data collected between 1994 and 2018, the most recent year for which such data were available, to assess whole-grain intakes of U.S. consumers and how they have changed over time (See "Measuring Trends in Whole-Grain Intakes" at end of this article.) The earliest DGA included general recommendations to eat whole-grain, fiber-rich foods, but the 2005 recommendations provided more specific advice. Recommended amounts were stated as "ounce equivalents"—the amount of whole grains found in a 1-ounce slice of whole-grain bread. Recommended consumption amounts are based on an individual's caloric intake. For example, the recommendation for a 2,000-calorie diet is 6 ounce equivalents of grains, with at least half being whole grains. Because caloric needs vary by age, gender, and physical activity, the researchers used a density measure (whole-grain ounce equivalents per 1,000 calories) based on a 2,000-calorie daily intake, the reference standard used for the Nutrition Facts panel on food labels. This results in a benchmark standard of 1.5 ounce equivalents of whole grains per 1,000 calories.

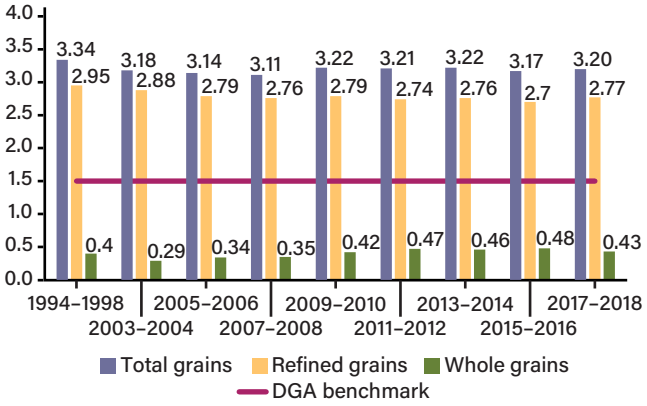
Imbalance Between Refined Grain and Whole-Grain Consumption

In 1994–98, total grain intake by U.S. residents 2 years old and over averaged 3.34 ounce equivalents per 1,000 calories, slightly above the benchmark of 3 ounce equivalents per 1,000 calories. Of this total, whole-grain intakes were 0.4 ounce equivalent per 1,000 calories, less than one-third the benchmark of 1.5 ounce equivalents. Refined grain intakes were roughly seven times higher. Public and private sector response to the 2005 DGA recommendation to balance whole- and refined-grain intakes included nutrition education and development or reformulation of products to include more whole grains. Notably, when Federal school nutrition policies were updated in 2012, meals served through the USDA National School Lunch (NSLP) and Breakfast (SBP) Programs were required to include foods rich in whole grains. New standards for snacks and other non-USDA foods sold at schools that participate in the NSLP also addressed whole-grain content.

Nevertheless, the disparity continued. Refined-grain intake was 2.77 ounce equivalents per 1,000 calories in 2017–18, while whole-grain intake was 0.43 ounce equivalents per 1,000 calories, essentially unchanged from 1994–98.

Balance of refined and whole grain consumption has narrowed only slightly since 2005 Federal recommendations

Ounce equivalents per 1,000 calories



Note: **DGA benchmark** is 1.5 ounce equivalents per 1,000 calories, the Dietary Guidelines for Americans benchmark for meeting whole-grain recommendations.

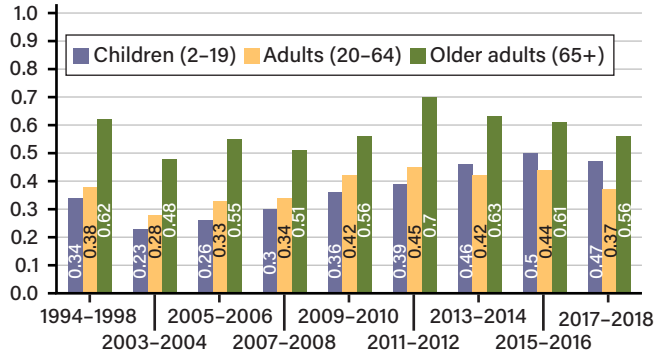
Source: USDA, Economic Research Service using data from USDA's 1994–96 and 1998 Continuing Survey of Food Intakes by Individuals and the continuous waves of What We Eat in America component of the National Health and Nutrition Examination Survey conducted by USDA and the U.S. Department of Health and Human Services during 2003–18.

Older Adults Consumed the Most Whole-Grain Dense Diets, But Only Children's Diets Saw an Increase

Compared with younger adults and children, older adults (65 years and above) consistently consumed more whole-grain dense diets. Even so, the whole-grain density of their diets was less than half the recommended level and was not significantly higher at the end of the period measured than it was at the beginning. Similarly, there was no significant difference in the whole-grain density of the diets of younger adults as of 2017–18 compared with 1994–98. Improvement occurred only among children. Starting in 2013–14, their diets were significantly more whole-grain dense than in earlier periods.

Children's diets showed a significant increase in whole-grain density after 2011–2012

Ounce equivalents per 1,000 calories



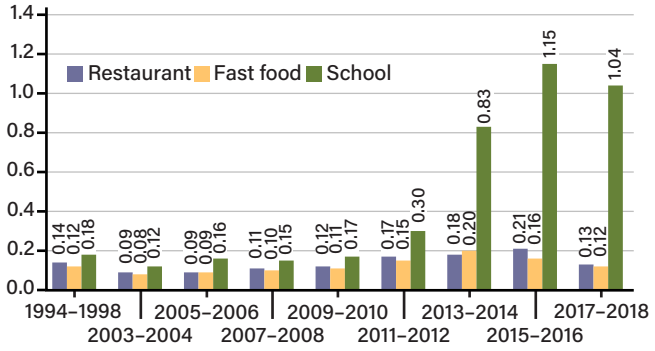
Source: USDA, Economic Research Service using data from USDA's 1994–96 and 1998 Continuing Survey of Food Intakes by Individuals and the continuous waves of What We Eat in America component of the National Health and Nutrition Examination Survey conducted by USDA and the U.S. Department of Health and Human Services during 2003–18.

Whole-Grain Content of School Foods Increased

Throughout the time studied, food prepared at home was more whole-grain dense than food prepared away from home, at least taken as a whole. But when researchers looked deeper into food prepared away from home, they found a considerable difference between foods obtained at school and other sources of foods prepared away from home. The difference widened after 2012, when changes in the nutrition standards for USDA school meals and other foods sold at schools established whole-grain requirements.

School food became significantly more whole-grain dense after 2012

Ounce equivalents per 1,000 calories



Source: USDA, Economic Research Service using data from USDA's 1994–96 and 1998 Continuing Survey of Food Intakes by Individuals and the continuous waves of What We Eat in America component of the National Health and Nutrition Examination Survey conducted by USDA and the U.S. Department of Health and Human Services during 2003–18.

After Change in Requirements, School Foods Played a Larger Role in Children's Whole Grain Intake

In this study, school foods are defined as foods obtained at school from USDA school meals or other foods, such as snacks, sold at school and not brought from home. The researchers first examined changes in the likelihood of children eating any whole grains from school food over the study period. They also examined changes in the amount of whole grains eaten from school food among those who ate any whole grain. For this analysis, amounts were expressed in terms of simple ounce equivalents, not per-calorie densities as in previous analyses. The child's age, gender, race and ethnicity, household income, and education of the household head were controlled for in both analyses of the probability and amount of whole grains consumed. Before 2012, fewer than 1 in 4 children eating school foods consumed whole grains as a part of those foods. After 2013, children eating school foods were more than twice as likely to consume whole grains from school. The estimated likelihood of eating whole grains from school food ranged from 0.48 to 0.58 between 2013 and 2018—that is, when students ate school foods, approximately one in every two students ate whole grains from school foods.

Moreover, those who ate whole grains as a part of the foods they obtained at schools ate them in larger amounts. Among children who ate whole grains when eating food obtained at school, their whole grain intakes from school foods were significantly higher in 2013–18 than in 1994–2010, with the amount more than doubling from 0.51 ounce equivalent to 1.20 ounce equivalents.

USDA began requiring inclusion of whole-grain-rich foods in school foods in 2012

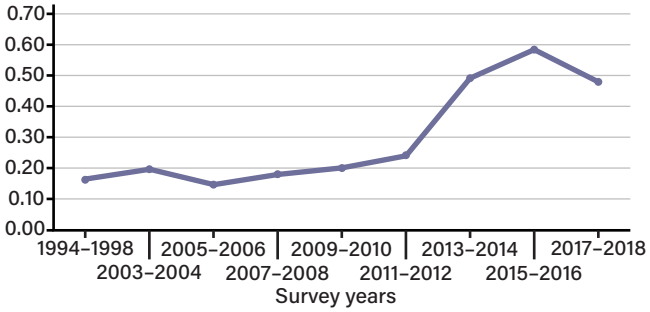
Before 2012	No requirement for whole grains.
2012–13	Grain offerings in National School Lunch Program (NSLP) lunches must be at least 50 percent whole grains (whole-grain rich).
2013–14	At least one-half of all grain offerings in School Breakfast Program (SBP) breakfasts must be whole-grain rich.
2014–15	For both NSLP lunches and SBP breakfasts, all grain offerings should be whole-grain rich.
2014–15	At all USDA school meal participating schools, non-USDA foods sold (such as from snack bars and vending machines) that were primarily grain were required to be at least 50-percent whole grain or have whole grain listed as the first ingredient.
2017–18	State agencies were allowed to exempt local school foodservices from serving specific whole-grain products if the foodservices found it difficult to procure acceptable products. However, it was required that at least half the grain products the foodservices offered as part of USDA meals be whole-grain rich.
2018–19	The rule on menu planning flexibilities set a requirement for whole-grain-rich offerings for lunches and breakfasts at 50 percent of all grain offerings.

Note: Dates are for school years.

Source: USDA, Economic Research Service using information from USDA, Food and Nutrition Service (FNS), National School Lunch Program and School Breakfast Program: Nutrition Standards in the National School Lunch and School Breakfast Programs, Federal Register, 2012; FNS, National School Lunch Program and School Breakfast Program: Nutrition Standards for All Foods Sold in School as Required by the Healthy, Hunger-Free Kids Act of 2010, Federal Register, 2016; FNS, Child Nutrition Programs: Flexibilities for Milk, Whole Grains, and Sodium Requirements: Interim Final Rule, Federal Register, 2017; FNS, Child Nutrition Programs: Flexibilities for Milk, Whole Grains, and Sodium Requirements: Final Rule, Federal Register, 2018.

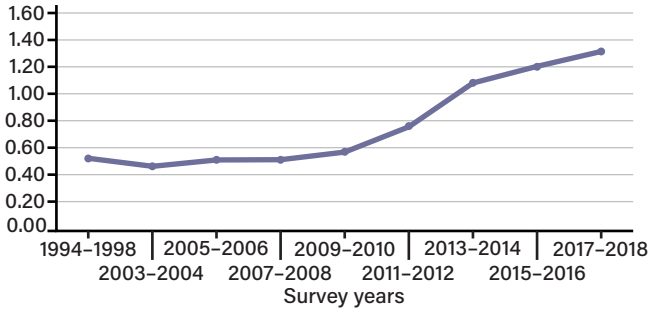
After 2012, children who ate school-provided foods were more likely to consume whole grains

Probability of consuming whole grains from school foods



Children who ate whole grains as a part of school-provided foods consumed larger amounts of them

Ounce equivalents



Source: USDA, Economic Research Service using data from USDA's 1994–96 and 1998 Continuing Survey of Food Intakes by Individuals and the continuous waves of What We Eat in America component of the National Health and Nutrition Examination Survey conducted by USDA and the U.S. Department of Health and Human Services during 2003–18.

Overall trends indicate grain intakes continue to be unbalanced, with more refined grains than recommended and fewer whole grains than recommended being consumed. Even so, children's diets have shown improvement in whole-grain density after 2012. Changes in foods obtained at school coinciding with USDA's requirement to include whole-grain-rich foods in school meals seem to have played an important role.

Measuring Trends in Whole-Grain Intakes

Using nationally representative food consumption survey data spanning 1994–2018, researchers at USDA, Economic Research Service and the University of Georgia examined trends in whole-grain consumption for the U.S. population as a whole and for three age groups: older adults (65 years and above), younger adults (20–64 years), and children 2–19 years old. The data include the USDA's 1994–96 and 1998 Continuing Survey of Food Intakes by Individuals (CSFII) and the continuous waves of the What We Eat in America component of the National Health and Nutrition Examination Survey (WWEIA/NHANES) conducted by USDA and the U.S. Department of Health and Human Services over 2003–18. The researchers also examined differences associated with where food was obtained. They compared food obtained at grocery stores and other retailers for home preparation (food at home, or FAH) with food prepared away from home (FAFH) at full-service restaurants, fast-food establishments, and for children at schools and daycare sites.

CITATIONS

This article is drawn from ...

Lin, B., Smith, T.A., & Guthrie, J. (2023). *Trends in U.S. whole-grain intakes 1994–2018: The roles of age, food source, and school food.* (Report No. ERR-311). U.S. Department of Agriculture, Economic Research Service.

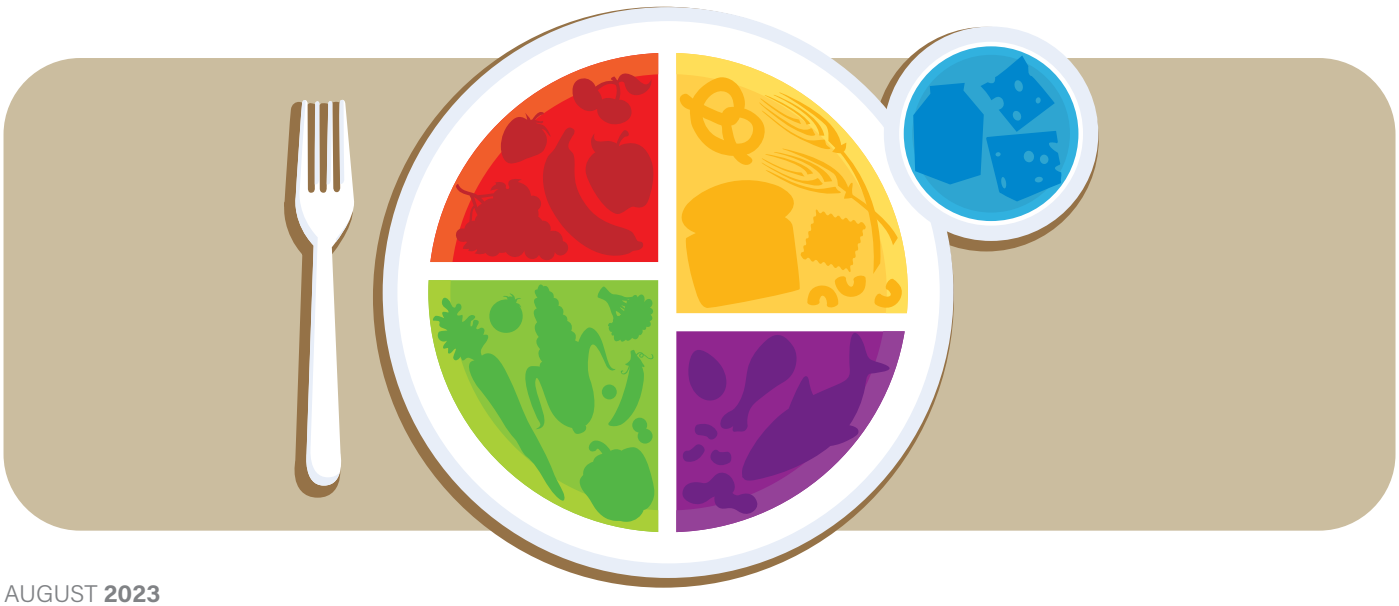
You may also be interested in ...

Lin, B., Guthrie, J., & Smith, T.A. (2023). *Dietary quality by food source and demographics in the United States, 1977–2018.* (Report No. EIB-249). U.S. Department of Agriculture, Economic Research Service.

Guthrie, J. (2021, May 3). USDA school meals support food security and good nutrition. ***Amber Waves***, U.S. Department of Agriculture, Economic Research Service.

Guthrie, J., Lin, B., Smith, T.A. (2020, February 3). Schoolchildren consumed more whole grains following change in school meals standards. ***Amber Waves***, U.S. Department of Agriculture, Economic Research Service.

Guthrie, J., Lin, B., & Smith, T.A. (2016, June 6). Linking federal food intake surveys provides a more accurate look at eating out trends. ***Amber Waves***, U.S. Department of Agriculture, Economic Research Service.



AUGUST **2023**

U.S. Food and Nutrition Assistance Programs Continued To Respond to Economic and Public Health Conditions in Fiscal Year 2022

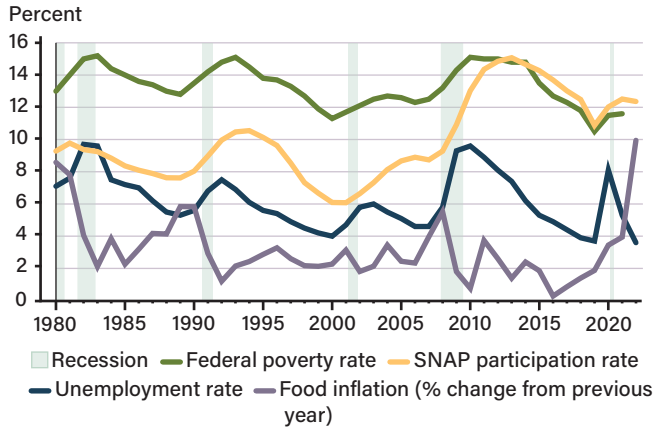
BY JORDAN W. JONES AND SAIED TOOSSI

Economic conditions and other factors affect spending on USDA's food and nutrition assistance programs by influencing the portion of the population that is eligible to participate, rates of participation, and benefit levels. Because these programs are means-tested, the portion of the population that is eligible to participate increases during economic downturns—when unemployment rates rise and incomes fall —as does the participation rate and the size of benefits for which participants are eligible. The Supplemental Nutrition Assistance Program (SNAP) provides low-income households with additional resources to buy food and reaches tens of millions of people each month. As one of the Nation's primary countercyclical programs, SNAP expands during economic downturns and contracts during periods of growth. Historically, the SNAP participation rate tends to track the unemployment and poverty rates.

HIGHLIGHTS

- Economic conditions and other factors affect spending on USDA's food and nutrition assistance programs by influencing the portion of the population that is eligible to participate, rates of participation, and benefit levels.
- In some ways, fiscal year (FY) 2022 marked a return to prepandemic operations for the largest food and nutrition assistance programs. However, new challenges also emerged, such as rising food inflation and infant formula shortages.
- Annual spending on food and nutrition assistance in FY 2022 fell to $183.0 billion from the record high total spending in FY 2021.

Economic conditions influence SNAP participation



Note: **SNAP** = Supplemental Nutrition Assistance Program. Measures shown are for calendar years, except SNAP participation, which is measured by fiscal year. SNAP participation is based on preliminary data from the October 2022 Program Information Report (Keydata) released by USDA, Food and Nutrition Service (FNS) in January 2023 and the September 2022 Keydata released in December 2022. Recessions represented: January–July 1980; July 1981–November 1982, July 1990–March 1991, March–November 2001, December 2007–June 2009, and February–April 2020.

Source: USDA, Economic Research Service using data from USDA, Food and Nutrition Service; U.S. Department of Labor, U.S. Bureau of Labor Statistics; and U.S. Department of Commerce, Bureau of the Census.

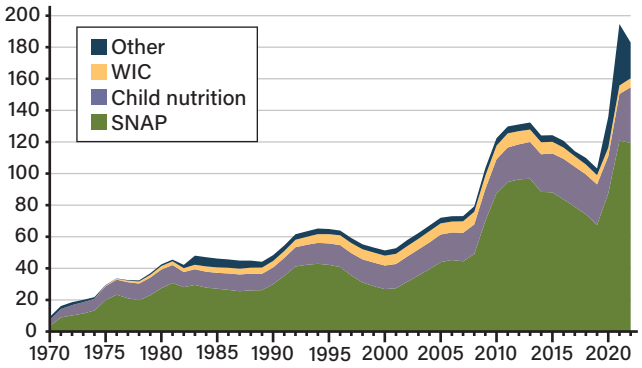
The Coronavirus (COVID-19) pandemic and related shutdowns, beginning in March 2020, disrupted businesses' regular operations and contributed to an economic recession characterized by a spike in the unemployment rate from 4.4 percent in March 2020 to 14.7 percent in April 2020. Compared with previous downturns, the 2020 recession was short-lived, and by 2022, the unemployment rate had fallen to lower than it was in 2019. However, the pandemic disrupted daily life and the overall economy in many unique ways. For example, many parts of the United States implemented limitations on indoor gatherings to curtail the virus' spread, and supply-chain disruptions affected industries across the economy. Additionally, food inflation grew modestly during the 2020 recession and then sharply increased in 2021. Annual food inflation reached 9.9 percent and overall inflation reached 8.0 percent in 2022, the highest annual increases in prices since the recessionary period of the early 1980s.

In response to the economic and public health conditions created by the pandemic, the Federal Government expanded USDA's existing food and nutrition assistance programs and adjusted program operations to protect the health and safety of program participants and staff. In addition to SNAP, the largest food and nutrition assistance programs administered by USDA include the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), the National School Lunch Program (NSLP), the School Breakfast Program (SBP), and the Child and Adult Care Food Program (CACFP). WIC provides supplemental food packages and other support to pregnant and postpartum women as well as infants and children up to age 5 who are at nutritional risk and living in low-income households. USDA's child nutrition programs, including the NSLP, SBP, and CACFP, provide nutritious meals and snacks at low or no cost to children in participating schools and childcare providers. Federal action in 2020 authorized USDA to create the Pandemic Electronic Benefit Transfer (P-EBT) program, which reimburses eligible families for the value of school meals their children missed because of the pandemic.

Annual USDA food and nutrition assistance spending rose during the pandemic, reaching a record high of $183.3 billion in fiscal year (FY) 2021. Adjusted to 2022 dollars, FY 2021 spending totaled $194.7 billion. Spending in FY 2022 fell to $183.0 billion, though this amount was still 38 percent above the prepandemic inflation-adjusted high in FY 2013.

Federal food and nutrition assistance spending fell in FY 2022, but remained higher than in prepandemic years

2022 dollars (billions)



Note: **FY** = fiscal year. **WIC** = Special Supplemental Nutrition Program for Women, Infants, and Children. **SNAP** = Supplemental Nutrition Assistance Program. **Child nutrition** = National School Lunch Program, School Breakfast Program, Special Milk Program, related commodity costs, Child and Adult Care Food Program, and Summer Food Service Program. Spending levels based on historical program data released by USDA, Food and Nutrition Service (FNS) in January 2023 and total spending data from the October 2022 Program Information Report (Keydata) released by FNS in January 2023 and the September 2022 Keydata released in December 2022. Data are supplemented by information on Seamless Summer Option earnings and other child nutrition costs provided by FNS as of January 2023. Spending is in 2022 dollars, adjusted using the Personal Consumption Expenditures price index, U.S. Department of Commerce, Bureau of Economic Analysis.

Source: USDA, Economic Research Service using data from USDA, Food and Nutrition Service and USDA, Agricultural Marketing Service.

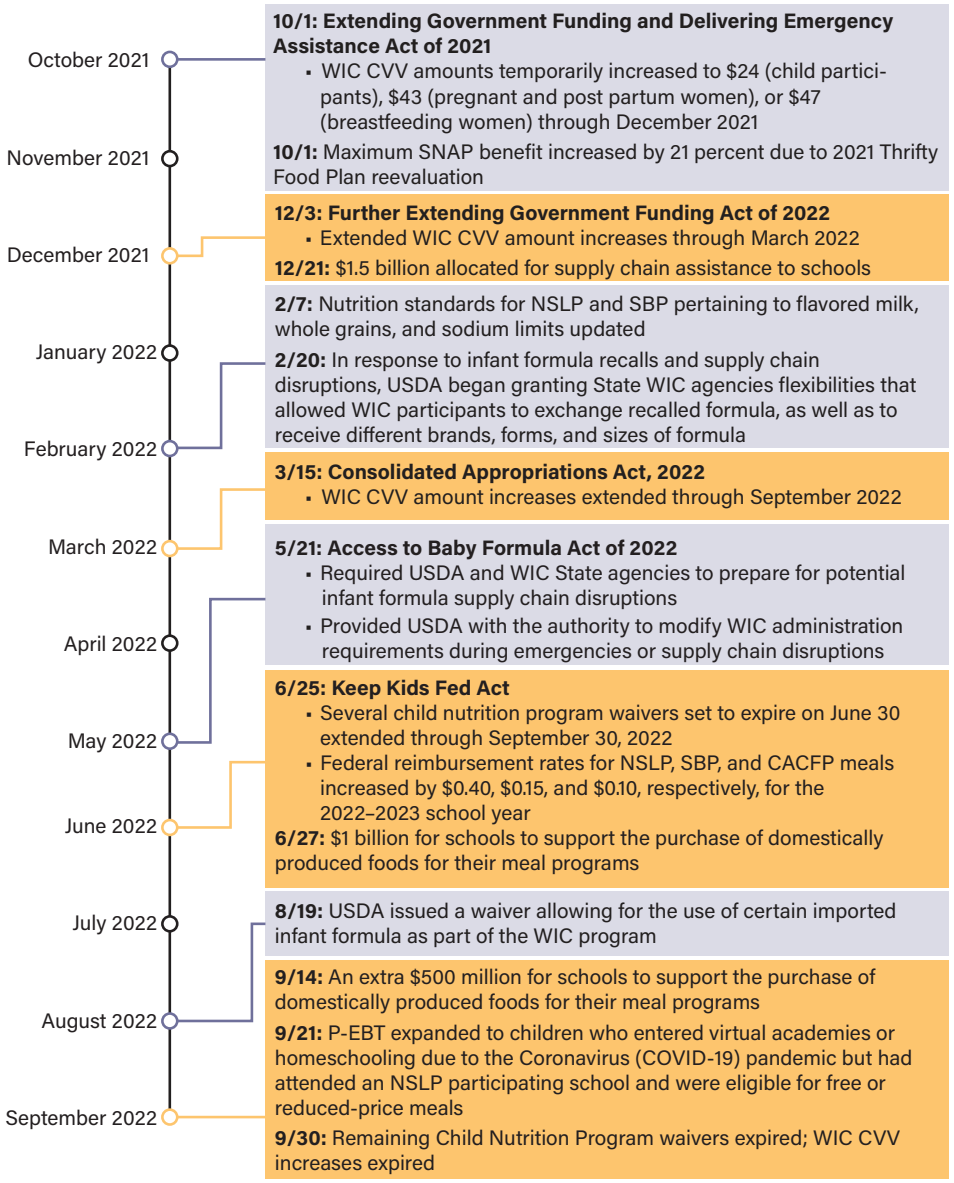
Food and Nutrition Assistance Policy Developments in FY 2022

In response to the pandemic, Congress passed legislation throughout FY 2020 and 2021 that affected the operations of USDA's food and nutrition assistance programs. Those bills included the Families First Coronavirus Response Act (FFCRA); the Coronavirus Aid, Relief, and Economic Security (CARES) Act; the Continuing Appropriations Act, 2021 and Other Extensions Act; the Consolidated Appropriations Act, 2021; and the American Rescue Plan Act (ARPA). During this period, USDA authorized increases in SNAP benefits and suspended work-related time limits on SNAP receipt for some adults. WIC appropriations were increased, and the WIC cash value voucher (CVV) benefit for fruits and vegetables was temporarily raised. USDA was given the authority to launch P-EBT and expand the size and scope of its summer meal programs targeting children. USDA relaxed several program requirements, allowing for greater flexibility in the operation of SNAP, WIC, and the child nutrition programs.

Food and nutrition assistance policy continued to develop in FY

2022 in response to the pandemic as well as new challenges, such as rising inflation and infant formula shortages. Major policy changes included changes in the amount of the WIC cash value voucher, as well as a permanent increase in the maximum SNAP benefit following the 2021 Thrifty Food Plan reevaluation. P-EBT was expanded to cover more children, and extra funding was allocated to support school meal programs. By the end of FY 2022, the temporary WIC cash value voucher benefit increases had expired (but were extended again in FY 2023), and the child nutrition programs returned to prepandemic Federal rules and guidelines.

Timeline of Federal food and nutrition assistance policy developments, FY 2022



Note: **WIC** = Special Supplemental Nutrition Program for Women, Infants, and Children. **CVV** = Cash Value Voucher. **SNAP** = Supplemental Nutrition Assistance Program. **NSLP** = National School Lunch Program. **SBP** = School Breakfast Program. **CACFP** = Child and Adult Care Food Program. **P-EBT** = Pandemic Electronic Benefit Transfer.

Source: USDA, Economic Research Service using information from USDA, Food and Nutrition Service.

SNAP Spending and Participation Down Slightly in FY 2022 after FY 2020–21 Increases

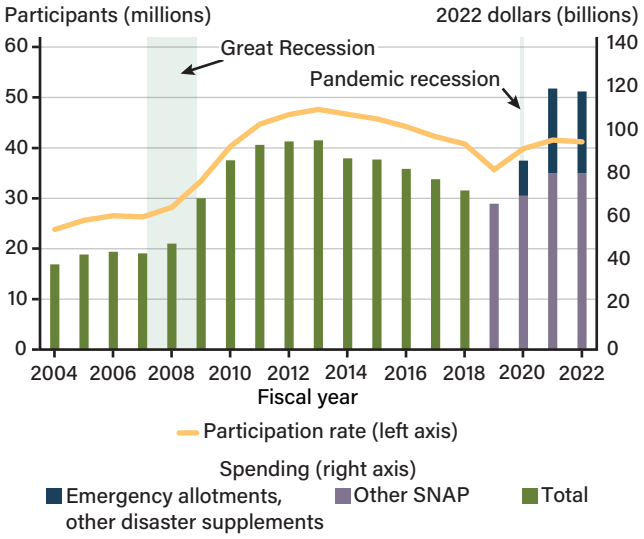
As a countercyclical program, SNAP participation tends to rise with increases in unemployment and poverty. However, decreases in participation can lag reductions in unemployment during the early stages of an economic recovery. Because SNAP is also an entitlement program, spending on benefits increases directly with participation.

Average monthly SNAP participation increased for a period after the start of the Great Recession in December 2007, as it did after the start of the short recession in February 2020 related to the COVID-19 pandemic. These periods of program growth, however, differ significantly from each other. The increase in participation after the Great Recession was much larger and longer lasting, reflecting the length and depth of that economic downturn. Participation increased for 6 consecutive years, from 26.3 million participants in FY 2007, before the recession, to 47.6 million in FY 2013. This represents an average increase of 13.5 percent per year. Adjusted for inflation to 2022 dollars, SNAP spending increased over this period from $44.5 billion in FY 2007 to $96.9 billion in FY 2013, an average 19.6 percent increase per year.

In contrast, the pandemic-related recession was concentrated over a shorter period. Accordingly, SNAP participation increased less overall and for a shorter period compared to the Great Recession. Participation increased from 35.7 million in FY 2019 to a peak of 41.6 million in FY 2021, an average 8.2 percent increase per year. Participation then fell slightly to 41.2 million in FY 2022. However, SNAP spending rose more quickly given the shorter

time span. Adjusted for inflation to 2022 dollars, spending on SNAP rose from $67.5 billion in FY 2019 to $120.8 billion in FY 2021, an average increase of 39.5 percent per year. Spending fell in FY 2022 to $119.5 billion.

SNAP spending rose higher, faster after start of pandemic than after start of Great Recession



Note: **SNAP** = Supplemental Nutrition Assistance Program. Based on preliminary data from the October 2022 Program Information Report (Keydata) released by USDA, Food and Nutrition Service (FNS) in January 2023 and the September 2022 Keydata released by FNS in December 2022. SNAP participation counts shown in this chart include only regular ongoing SNAP participation. **Emergency allotments and other disaster supplements spending** includes emergency allotments (which made up almost all the disaster supplements issued to ongoing SNAP recipient households in fiscal years 2020–22) and other minor disaster supplements. **Other SNAP spending** includes regular ongoing benefits, Disaster SNAP new participation, replacements, administrative expenses, and other costs. Spending is noted in billions of 2022 dollars, adjusted using the Personal Consumption Expenditures price index, U.S. Department of Commerce, Bureau of Economic Analysis.

Source: USDA, Economic Research Service using data from USDA, Food and Nutrition Service.

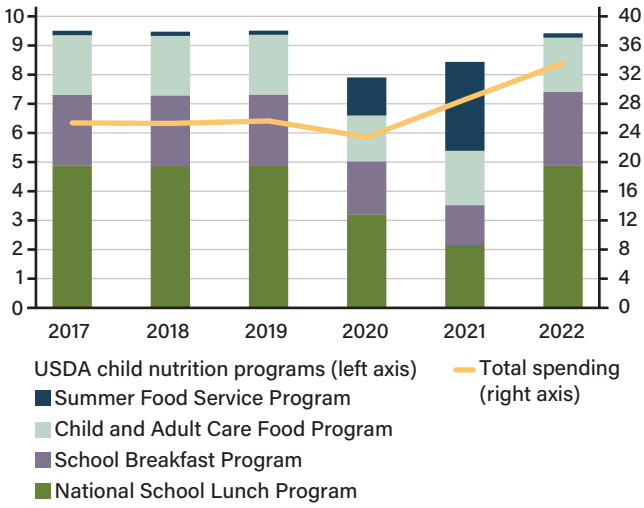
Why did SNAP spending increase more quickly after the pandemic's onset, compared with the Great Recession, given the smaller increase in participation? The maximum allotment was increased during both periods but by different amounts: by 13.6 percent from April 2009 to November 2013, by 15 percent from January 2021 to September 2021, and by about 21 percent, permanently, beginning in October 2021. Additionally, emergency allotments were central to the spending growth during the pandemic. Emergency allotments were issued as monthly disaster supplements starting in March, April, or May 2020, depending on the State. These supplements brought all recipient households' benefits to the maximum allowed each month and later provided a minimum $95 in extra benefits. In FY 2021, inflation-adjusted disaster supplements accounted for $39.2 billion, almost a third of total spending. Without disaster supplements, total spending would have been $81.6 billion in FY 2021, about $15 billion less than FY 2013 spending, adjusting for inflation. Emergency allotments were phased out in 17 States over FY 2021–22 and in the remaining States in January and February 2023.

Number of Meals Served Through Child Nutrition Programs Returns to Prepandemic Level

The Families First Coronavirus Response Act allowed USDA to issue nationwide waivers of child nutrition program requirements in response to pandemic disruptions to in-person education and childcare. One set of waivers expanded the scope and coverage of the Summer Food Service Program (SFSP) and the NSLP and SBP's Seamless Summer Option (SSO). Typically, these programs allow qualifying organizations to provide free meals to children when schools are not in session in areas or sites where at least half of children live in households with income less than 185 percent of the Federal poverty level. USDA waived these requirements, allowing the provision of free meals in all areas, regardless of income, throughout the year.

One important difference between the SFSP and SSO is that meals served through the SFSP receive higher Federal reimbursements than those served through the SSO, which are reimbursed at the same rates as for the NSLP and SBP. As such, in FY 2021, most schools opted to serve meals through the SFSP, making it one of the largest child nutrition programs that year. This changed in July 2021, when USDA allowed SSO meals to be reimbursed at the higher SFSP rates. As a result, most meals were served through the NSLP and SBP's Seamless Summer Option in FY 2022. The number of meals served through the Child and Adult Care Food Program (CACFP) in FY 2022 was about the same as in FY 2021 and FY 2019.

USDA's School Breakfast Program and National School Lunch Program once again served the most meals in FY 2022



Note: **FY** = fiscal year. Based on preliminary data from the October 2022 Program Information Report (Keydata) released by USDA, Food and Nutrition Service (FNS) in January 2023 and the September 2022 Keydata released in December 2022, supplemented by additional information on Seamless Summer Option earnings and other child nutrition costs provided by FNS as of January 2023. Spending is noted in 2022 dollars, adjusted using the Personal Consumption Expenditures price index, U.S. Department of Commerce, Bureau of Economic Analysis.

Source: USDA, Economic Research Service, using data from USDA, Food and Nutrition Service.

Most child nutrition program waivers—including the waiver allowing for higher reimbursements for SSO meals—expired at the end of June 2022. In anticipation of the waivers' expiration, Congress passed the Keep Kids Fed Act in the same month. This legislation increased Federal reimbursements for NSLP, SBP, and CACFP meals and extended some of the waivers—such as the waiver allowing SFSP to operate in all areas—through September 2022.

The number of meals served through the NSLP, SBP, CACFP, and SFSP increased to 9.4 billion in FY 2022 from 8.4 billion in FY 2021 and 7.9 billion in FY 2020 and was about the same as the number served before the pandemic in FY 2019. The larger number of meals served, higher reimbursement rates for meals, and the fact that nearly all meals were served for free in FY 2022 translated to higher spending across all four programs. Total spending on the four programs rose to $33.6 billion in FY 2022 from $28.6 billion in FY 2021, adjusted for inflation.

WIC Program Challenged by Infant Formula Recall in FY 2022

State WIC agencies continued to use waivers in FY 2022 that allowed for flexibilities in WIC services during the pandemic. These waivers, first issued in FY 2020, allowed for alternative modes of service delivery (such as remote certification and recertification) and deferrals of medical documentation requirements for applicants. They also allowed for food package substitutions to accommodate supply chain disruptions that had led to shortages of some foods.

These disruptions intensified in February 2022 because of an infant formula recall prompted by evidence of a bacteria at a major infant formula manufacturer's facility that may have been harmful to infants if present in formula and the subsequent shutdown of the facility. In response, USDA issued new waivers in FY 2022 that allowed WIC participants to exchange recalled formula, as well as to receive different brands (including certain imported formulas) of formula, forms of formula, and sizes of formula containers.

WIC's cash value voucher (CVV), which provides a fixed dollar amount that can be used to buy a variety of fruits and vegetables, was also revised in FY 2022. In FY 2021, the American Rescue Plan Act gave States the option to increase the CVV benefit to a maximum of $35 per participant for up to 4 months through September 2021. Beginning in October 2022 and extended through the end of FY 2022, the voucher amounts were changed to $24 for children, $43 for pregnant or postpartum participants, and $47 for breastfeeding women. Federal spending on the program totaled $5.7 billion in FY 2022, higher than the $5.4 billion spent in FY 2021, adjusted for inflation. This reflects an increase in monthly WIC food package costs per person to $47.72, up 26 percent from FY 2021, adjusted for inflation.

Spending on Pandemic Electronic Benefit (P-EBT) Program Declined in FY 2022

The Families First Coronavirus Response Act also authorized USDA to create the temporary P-EBT program to reimburse eligible families for the value of school meals missed because of pandemic-related disruptions to school operations. States proposed plans to provide P-EBT benefits on different timelines, which USDA then approved. Some States issued benefits in a lump sum to cover an entire period of missed meals, and others issued multiple smaller payments.

The Federal Government expanded P-EBT several times in FY 2021 and FY 2022. In October 2020, P-EBT was expanded to include eligible children under age 6 and to operate in Puerto Rico, the Northern Mariana Islands, and American Samoa. In January 2021, the program's benefits were increased about 15 percent to include the value of school snacks. In March 2021, the American Rescue Plan Act authorized the P-EBT program to cover the summer months and operate in any future school year with a COVID-19 public health emergency declaration in place. In September 2022, the program was expanded again to include eligible children who entered virtual academies or homeschooling because of the pandemic but who previously had attended an NSLP participating school. Spending on the program amounted to $17.9 billion in FY 2022, down 41 percent from $30.2 billion in FY 2021, adjusted for inflation.

U.S. Food and Nutrition Assistance Changes Continue in FY 2023

U.S. food and nutrition assistance programs continued to develop in FY 2023. The Consolidated Appropriations Act, 2023, ended SNAP emergency allotments after February 2023 benefits were issued. Emergency allotments were initially slated to expire one month after the expiration of the Federal public health emergency. The act also established a permanent Summer Electronic Benefit Transfer (Summer EBT) program, which would issue benefits redeemable for food to families with eligible children during the summer months when regular school meals are not available. P-EBT will end in September 2023. Several States adopted legislation providing free school meals to all students. USDA, Economic Research Service researchers will continue to track how these and other changes affect the domestic food and nutrition assistance landscape.

SM
SNAP Supplemental Nutrition Assistance Program

CITATIONS

This article is drawn from ...

Toossi, S., & Jones, J.W. (2023). ***The food and nutrition assistance landscape: Fiscal year 2022 annual report.*** (EIB-255). U.S. Department of Agriculture, Economic Research Service.

You may also be interested in ...

Toossi, S., Jones, J.W., & Hodges, L. (2022, September 6). Pandemic-related program changes continued to shape the U.S. food and nutrition assistance landscape in fiscal year 2021. ***Amber Waves***, U.S. Department of Agriculture, Economic Research Service.

Jones, J.W., Toossi, S., & Hodges, L. (2022). ***The food and nutrition assistance landscape: Fiscal year 2021 annual report.*** (Report No. EIB-237). U.S. Department of Agriculture, Economic Research Service.

Hodges, L., Jones, J.W., & Toossi, S. (2021, October 4). Coronavirus (COVID-19) pandemic transformed the U.S. federal food and nutrition assistance landscape. ***Amber Waves***, U.S. Department of Agriculture, Economic Research Service.

Toossi, S., Jones, J.W., & Hodges, L. (2021). ***The food and nutrition assistance landscape: Fiscal year 2020 annual report.*** (Report No. EIB-227). U.S. Department of Agriculture, Economic Research Service.

Toossi, S. (2023). ***Cost of school meals and households' difficulty paying for expenses: Evidence from the Household Pulse Survey.*** (Report No. EB-37). U.S. Department of Agriculture, Economic Research Service.

U.S. Department of Agriculture, Economic Research Service. (2023, April 10). ***Food & nutrition assistance.*** [Topic page].

JUNE **2023**

Climate Change Projected To Increase Costs of U.S. *Vibrio* Infections

BY SANDRA HOFFMANN, MEGAN SHEAHAN, CAITLIN A. GOULD, AND MICHAEL KOLIAN

Vibrio are bacteria that thrive in brackish and marine waters. In the United States, *Vibrio* are found in coastal areas and are most prevalent in the summer, when waters are warm. Many *Vibrio* species can cause human illness through foodborne and waterborne exposure. Foodborne exposure typically occurs from eating raw or undercooked seafood. *Vibrio* exposure may cause mild vomiting, diarrhea, swimmer's ear, or skin infections. However, it can also result in rare but more serious outcomes like sepsis, amputations, and death.

Climate change is expected to expand the range and season of *Vibrio* infections as sea surface temperatures become warmer. There is evidence this already may be happening. In 2004, a *Vibrio* outbreak occurred in Alaska, more than 600 miles north of any previously recorded. Once rare in Oregon and Washington, infections now regularly occur there.

Researchers from USDA's Economic Research Service (ERS), U.S. Environmental Protection Agency (EPA), and the private consulting firm Industrial Economics Inc. (IEc) recently used data on sea surface temperatures and non-cholera *Vibrio* infection surveillance data to project how much climate change could increase the incidence of these infections in the United States. ERS' per-case cost estimates of foodborne illnesses were used to project the costs of additional illnesses, including:

- medical or treatment costs,
- productivity losses (the value of time affected by illness),
- and the value of premature deaths (an economic measure of the impact of deaths).

The International Panel on Climate Change has adopted a set of Representative Concentration Pathways (RCPs) for modeling the effects of climate change, including increased

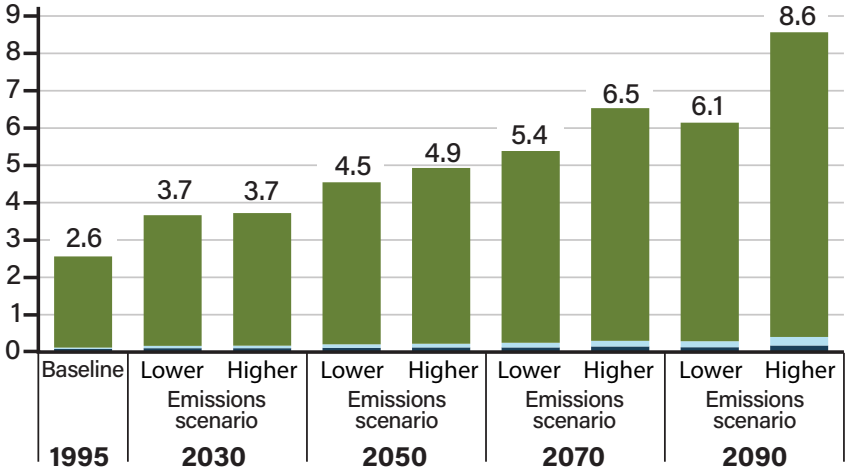
sea surface temperature. The measure RCP4.5 represents a moderate increase in greenhouse gas concentrations, and RCP8.5 denotes concentrations expected from unmitigated climate change.

Results show that U.S. cases of illness from non-cholera *Vibrio* infections may increase 50 percent by 2090 relative to 1995 because of higher sea surface temperatures associated with moderate increases in greenhouse gas concentrations and by more than 100 percent if global warming is not mitigated. Annual total cost of these illnesses more than doubles from nearly $2.6 billion in 1995 to $6.1 billion in 2090 (in 2022 dollars) under the lower emissions scenario (RCP4.5) and more than triples to nearly $8.6 billion under the higher emissions scenario (RCP8.5). Across both scenarios, about 95 percent of total costs are attributable to deaths caused by *Vibrio* infections.

Vibrio are only one type of pathogen whose impacts are likely to intensify in the 21st century because of climate change. This study is an example of how bioeconomic modeling can provide information to decisionmakers about potential climate change impacts.

Projected costs from *Vibrio* infections in the United States grow as surface temperatures rise

2022 U.S. dollars (billions)



Major costs associated with *Vibrio* infections

Direct medical costs Indirect productivity losses Premature mortality

Note: **Baseline** represents estimated costs of *Vibrio* infections in the United States in 1995. The International Panel on Climate Change measures greenhouse gas emissions scenarios using Representative Concentration Pathways (RCPs). **Lower emissions scenario** refers to RCP4.5, and **higher emissions scenario** refers to RCP8.5.

Source: USDA, Economic Research Service using data from "Examining the Relationship between Climate Change and Vibriosis in the United States: Projected Health and Economic Impacts for the 21st Century," Environmental Health Perspectives, 2022.

CITATIONS

This article is drawn from ...

Sheahan, M., Gould, C., Neumann, J., Kinney, P., Hoffmann, S., Fant, C., Wang, X., & Kolian, M. (2022). Examining the relationship between climate change and vibriosis in the United States: Projected health and economic impacts for the 21st century. *Environmental Health Perspectives*, 130(8): 087007.

You may also be interested in ...

Hoffmann, S. (2023). ***Cost estimates of foodborne illnesses.*** [Data product]. U.S. Department of Agriculture, Economic Research Service.

Hoffmann, S., & Ollinger, M. (2021, January 25). ***Food safety.*** [Topic page]. U.S. Department of Agriculture, Economic Research Service.

Markets *and* Trade

FEBRUARY **2023**

Declining Crop Prices, Rising Production and Exports Highlight U.S. Agricultural Projections to 2032

BY BRIAN WILLIAMS, ERIK DOHLMAN, AND MATTHEW MILLER

HIGHLIGHTS

- Corn, soybean, and upland cotton production and exports through 2032/33 are expected to approach or exceed record levels.
- U.S. crop prices are projected to decline in the next 3 years and then generally stabilize.
- Production and exports of beef, chicken, and pork are projected to increase over the next 10 years.
- Beef and chicken prices are projected to remain elevated, while hog prices are expected to fall.

Global economic and market conditions continue to challenge U.S. crop and livestock farming. Inflation, extreme weather events, supply chain disruptions, high input costs, and Russia's war against Ukraine have pushed commodity prices above historic trends. The situation in Ukraine has affected wheat and corn markets in particular. These conditions set the stage for the long-term outlook for U.S. and global supply, demand, and trade for major field crops (corn, soybeans, wheat, and upland cotton) and major meats (beef, pork, poultry), key commodities for gauging the performance of the U.S. farm sector.

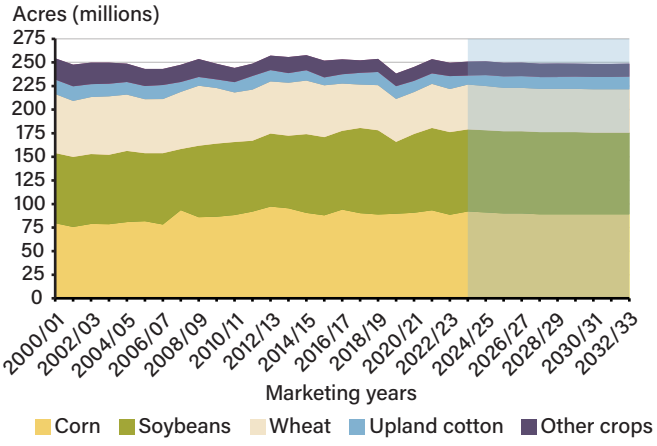
Each year in its Agricultural Baseline Projections, USDA provides a 10-year outlook for major crop and livestock commodities based on key assumptions related to macroeconomic conditions, U.S. policy, and existing international agreements. The data include agricultural production, trade, and domestic demand projections. Projections are made assuming normal or "average" weather (without extreme weather events) and use data available as of the October 2022 World Agricultural Supply and Demand Estimates (WASDE) report and are not updated to reflect subsequent revisions (see "Making Sense of USDA Forecasts and Projections" at the end of this article).

These projections, popularly referred to as the "Baseline," are critical for supporting estimates of farm program spending under the President's budget released each year by the U.S. Office of Management and Budget. In addition, the projections can be used in crop planning and investment decisions, as well as domestic and international business decisions throughout the agribusiness supply chain. For crops, the projections begin with marketing year 2023/24 and end at 2032/33. Livestock Baseline projections start with the 2024 calendar year and end in 2032. Overall, the 2023 Baseline projections offer a mixed picture for the various commodities reflecting longer term underlying trends, including income and population growth, yield growth, domestic and foreign land allocation, and dietary preferences.

Overall U.S. Crop Area Is Expected To Remain Steady Through 2032

Despite rising prices for farm commodities, the total area planted to the eight major field crops (barley, corn, cotton, oats, rice, sorghum, soybeans, and wheat) dipped to 249.5 million acres in marketing year 2022/23 from 253.4 million acres in 2021/22 largely because of an increase in weather-related prevented plantings in 2022/23. Changes in planted acreage were led by the largest four crops—corn, soybeans, wheat, and upland cotton—which combined for more than 94 percent of the eight-crop total in 2022/23. Based on the market conditions that existed with the October WASDE, the area planted to corn is projected to rise by 3.4 million acres in 2023/24 to 92.0 million acres before tapering to 89.0 million acres by 2032/33. Soybean acreage is projected to decrease from 87.0 million in 2023/24 to 86.5 million acres by 2032/33.

U.S. planted acreage projected to continue with levels of last 20 years



Notes: **Other crops** includes barley, oats, rice, and sorghum. The shaded area on the right represents the USDA's Agricultural Baseline Projection period.

Source: USDA, Economic Research Service using projections from the USDA, Office of the Chief Economist, the World Agricultural Outlook Board, and the Interagency Agricultural Projections Committee. Data are as of November 7, 2022, and are subject to revision.

Higher prices resulting from uncertainty over global wheat production and trade are projected to result in a 4-percent increase (1.8 million acres) in U.S. wheat area planted in 2023/24 to 47.5 million acres. The area planted to wheat is then projected to decline to 46.0 million acres by 2025/26 and then remain steady until 2032/33.

A decline in upland cotton prices combined with relatively favorable prices for corn—a crop often planted in rotation with cotton—is expected to result in a drop in upland cotton area planted to 9.5 million acres in 2023/24, down from 13.6 million acres planted in 2022/23 and among the lowest since 1960. The area planted to upland cotton—the dominant variety grown in the United States—is projected to recover and grow steadily after that as the global economy improves, ending with 13.3 million acres in 2032/33.

For corn, soybeans, and wheat, yields are expected to increase at rates consistent with historic trends, reflecting continuing advancements in production practices and in technology, including improvements in seed varieties and chemicals. Higher yields are expected to more than compensate for reduced planted acreage, resulting in record-high production for corn and soybeans and increased wheat production. However, projections show wheat production remaining well below levels from most of the past two decades.

Corn yield is projected at 181.5 bushels per acre in 2023/24, up from a drought-depressed yield of 171.9 bushels, in 2022/23 and is expected to continue rising to just under 200 bushels by 2032/33. Corn production is projected to grow from 15.27 billion bushels in 2023/24 to a record 16.18 billion bushels in 2032/33.

As with corn, soybean yields are expected to recover from a 4-year low of 49.8 bushels per acre in 2022/23 after dry growing conditions. Yields are expected to increase to 52.0 bushels per acre in 2023/24 and to 56.5 bushels by 2032/33. With the yield increase, soybean production is projected to grow 8 percent over the 10-year period, rising to a record 4.84 billion bushels in 2032/33.

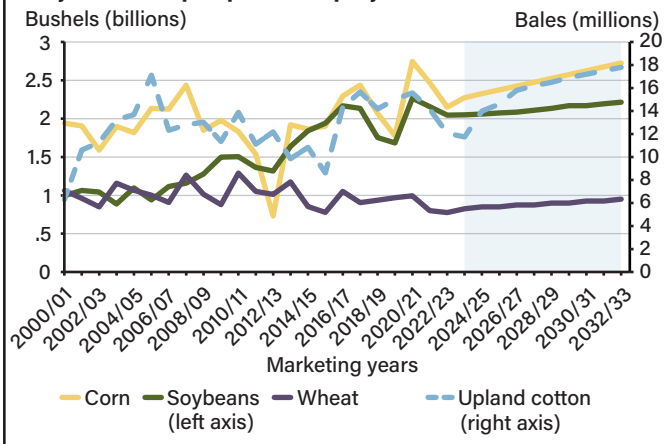
Wheat yields are expected to return to more typical levels for 2023/24, to 49.2 bushels per acre, and to continue rising through the projection period, ending at 52.7 bushels per acre in 2032/33. However, after an initial jump in 2023/24, wheat production is projected to decline for several years, reflecting a reduction in area planted. As the number of acres planted level out, projected yield growth is expected to boost wheat production through the remainder of the projection period to just under 2.0 billion bushels. This remains less than the record of nearly 2.8 billion bushels in 1981/82.

In contrast to corn, soybeans, and wheat, upland cotton is expected to show gains in both planted area (40 percent) and yield (just more than 5 percent). With more acres planted and higher yield, cotton production is expected to grow 47 percent during the projection period, from 13.9 million bales in 2023/24 to 20.4 million bales by 2032/33.

Domestic Consumption, Trade Projected To Grow for Corn, Soybeans, Wheat, and Cotton

Domestic demand for corn, soybeans, wheat, and cotton are all expected to grow over the next decade. Exports of the four crops also are expected to increase over the next decade, reaching record highs for upland cotton and near record levels for corn and soybeans. Projections show wheat exports rebounding from a projected 50-year low in 2022/23.

Major U.S. crop exports are projected to rise



Note: The shaded area on the right represents the USDA's Agricultural Baseline Projection period.

Source: USDA, Economic Research Service using projections from the USDA, Office of the Chief Economist, the World Agricultural Outlook Board, and the Interagency Agricultural Projections Committee. Data are as of November 7, 2022, and are subject to revision.

Domestic corn use is expected to steadily increase through the projection period, growing from 12.5 billion bushels in 2023/24 to 13.4 billion bushels by 2032/33. Driven by growth in the pork, chicken, and beef sectors, feed and residual corn use is projected to increase about 18 percent over 10 years. Use of corn for food, seed, and in industrial applications, including ethanol, is projected to decline slightly over the same period. U.S. corn exports are expected to rise nearly 20 percent from 2023/24 to 2032/33, ending at 2.7 billion bushels, which, if realized, would mark the second-highest corn export volume on record.

Soybean crush—the processing of soybeans into soybean meal and soybean oil—is expected to rise from 2.3 billion bushels in 2023/24 to 2.5 billion bushels in 2032/33. Soybean exports are expected to rise 8 percent over the projection period.

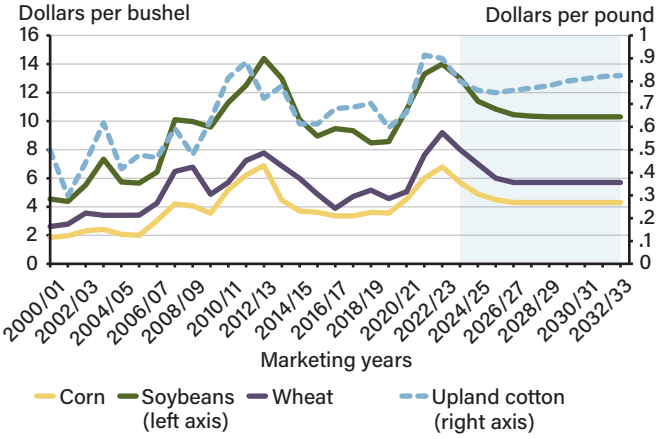
Domestic use of wheat is projected to remain relatively steady, rising 2.4 percent through 2032/33, compared with a 15-percent increase in exports over the same period. The United States also imports some wheat, mostly from Canada, to meet local demand and protein-blending requirements as a supplement to domestic supplies. Total imports are projected to range between 110 million and 120 million bushels annually.

Domestic mill use for upland cotton is expected to grow slowly over the projection period, rising nearly 9 percent from 2023/24 to 2032/33. Domestic mill use of cotton has fallen since trade barriers for imported mill products were phased out in recent decades. Use is projected at 2.5 million bales or less through 2032/33, but it exceeded 10.0 million bales during much of the 1990s. Upland cotton exports are expected to grow at a much faster rate, rising from an 8-year low of nearly 11.8 million bales in 2023/24 to 17.8 million bales in 2032/33, a 51-percent increase.

Crop Prices Generally Expected To Decline in the Near-Term, Then Stabilize

Corn prices are expected to fall from a near-record peak season average farm price of $6.80 per bushel in 2022/23 to $5.70 per bushel the following year and continue a downward trend through 2026/27 before stabilizing at $4.30. Soybean prices follow a similar trend, falling to $13.00 a bushel in the first year of the projection period, down $1.00 from the recent peak. Soybean prices are expected to continue falling through the first half of the projection period, stabilizing at $10.30 per bushel the remaining years.

U.S. crop farm prices are projected to decrease in the near-term, then mostly stabilize



Note: The shaded area on the right represents the USDA's Agricultural Baseline Projection period.

Source: USDA, Economic Research Service using projections from the USDA, Office of the Chief Economist, the World Agricultural Outlook Board, and the Interagency Agricultural Projections Committee. Data are as of November 7, 2022, and are subject to revision.

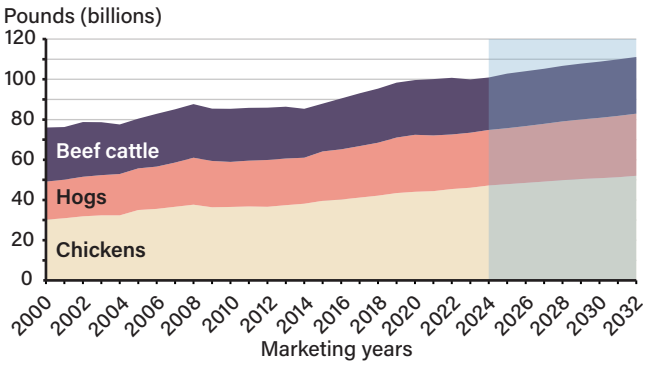
Wheat prices are expected to drop from a record $9.20 a bushel in 2022/23 to $8.00 in 2023/24, still the second highest price on record. Prices are projected to continue to fall through 2026/27 before settling at $5.70 through 2032/33.

After 2 consecutive years of record or near-record highs, the price for upland cotton is expected to drop for the first year of the projection period to $0.80 per pound, down from $0.90 in 2022/23. Upland cotton prices are expected to fall further to $0.75 per pound in 2025/26 before starting a steady rise though 2032/33, ending at $0.825 per pound.

U.S. Livestock Production Expected To Continue Expanding Through 2032

Commercial beef production is projected to grow through 2032, after contracting in 2023 and 2024. Commercial slaughter volumes and weights are expected to increase, expanding production to record levels by 2032. Beginning at 26.0 billion pounds in 2024, production is projected to grow to 28.1 billion pounds in 2032.

U.S. livestock production projected to increase over the next decade



Note: The shaded area on the right represents the USDA's Agricultural Baseline Projection period.

Source: USDA, Economic Research Service using projections from the USDA, Office of the Chief Economist, the World Agricultural Outlook Board, and the Interagency Agricultural Projections Committee. Data are as of November 7, 2022, and are subject to revision.

Commercial pork production is also projected to increase over the 10-year projection period, driven by rising hog inventories as producers increase supply to meet processor demand. Total commercial production of pork is projected to grow from 27.6 billion pounds in 2024 to a record 30.9 billion pounds in 2032, a 12-percent increase.

Chicken production is expected to follow a similar pattern, growing 10 percent over the projection period to a record 52.0 billion pounds in 2032.

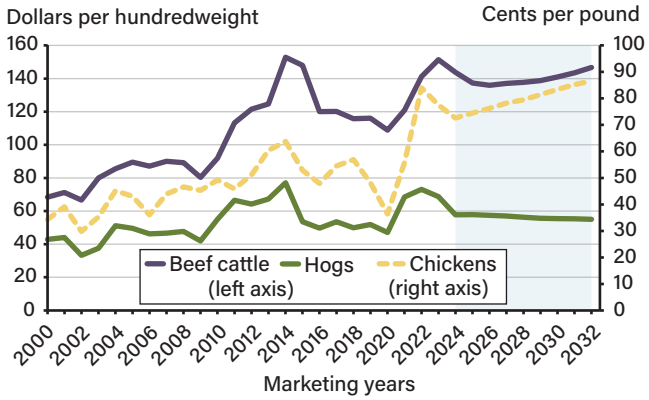
Beef, Pork, Chicken Exports Each Expected To Climb to Record or Near-Record Levels by 2032

Of the three meats, exports for chicken—one of the cheapest sources of animal protein globally—are expected to be notably strong. Chicken exports are expected to rise almost 13 percent from 7.5 billion pounds in 2024 to a record 8.4 billion by 2032. As the U.S. cattle herd is rebuilt after a higher-than-normal rate of slaughter in 2022 during drought conditions, beef exports are expected to decline in 2023 and 2024 and then rise during the remainder of the projection period, reaching near-record levels in 2032 at 3.3 billion pounds. Pork exports are projected to climb throughout the period, approaching record levels as they rise from 6.3 billion pounds in 2024 to 6.9 billion in 2032.

The United States is a significant importer of beef, with import volumes often similar to those of its exports. The country sends a surplus of higher value cuts of feedlot-finished beef to Europe and Asia and imports lower value lean beef to supplement the domestic production of ground beef. To support domestic consumption, U.S. beef imports are expected to rise to 3.6 billion pounds in 2024 but decline after, hovering around 3.1 billion to 3.2 billion pounds annually. If realized, beef imports would still be above the annual average of the prior two decades.

The United States is also a significant importer of pork, although exports still outweigh imports. Pork imports increased rapidly in recent years, rising from a recent low of 904 million pounds in 2020 to a projected 1.477 billion in 2022. Imports are expected to grow to a record 1.683 billion pounds by 2032, boosted by a strong U.S. dollar and an influx of Canadian pork that had historically been exported to China.

U.S. farm prices projected to rise for beef cattle and chicken, stay steady for hogs



Note: The shaded area on the right represents the USDA's Agricultural Baseline Projection period.

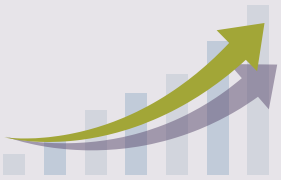
Source: USDA, Economic Research Service using projections from the USDA, Office of the Chief Economist, the World Agricultural Outlook Board, and the Interagency Agricultural Projections Committee. Data are as of November 7, 2022, and are subject to revision.

In the near term, farm prices (not adjusted for inflation) for all animals and animal products are projected to fall from recent record or near-record levels set in 2022. After an initial decline, cattle prices are expected to rise steadily after 2026. Hog prices are expected to decline through most of the projection period, with the farm price for hogs in 2032 almost 5 percent lower than in 2024. By the end of the projection period, chicken prices are expected to approach record levels, with farm prices for broilers (young chickens) rising 19 percent.

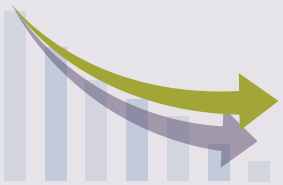
CITATIONS

This article is drawn from ...

Baseline Team. (2023). *Agricultural baseline database.* [Data product]. U.S. Department of Agriculture, Economic Research Service.



Making Sense of USDA Forecasts and Projections



USDA produces three separate projections of crop and animal product supply and use, which are released either on a monthly or annual basis. These depend on certain conditions and expectations as of a specific date and can cover different timeframes.

The most widely followed market projections are released monthly in the World Agricultural Supply and Demand Estimates (WASDE) report, which provides the official USDA forecasts for the current year. The WASDE forecasts market conditions for the current marketing year still underway, and, at most, the forthcoming marketing year. Crop marketing years span 2 calendar years (the period from when the crop is harvested until the next year's harvest begins), while animal product forecasts are on a calendar-year basis.

The USDA also annually releases a set of long-term (10-year) projections and an initial outlook for the new crop year that reflects market conditions ahead of the spring planting season. USDA's Long-Term Baseline projections are released in November of each year, and the initial outlook for the new crop year is released each February during USDA's annual Agricultural Outlook Forum. Below is a brief primer on the cycle of each of these sets of forecasts/projections:

WASDE—The WASDE is released monthly and provides data for the two most recently completed marketing years, including updates of forecasts for the current marketing year (such as 2022/23). Each May, the WASDE begins to report forecasts for crops that will be harvested during the coming summer and fall—the forthcoming crop year (for instance, forecasts for 2023/24 will be issued in May 2023). This is the first "official" forecast for the upcoming crop year.

Baseline—In November each year, the USDA Long-Term Projections provide the first domestic projections for the forthcoming marketing year that will be updated and reported as an official forecast by the WASDE the following May. Unlike the WASDE, the Baseline projections include expectations for the ensuing 9 years. These projections assume that current laws affecting Federal spending and revenues remain in place throughout the projection period and do not attempt to predict global policy or political outcomes, abnormal weather events, or other external shocks that could affect market outcomes. Instead, they reflect USDA's assessment of how markets would evolve under current conditions, existing laws, and normal weather patterns. Rather than serving as a prediction of the future, they are primarily intended to serve as a neutral benchmark for measuring the effects of proposed legislation or external developments that could have enduring effects on agricultural markets. They are based on conditions as of the October WASDE—the most recent available at the time—and are not updated until a new cycle begins the following November. The full Baseline report, containing additional information such as international projections (but no updates to the domestic supply and use numbers), is released in mid-February.

USDA Agricultural Outlook Forum Commodity Outlooks—Each year in late February, USDA's commodity committees provide an updated set of forecasts for the new marketing year, but not beyond. These data are presented at the annual USDA Forum and use information from the most recent (February) WASDE report. These interim figures represent USDA's latest expectations for the upcoming marketing year and will be officially updated in May, including area information from USDA's March Prospective Plantings report.

FEBRUARY **2023**

Market Opportunities Expanding for Agricultural Trade and Investment in Africa

BY MICHAEL E. JOHNSON, STEPHEN MORGAN, AND JARRAD FARRIS

HIGHLIGHTS

- Africa is likely to become a key emerging market for international trade and investment over the coming decades. Multinational corporations are positioning themselves to benefit from the growing demand for goods and services on the continent.
- The launch of the African Continental Free Trade Area (AfCFTA) could help further expand these opportunities through greater economic integration, intraregional trade, and investment among member countries.
- Africa faces challenges related to agricultural trade and investment, which may inhibit the full potential of the AfCFTA.

Many African countries have become increasingly important destinations for global trade and foreign investment. The continent has more than 1.4 billion people, and the population is expected to continue growing at some of the fastest rates in the world. The United Nations projected Africa could become the most populous geographic region in the world by the end of this century, reaching up to 3.4 billion people. Compounding the effects of population growth on the future demand for agricultural imports is the even faster rate of urbanization on the continent. By 2050, the share of the total population living in urban areas is projected to be a majority as the number of urban dwellers more than triples from what it is today. With rising urbanization comes shifts in consumer preferences. Urban consumers typically buy foods more convenient for their lifestyles such as prepared foods or meals at restaurants. As incomes also rise in urban settings, consumers seek a greater diversity of food in their diet, especially animal-based protein, prepared cereals, fats and sugars, and fruits and vegetables. Current production trends indicate Africa's agricultural output alone will not be enough to feed the region's growing population.

Projected changes in demographic, income, and food demand patterns in Africa offer potential opportunities for trade and investments in African agriculture and agri-food value chains—the processes connecting food production, delivery, and the consumer. The African Continental Free Trade Area (AfCFTA), which launched January 1, 2021, is expected to help expand these opportunities through economic integration, intraregional trade, and investment among member countries. The economic transformation of the continent combined with changes in demographics and consumer preferences are projected to help the region to become an economic powerhouse for global trade and invest-

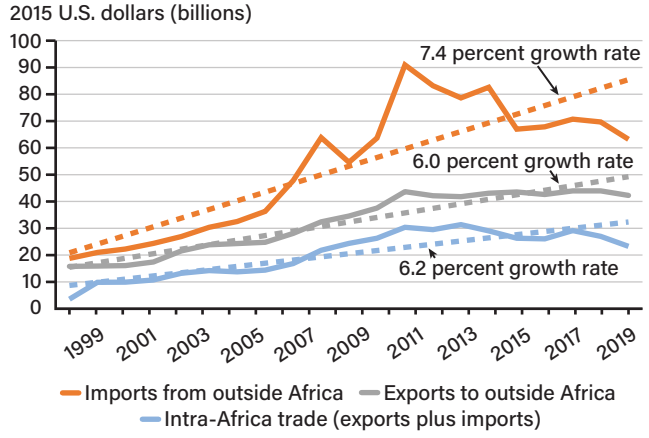
ments. Researchers at USDA's Economic Research Service (ERS) are assessing these trends and prospects for economic transformation in Africa, beginning with an exploration of investment flows in the lead-up to AfCFTA's launch as well as current emerging trends of agricultural trade.

Trade Patterns and Opportunities

The AfCFTA offers the opportunity for African countries to diversify their exports, attract foreign direct investments, accelerate income growth and development, and ultimately trade more with the world. Trading under the AfCFTA agreement has been slow to ramp up since its 2021 launch. Negotiations are still ongoing on additional issues related to the agreement, such as tariffs, intellectual property, and investment protocols. According to the AfCFTA Secretariat, as of December 2022, 44 of the 54 signatory countries had ratified the agreement.

Agricultural trade in Africa has been consistently growing over time and import demand has been particularly strong. Between 1999 and 2019, the value of agricultural imports in Africa grew at an average annual rate of 7.4 percent compared with a 6.0 percent growth rate for agricultural exports. Over the same period, intraregional trade (trade with other African countries) also has been growing, a trend that is expected to continue to accelerate with AfCFTA's implementation. In fact, ERS researchers found evidence this already had been occurring before AfCFTA and among some of Africa's existing subregional free trade areas.

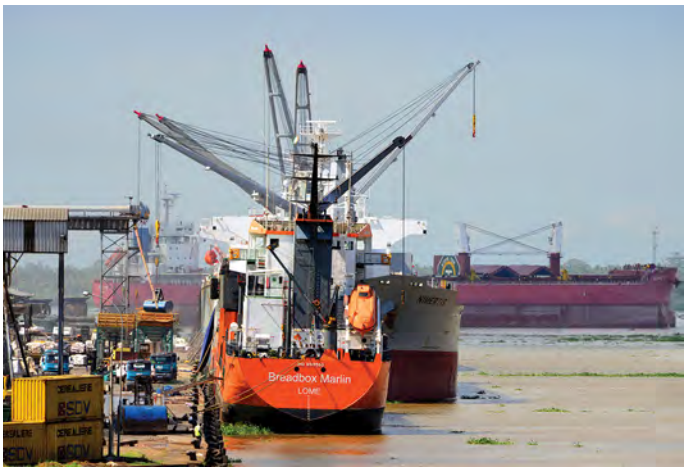
The value of Africa's agricultural imports from outside the region has grown faster than agricultural exports and intraregional trade



Note: **Growth rate** represents estimated average annual growth rates for each category from 1999–2019.

Source: USDA, Economic Research Service calculations based on the international trade data (BACI) compiled by the French Center for Research and Expertise on the World Economy.

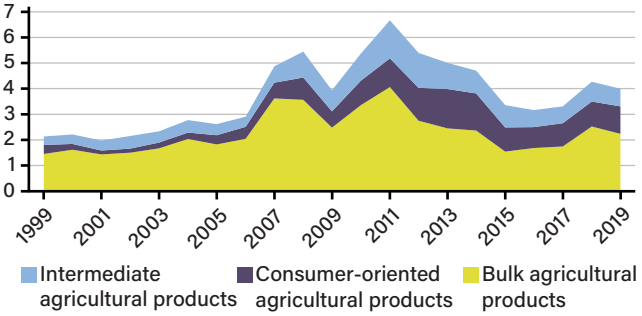
Africa traditionally has been a leading importer of bulk agricultural commodities such as wheat, corn, rice, and soybeans.



Imports of cereals and oilseeds play a significant role in food security in the region and form a staple part of many diets, including feed for livestock. Because of the dependency on imports for food security in some countries, sudden and substantial price changes in these bulk commodities can increase food insecurity in a country. According to ERS' International Food Security Assessment, 2022–32, the additional number of people considered food insecure worldwide rose by 41.7 million in 2022 as a direct consequence of recent events including the Coronavirus (COVID-19) pandemic and Russia's military invasion of Ukraine. These events led to rising global commodity prices, affecting especially sub-Saharan Africa—which has the highest prevalence of food insecurity in the region—and North Africa, where cereal imports from the Black Sea Region are significant. For sub-Saharan Africa, ERS projects bulk grain imports to grow by 4.9 percent per year, totaling 152 million tons by 2032.

The United States has typically exported bulk commodities to Africa. However, with Africa's rising incomes and growing populations, combined with increasing urbanization, demand has increased for consumer-oriented agricultural products such as beverages, prepared cereals, poultry meat, and dairy products, and for intermediate goods such as soy meal, vegetable oils, and other feeds. The import share of these products in Africa has risen faster than bulk commodities. Together, consumer-oriented and intermediate agricultural goods accounted for 44 percent of U.S. agricultural exports to Africa in 2017–19, up from 29 percent in 1999–2001. Recent ERS research also shows this to be true in Africa's rural areas, where incomes and employment patterns may have changed.

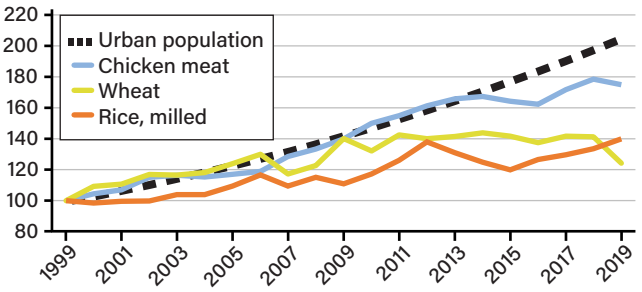
In 2019, the United States exported about $4 billion in agricultural goods to Africa, more than half of which was in bulk commodities



Note: Annual values are based on a calendar year.
Source: USDA, Economic Research Service calculations based on U.S. Department of Commerce, Census Bureau Trade Data.

One of the most significant areas of U.S. agricultural export growth to Africa has been in poultry meat. Demand for poultry meat, especially chicken, in urban areas has grown almost in tandem with urban population growth. At this rate, ERS projects sub-Saharan Africa to remain the top global importer of poultry over the next 9 years, with import volumes reaching more than 2.5 million metric tons per year by 2031. Increasing demand for poultry—a relatively affordable source of protein—is expected to combine with relatively low levels of domestic production to drive import demand.

Population growth in Africa has outpaced commodity supply growth



Note: Chart shows growth in population and in per capita supply of each commodity listed.
Source: USDA, Economic Research Service calculations based on data from the United Nation's Food and Agriculture Organization Statistical Database.

A principal goal of the AfCFTA is to increase intraregional trade on the continent, which has the potential to shape the future of agricultural trade with the rest of the world if trade with external partners is also liberalized. So far, trade in agricultural consumer-oriented goods within the region has been increasing. These goods explain about half of intra-Africa agricultural trade and much of its growth over the last two decades. The growing shift in intra-Africa agricultural trade toward higher value consumer goods reflects growing demand and could provide an opportunity for external trading partners, including the United States.

Investment Patterns and Opportunities

Although AfCFTAs framework for guiding investment protocols is not finalized, the agreement is expected to promote private investment that spans economic sectors and national borders. Through more open markets, investors in one AfCFTA member country are likely to have better access to consumers in other African member countries. The free trade agreement is expected to harmonize regulatory requirements across borders, which could make it less expensive for African countries to do business across the region. New opportunities for investment in food production, processing, and delivery across Africa are expected to benefit the food and agricultural sector as incomes and populations continue to rise.

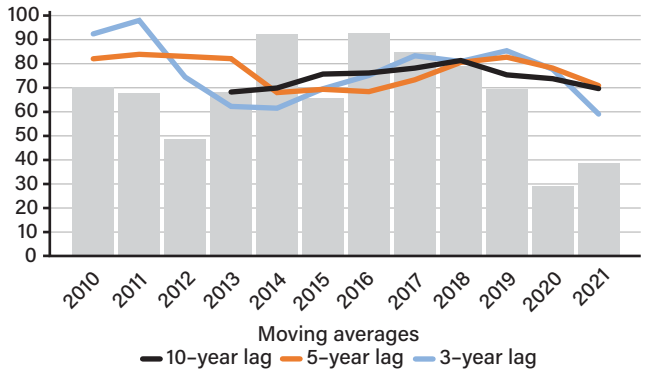
Africa has lagged other regions as a global destination for foreign direct investment (FDI), and European investors have accounted for most of the foreign direct investment in the region. However, investment from Asia and Latin America has increased in the past two decades, with investments from China increasing rapidly. Comparing across 5-year averages, ERS estimates that Asia's share of FDI to Africa increased from 18 percent in 2004–08 to more than 30 percent in 2014–18. In the past, much of the investment (80 percent) flowed into northern and southern Africa. However, FDI has started to increase to other subregions. Eastern Africa, for example, saw an eightfold increase on average of FDI inflows over the past decade—from $4 billion annually in 2004–08 to $32 billion annually in 2014–18.

One subset of total FDI is greenfield FDI, which is when firms make investments to start a new venture or subsidiary in another country. Because greenfield FDI is a new investment, these flows can provide insight into investor sentiment and how private investors view opportunities in Africa. Drawing on data provided by fDi Markets, Financial Times Limited, ERS researchers determined that about $75 billion to $80 billion a year in greenfield foreign direct investment entered Africa before the COVID-19 pandemic. With the onset of the pandemic, these flows declined to under $30 billion in 2020.

Projected changes in demographic, income, and food demand patterns in Africa offer potential opportunities for trade and investments in African agriculture and agri-food value chains

Greenfield FDI flows in Africa improved marginally in 2021 but remained well below historical trends for the continent, highlighting a substantial pandemic-related gap in private sector investment.

From 2010–21, greenfield annual foreign direct investment in Africa ranged from over $90 billion in 2014 and 2016 to under $30 billion during the COVID-19 pandemic in 2020

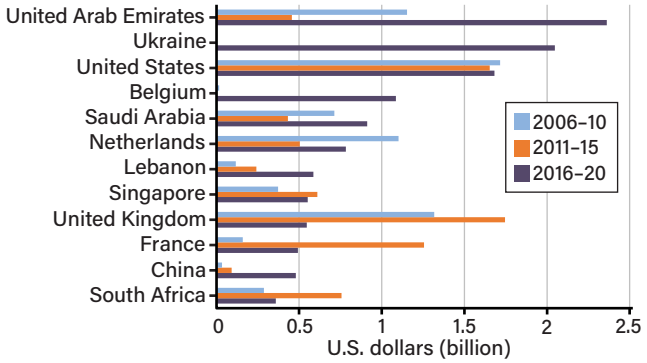


Source: USDA, Economic Research Service calculations using data provided by fDi Markets, Financial Times Limited (2021).

Many African countries rely heavily on agriculture for their economic development and food security strategies, so investment in the food and beverage sector would benefit Africa's economies. Although investment flows in the food and beverage sector are a small part of total greenfield FDI (3–5 percent), they are one mechanism to build and extend agricultural value chains in Africa. AfCFTA trade and investment provisions also could help cross-border opportunities for production, processing, marketing, and wholesale and retail activities.

In 2016–20, the United Arab Emirates, Ukraine, the United States, and Belgium were the largest investors in the food and beverage sector in Africa. U.S. food and beverage greenfield FDI has been particularly consistent since 2006, ranging between $1.5 billion and $2 billion during each 5-year period since then. Notably, China's greenfield FDI activity in this sector reached just under $500 million in 2016–20, less than a third of the $1.7 billion from the United States.

For Africa's food and beverage sector, the United States consistently has been one of the top sources of greenfield foreign direct investment, 2006–20



Source: USDA, Economic Research Service calculations using data provided by fDi Markets, Financial Times Limited (2021).

In 2016–20, investments into the grains and oilseed subsector were the highest among sectors, totaling more than $3 billion. Sugar and confectionery products followed at more than $2.4 billion, and food and beverage stores came in at just under $2 billion. More than half of U.S. greenfield FDI from 2016–20 was in the subsectors of soft drinks and ice as well as sugar and confectionery products. For U.S. greenfield investment in Africa during that time, about 15 percent was in the grains and oilseed subsector.

Remaining Challenges

Africa faces several challenges related to agricultural trade and investment that could inhibit the full realization of the AfCFTA's goals to promote greater economic integration and increased intraregional trade and investments on the continent.

First, intra-African trade faces higher costs compared with other regions. AfCFTA represents an opportunity to reduce trade costs by lowering different types of trade barriers among countries within the region. Lowering tariffs and non-tariff measures, harmonizing regulatory systems, and supporting market institutions and infrastructure under AfCFTA are expected to help cut these costs over time.

Second, some African countries are reliant on natural resources for export revenue and foreign exchange, and as a driver of economic growth. However, dependence on natural resource exports can leave countries vulnerable to macroeconomic shocks that affect commodity prices and, consequently, agricultural trade. Recent ERS research highlighted how dependence on oil exports affected trade and consumption in sub-Saharan Africa during the COVID-19 pandemic. For example, consumption and imports of rice, wheat, and poultry all declined from pre-pandemic levels.

Third, maintaining agricultural productivity growth is important to meet increasing food and fiber demand in Africa. It allows farmers to produce commodities with fewer resources, which can reduce unit costs and, subsequently, agricultural prices. A slowdown in the growth of agricultural productivity is likely to prolong Africa's dependence on food imports. Recent ERS research showed a slowdown in agricultural productivity growth in sub-Saharan Africa throughout the 2010s, suggesting growth in output has relied mostly on expanding inputs such as the amount of land under cultivation.

The benefits from AfCFTA for Africa and for global agricultural trade are expected to grow as the agreement is implemented even as challenges remain to be addressed. Ultimately, while all trading partners will benefit from continued economic and population growth in Africa, the region will likely play a large role in shaping global agricultural markets.

CITATIONS

This article is drawn from ...

Farris, J., Morgan, S., & Johnson, M.E. (2022). ***COVID-19 working paper: The COVID-19 pandemic and changes in greenfield foreign direct investment in Africa***. (Report No. AP-106). U.S. Department of Agriculture, Economic Research Service.

Johnson, M.E., Farris, J., Morgan, S., Bloem, J., Ajewole, K., & Beckman, J. (2022). ***Africa's agricultural trade: Recent trends leading up to the African Continental Free Trade Area.*** (Report No. EIB-244). U.S. Department of Agriculture, Economic Research Service.

Morgan, S., Farris, J. & Johnson, M.E. (2022). ***Foreign direct investment in Africa: Recent trends leading up to the African Continental Free Trade Area (AfCFTA)***. (Report No. EIB-242). U.S. Department of Agriculture, Economic Research Service.

Gerval, A. & Hansen, J. (2022, September 26). Sub-Saharan Africa's reliance on oil exports leads to decline in agricultural imports during pandemic. ***Amber Waves***, U.S. Department of Agriculture, Economic Research Service.

Sauer, C. (2022, October 3). Rural Tanzanians turn to processed food and meals away from home as incomes rise and employment patterns shift. ***Amber Waves***, U.S. Department of Agriculture, Economic Research Service.

Miller, M. Gerval, A., Hansen, J., & Grossen, G. (2022, August 1). Poultry expected to continue leading global meat imports as demand rises. ***Amber Waves***, U.S. Department of Agriculture, Economic Research Service.

Zereyesus, Y.A., Cardell, L., Valdes, C., Ajewole, K., Zeng, W, Beckman, J., Ivanic, M., Hashad, R.N., Jelliffe, J., & Kee, J. (2022). ***International food security assessment, 2022–32***. (Report No. GFA-33). U.S. Department of Agriculture, Economic Research Service.

You may also be interested in ...

Johnson, M.E. (2023, June 29). Africa. [Topic page]. U.S. Department of Agriculture, Economic Research Service.

APRIL **2023**

Farm Animal Welfare Policies Cover Breeding Sows, Veal Calves, or Laying Hens in 14 U.S. States

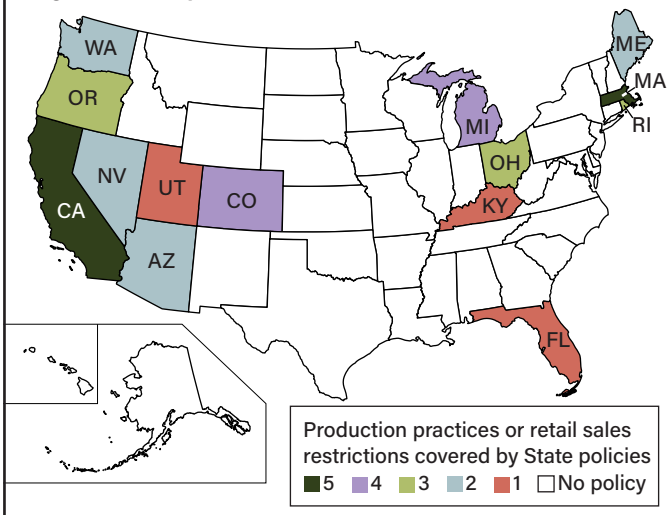
BY DANIELLE J. UFER

In the United States, animal welfare standards are among the many considerations facing producers. Until recently, relatively few Federal policies addressed standards of treatment for farm animals, allowing each industry to largely define those standards. Since 2002, 14 U.S. States have passed policies addressing practices that can affect farm animal welfare, with the most common policies aimed at the use of animal confinement in pork, veal, and egg production. Moreover, some States ban sales of animal products imported from operations in other States that do not follow the animal welfare requirements. But even with a growing geographic reach, these policies cover a relatively small proportion of U.S. animal production.

HIGHLIGHTS

- Farm animal welfare policies covering production practices before slaughter are in place in 14 States, with policies largely focused on confinement practices. Requirements for alternative methods of animal production are expected to come at a cost.
- In-State animal operations targeted by these bans account for a relatively small proportion of total U.S. production.
- Some laws also restrict the sale of animal products originating from any noncompliant operation, including from States where such bans are not in place. This can create a bleed-over effect in which out-of-State producers must adopt similar animal welfare practices to keep their market access.

In 2022, 14 States had passed at least one policy addressing poultry, hog, or veal calf production or retail sales



Note: Categories indicate the number of animal confinement or retail sales policies passed as of 2022. In some cases, multiple practices or retail sales restrictions may be addressed in a single piece of legislation and are counted as individual policies here. Policies cover five actions: gestation crate bans, veal crate bans, pork and veal sales restrictions, cage or confinement bans for laying hens, and egg sales restrictions.

Source: USDA, Economic Research Service using information from State legislation repositories.

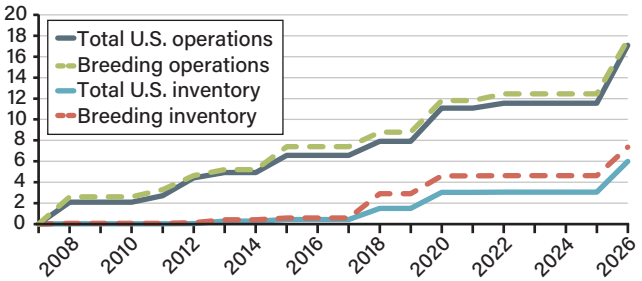
Hog Gestation Crate Bans Will Cover 10 States and 6 Percent of U.S. Hog Herd by 2026

Over the past two decades, the hog industry has been at the center of much of the State legislation addressing farm animal welfare. Ten States (Arizona, California, Colorado, Florida, Maine, Massachusetts, Michigan, Ohio, Oregon, and Rhode

Island) have passed laws restricting the use of gestation crates for hogs, in many cases allowing confinement only in limited circumstances. These crates typically are metal pens about 7 feet long that house individual breeding sows for the entire gestation. Other than Michigan and Ohio, most States banning gestation crates each produce less than 1 percent of total U.S. pork output. By 2026, when all currently passed policies will have been fully implemented, less than 8 percent of the U.S. breeding hog inventory (at currently reported levels) will be covered by a gestation crate ban. Even so, the bans will affect a proportionally smaller share of pork producers because hog operations in these 10 States tend to be smaller than those in States with larger industries. While the gestation crate bans will cover about 6 percent of the total U.S. hog inventory by 2026, more than 17 percent of U.S. pork producer operations will be subject to a gestation crate ban if the distribution of operations remains at current levels.

By 2026, State policies will cover about 8 percent of the U.S. breeding hog inventory and 17 percent of hog operations

Hog inventory, operations affected by State laws, 2007–26 (percent)



Note: 2026 estimates are based on legislation currently in place. State inventory shares are based on average shares calculated from USDA's 2002–2020 National Agricultural Statistics Service survey data. State operations shares are based on average shares across 2007, 2012, and 2017 Census of Agriculture values for operations with inventory.

Source: USDA, Economic Research Service using data from USDA, National Agricultural Statistics Service.

Gestation crates have been shown to increase efficiency compared with putting sows in group settings. The crates allow producers to control how much each sow eats, to alleviate problems if sows become aggressive, and to monitor overall health. Converting operations to other containment methods could pose an additional cost to producers. For an operation that raises hogs from birth to slaughter weight (farrow-to-finish operations), converting away from gestation stalls would increase the per-pound cost of producing finished hogs by 8.7 percent, according to a 2011 estimate by Oklahoma State University researchers. Although these costs can be substantial for producers, the small size of industries in States that have banned crates and the retail availability of pork produced in States without the same restrictions mean that gestation crate bans alone may not have a discernible effect on retail prices.

However, when the policies extend beyond the hog barn and reach the grocery aisles, those costs can affect consumer prices. California and Massachusetts passed bans on retail sales of all pork from hogs that were kept in gestation crates, as well as their offspring, even if they were raised in other States. In California, it is estimated pork prices could increase 7.7 percent under the ban, reducing demand by 6.3 percent and resulting in an annual loss of economic benefits to consumers worth $320 million. However, enforcement of the California ban, stemming from voter approval of a ballot issue known as Proposition 12, as well as a similar ban in Massachusetts, has been delayed until the U.S. Supreme Court rules on a challenge to Proposition 12.

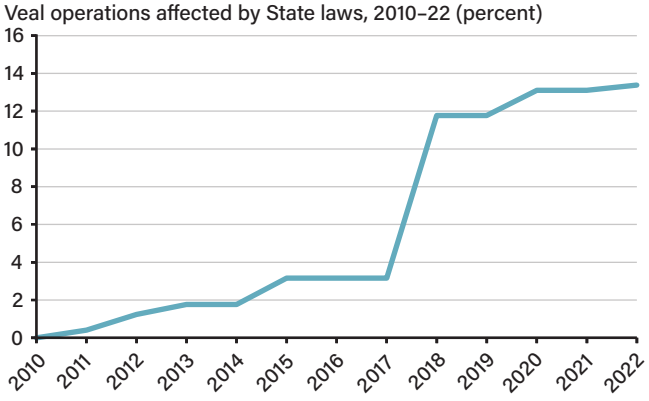
Nine States Prohibit Veal Crates, Affecting 13 Percent of Veal Operations as of 2022

Several State policies outlawing the use of gestation crates or confinement in pork production also prohibit the use of crates in the veal industry. Of the 10 States with gestation crate laws, 8 States (not including Florida and Oregon) also prohibit veal crates. In addition, Kentucky enacted a ban on veal crates in 2014. Bans on crating veal calves have had minimal effect on that industry. Crates were historically used in veal production to limit calf movement and interaction with other calves with the goals of improved animal health and meat quality. However, the American Veal Association reports producers already have moved away from veal crates as the industry standard and instead house veal calves in small groups. Moreover, the U.S. veal industry has seen significant decline since its peak in 1944, when more than 1.7 billion pounds of veal were produced. By 2020, U.S. veal output had dropped to 69 million pounds. Even with a relatively small national industry, State policies banning veal crates affect production along the same lines as hog gestation crate bans. Before policies in Kentucky and Ohio went into full effect in 2018, veal crate ban policies covered slightly more than 3 percent of veal operations nationally. Kentucky's ban alone

raised this number by 6 percent and, with all current bans fully implemented in 2022, about 13 percent of veal operations in the United States are covered by a crate ban.

As of 2022, crate bans covered about 13 percent of U.S. veal operations

Veal operations affected by State laws, 2010–22 (percent)



Note: State shares are based on average shares across 2007, 2012, and 2017 Census of Agriculture values of number of operations with veal calves raised or sold.

Source: USDA, Economic Research Service using data from USDA, National Agricultural Statistics Service.

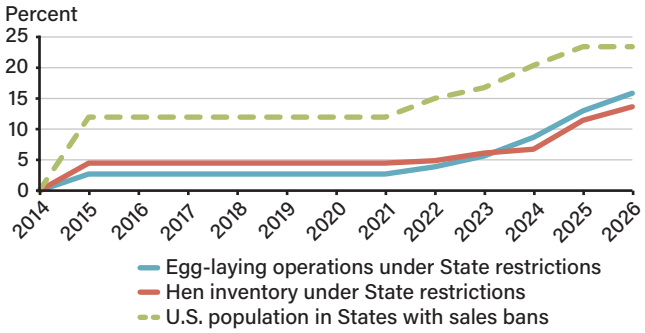
Welfare Laws for Egg-Laying Hens to Cover 16 Percent of All U.S. Operations By 2026

Since 2008, 10 States (California, Colorado, Massachusetts, Michigan, Nevada, Ohio, Oregon, Rhode Island, Utah, and Washington) have instituted policies addressing the caging or confinement of poultry, primarily affecting the egg industry. The policies in these 10 States typically require either a minimum amount of space per bird (in some cases a 73-percent increase in space over the industry standard) or have outlawed the use of battery cages, which confine large groups of laying hens in a small space and are stacked multiple layers deep within a barn. Though confinement and cage ban policies covered less than 5 percent of U.S. layers and egg operations before 2022, upon full implementation in 2026 they will cover at least 16 percent of operations, accounting for nearly 14 percent of layers (at currently reported levels, excluding Ohio where regulations do not automatically cover all in-State producers).

Researchers at the University of California, Davis, estimated that in-State producers faced as much as a 20-percent increase in production costs from these laws. With the stated goal of protecting in-State egg producers, California, Colorado, Massachusetts, Michigan, Nevada, Oregon, and Washington also have imposed bans on retail sales of products from any operations that do not comply with their individual State's production regulations. Under current population levels, by 2026 more than 23 percent of the U.S. population would reside in States with retail sales restrictions. That will put pressure on in-State industries to meet demand and spread the effects of these State policies to States that do not have their own restrictions. The retail sales policies have increased egg prices both inside and outside of the States implementing them. Researchers estimated egg prices in California increased by 33 percent to 70 percent from January 2014 (before California's

retail sales law went into effect) to July 2015. From 2016 to 2017, wholesale egg prices outside of California were estimated to have increased 4 percent to 6 percent, though the estimated price effects of California's legislation around this time could also have been influenced by the 2014–15 U.S. outbreak of highly pathogenic avian influenza.

By 2026, hen confinement regulations will cover 16 percent of U.S. egg-laying operations



Note: State operations shares are based on average shares across 2002, 2007, 2012, and 2017 Census of Agriculture values of operations with sales. State inventory shares are based on average shares calculated from available 2008–2020 USDA, National Agricultural Statistics Service survey data. Ohio is excluded from the calculations because operations in the State are not automatically covered.

Source: USDA, Economic Research Service using data from U.S. Department of Commerce, Bureau of the Census 2020 Population Estimates and USDA, National Agricultural Statistics Service.

Though State policies on the treatment and welfare of farm animals have limited coverage and have faced legal challenges, they are not operating in a vacuum. In addition to the direct regulatory effects on industry, several national trends have emerged with similar objectives. U.S. cage-free egg production has steadily increased over the past 5 years, rising from an estimated cage-free hen inventory of 12.9 percent in 2017 to 24 percent at the end of 2021. Additionally, USDA Certified Organic egg production, which prohibits cage systems and confinement that restricts animal movement, has grown to represent more than 4.5 percent of the national layer inventory in 2019. Members of the supply chain have increased their attention to animal treatment, with several national grocery chains, wholesalers, and food service providers making commitments to phase out egg and pork products originating in battery cage or gestation crate systems. Together with increased implementation of State policies addressing these practices, current trends in the pork and egg industries reflect an ongoing shift in U.S. standards of animal production.

Retail Sales Restrictions and Legal Challenges

In many States with farm animal production policies, the amount of pork, veal, and eggs produced is limited compared with the amount consumed. Therefore, those products are often imported from other States. As a result, some States also restrict sales of egg, pork, and veal products from operations that use prohibited practices, no matter their State of origin. These retail sales measures have been more controversial than those dealing simply with in-State production, leading to multiple rounds of litigation. One prominent case was brought by national pork industry advocates in the U.S. Supreme Court in October 2022 against California's Proposition 12 restrictions on the sale of pork from hogs kept in gestation crates or their offspring. The decision of the Supreme Court could determine the reach of State legislation across State borders and the ultimate effects on national industries.

CITATIONS

This article is drawn from ...

Ufer, D.J. (2022). ***State policies for farm animal welfare in production practices of U.S. livestock and poultry industries: An overview.*** (Report No. EIB-245). U.S. Department of Agriculture, Economic Research Service.

You may also be interested in ...

Knight, R., Davis, C.G., Hahn, W., Cessna, J., Terán, A., Haley, M., Valcu-Lisman, A., Grossen, G., Taylor, H., Cornelius, M., & Ufer, D.J. (2022). ***Livestock, dairy, and poultry outlook: February 2022***. (Report No. LDP-M-332). U.S. Department of Agriculture, Economic Research Service.

JUNE **2023**

Fuel Ethanol Use Expanding Globally but Still Concentrated in Few Markets

BY STEVEN RAMSEY

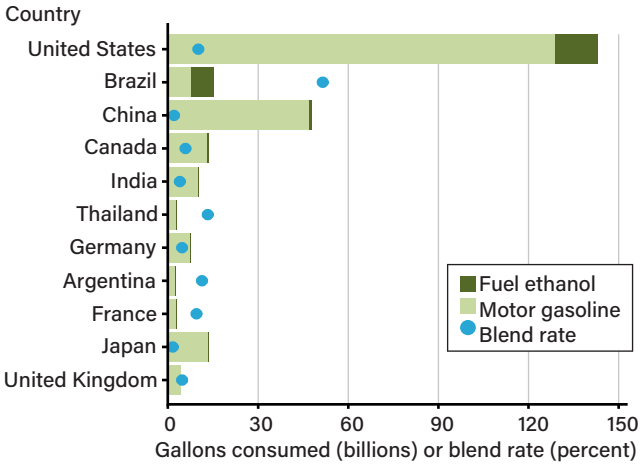
In the last 20 years, global consumption of ethanol for transportation fuel has increased because of growing demand in the United States and a small number of other countries. For the last 10 years, about 37 percent of U.S. corn production went into making ethanol, which is directly blended with motor gasoline in almost all markets. As global motor gasoline consumption has grown, so has ethanol consumption. The adoption of Government policies intended to reduce dependence on fossil fuels and support domestic agricultural industries has contributed to expanding ethanol use. Further, in recent years, ethanol's use as an economical blending feedstock to produce higher grades of finished gasoline has driven consumption even higher.

Before the onset of the Coronavirus (COVID-19) pandemic and its related travel restrictions, global motor gasoline use grew 74 percent from 1980 to 2018, with consumption outside the United States nearly doubling, according to the U.S. Department of Energy and USDA, Foreign Agricultural Service. In 2018, global motor gasoline consumption was estimated at about 403 billion gallons, and 260 billion of those gallons were by non-U.S. countries. Fuel ethanol consumption, meanwhile, grew from about 1.2 billion gallons in 1981 to 27.6 billion gallons in 2018. Much of this growth was attributable to a combined increase of 21.1 billion gallons in the United States and Brazil. Expanding consumption in the rest of the world, however, was greater in relative terms, having grown from 10.7 million gallons to 5.3 billion gallons, or almost 50,000 percent. U.S. consumption of fuel ethanol has rebounded but not yet returned to pre-COVID levels. Fuel ethanol use has also recovered elsewhere, such as the European Union and Canada, where consumption is now estimated to exceed prepandemic levels.

The growth in global fuel ethanol consumption has not been universal, and most countries do not use fuel ethanol. In the countries that do, the amount consumed varies. Brazil was the world's largest consumer from 1981 to 2002 and the second largest, behind the United States, from 2003 to 2018. Excluding the United States and Brazil, China was the largest consumer of fuel ethanol from 2002 to 2018. In 2018, ethanol for fuel use in Brazil was 7.9 billion gallons, more than eight times that of China (960 million gallons) and Canada (790 million gallons), the two next largest consumers. Combined, Brazil, China, and Canada accounted for 35 percent of global fuel ethanol consumption and 73 percent of all non-U.S. consumption in 2018. Adding in the next 7 largest fuel ethanol consumers—India, Thailand, Germany, Argentina, France, Japan, and the United Kingdom—these 10 countries consumed about 11.7 billion gallons in 2018, or about 43 percent of global consumption. Countries outside of the 11 largest fuel ethanol consumers accounted for 5 percent of global consumption in 2018. So, while fuel ethanol consumption has grown in many markets, the bulk of consumption remains concentrated in a handful of markets.

Global fuel ethanol consumption also varies in terms of blend rates—the ratio of the fuel ethanol volume to the combined fuel ethanol and motor gasoline volume. The blend rate in the United States has remained around 10 percent for much of the last decade. As of 2018, the global effective blend rate (excluding the United States) was about 5 percent. That rate is skewed by the high use of fuel ethanol in Brazil, where ethanol is used either at high-blend levels or directly as a fuel. Excluding the United States and Brazil, the global effective blending rate is about 2 percent. Blending rates vary widely by country, with only a handful of countries blending ethanol at 10 percent or higher, and the remaining countries blending at a low rate or not at all. Blend rates, along with motor gasoline market size and consumption trends, are expected to determine the future path of ethanol demand.

United States leads in fuel ethanol consumption; Brazil leads in blend rate, 2018



Note: Motor gasoline calculated by subtracting the fuel ethanol component. Countries are listed in order of fuel ethanol consumption in 2018. For information on additional countries, please see the USDA, Economic Research Service report "Global demand for fuel ethanol through 2030."

Source: USDA, Economic Research Service using data from U.S. Department of Energy, Energy Information Administration and USDA, Foreign Agricultural Service.

CITATIONS

This article is drawn from ...

Ramsey, S., Williams, B., Jarrell, P., & Hubbs, T. (2023). ***Global demand for fuel ethanol through 2030.*** (Report No. BIO-05). U.S. Department of Agriculture, Economic Research Service.

You may also be interested in ...

Valdes, C., Hjort, K., & Seeley, R. (2016). ***Brazil's agricultural land use and trade: Effects of changes in oil prices and ethanol demand.*** (Report No. ERR-210). U.S. Department of Agriculture, Economic Research Service.

Toasa, J. (2009). ***Colombia: A new ethanol producer on the rise?*** (Report No. WRS-0901). U.S. Department of Agriculture, Economic Research Service.

Ramsey, S. (2022, September 6). ***Bioenergy.*** [Topic page]. U.S. Department of Agriculture, Economic Research Service.

Ates, A.M. & Williams, A. (2023, September 28). ***Corn and Other Feed Grains.*** [Topic page]. U.S. Department of Agriculture, Economic Research Service.

SEPTEMBER **2023**

Global Fertilizer Market Challenged by Russia's Invasion of Ukraine

BY JENNIFER KEE, LILA CARDELL, AND YACOB ABREHE ZEREYESUS

When Russia invaded Ukraine in February 2022, fertilizer prices already were on the rise. The Coronavirus (COVID-19) pandemic, with its ensuing supply chain disruptions and transportation bottlenecks, had challenged the world's ability to produce and deliver fertilizer. In August 2021, most fertilizer prices were 25 percent above those in March 2021. The Russian invasion in early 2022 led to additional transportation interruptions in the Black Sea region and enactment of new trade restrictions. That curtailed already short fertilizer supplies, driving up prices over 50 percent from February to April 2022.

Because fertilizer is important for grain production, shortages and high prices affect the entire food supply chain. According to the 2022 Commodity Costs and Returns data from USDA's Economic Research Service, fertilizer costs account for nearly 45 percent of operating expenses for U.S. wheat and corn farms compared with 23 percent for U.S. soybean farms. In response to high fertilizer prices, farmers may adjust their production practices. They might use fertilizer remaining from the previous growing season, reduce planted acreage of some crops, or shift acreage to crops such as soybeans that require less fertilizer. For example, in 2022, U.S. planted acreage decreased for corn and wheat but increased for soybeans. Some may simply reduce the use of fertilizer altogether, which can result in lower yields, potentially contributing to higher commodity prices.

As the Black Sea region conflict continues in its second year, fertilizer prices have fallen, but trade challenges continue to contribute to uncertainty in global markets. As of June 2023, USDA showed increases in planted acreage for corn and wheat, while soybean acreage remained steady. In addition, commodity prices have risen, supporting those projections.

HIGHLIGHTS

- The Russian invasion of Ukraine in February 2022 exacerbated already high food and fertilizer prices, which had increased during the COVID-19 pandemic.
- In the aftermath of Russia's invasion of Ukraine, global powers imposed trade restrictions such as bans, quotas, and duties on fertilizer, affecting fertilizer trade and agricultural production, particularly for staple grains.
- After price spikes in April 2022, fertilizer prices returned to price levels seen before the invasion of Ukraine. As of March 2023, prices remained above 2021 levels and uncertainties remained, especially for low-income countries.

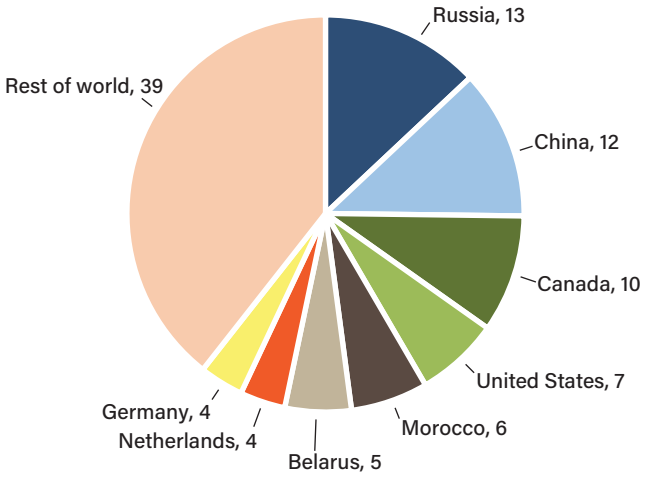
Russia's Invasion of Ukraine Resulted in Further Restrictions in Fertilizer Trade

In 2020, the most recent year for which fertilizer trade data are available, Russia and its neighbor Belarus were the world's top fertilizer exporters, accounting for nearly 20 percent of the three major types traded globally: nitrogen, phosphate, and potash. China had the second largest export share with 12.2 percent, followed by Canada, the United States, and Morocco.

According to the World Bank, Russia accounted for 16 percent of urea (a source of nitrogen) exports and 12 percent of phosphate exports. Russia and Belarus combined provided 40 percent of global potash exports. In 2020, the United States was one of the main destinations for Russian and Belarusian fertilizer, along with Brazil, China, and India. While the United States was a top producer of nitrogen and phosphate, it also imported significant amounts of Russian potash.

Russia provided 13 percent of all fertilizer trade in 2020

Fertilizer export share (percent)



Source: USDA, Economic Research Service using data from United Nations Comtrade (2020).

Trade restrictions already had stymied the flow of fertilizer before the invasion of Ukraine. In 2021, the year before the conflict started, the European Union (EU) and the United States imposed sanctions on imports of potash from Belarus, and China imposed a ban in July 2021 on their exports of phosphates to preserve domestic fertilizer supplies. In February 2022, after Russia's invasion of Ukraine, the EU imposed sanctions on individual oligarchs who owned fertilizer industries and on Russian potash. It also restricted the transit of fertilizer through EU territory. Canada placed a 35-percent tariff on Russian fertilizers in March 2022. At the same time, Russia prohibited the export of ammonium nitrate fertilizers until May 2022. On the other hand, the United States, seeking to avoid fertilizer supply shortages and price increases, did not impose sanctions on Russian fertilizers. In July 2022, the U.S. Department of Treasury issued a fact sheet to clarify that sales or transport of Russian fertilizers to the United States were exempt from sanctions. With concerns growing about global food insecurity, the EU eased its sanctions in December 2022 by allowing individual EU state members to unfreeze the assets of Russian fertilizer oligarchs to support the transport of food and fertilizer. Meanwhile, Russia set quotas on the export of fertilizers until May 2023 to maintain sufficient fertilizer supplies for its own farmers. As of January 2023, Russia imposed a 23.5-percent duty on all fertilizer exports with a price above $450 per ton.

Fertilizer Prices Rose Even More After Russian Invasion of Ukraine, Later Returning to 2021 Levels

Russia mainly supplies five types of fertilizers to markets around the world:

- Potassium chloride, or muriate of potash (MOP)
- Phosphate rock
- Diammonium phosphate (DAP)
- Urea
- Triple superphosphate (TSP)

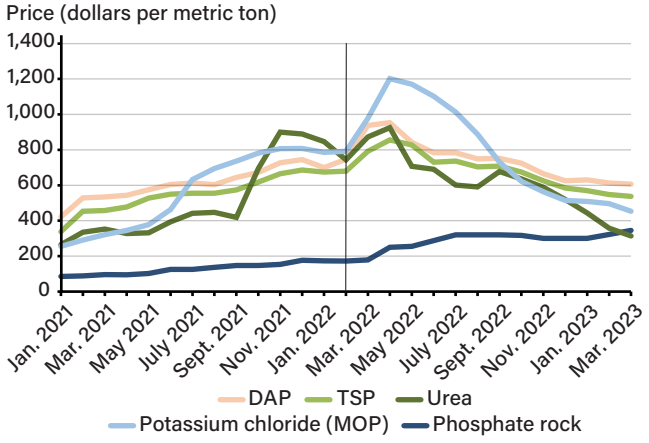
During spring 2022, prices rose for all five fertilizers, but the increase for MOP was more pronounced. The price of MOP, mainly exported by Russia and Belarus, was 53 percent higher in April 2022 compared with January 2022, a larger increase than any of the other fertilizers. In those 3 months, prices rose 38 percent for phosphate rock, 36 percent for DAP, and 9 percent for urea. The price for TSP rose 27 percent, although countries other than Russia also export that type of fertilizer.

When sanctions on Russia and Belarus impeded fertilizer trade, importers and other suppliers made adjustments. Top fertilizer importers, such as Brazil, imported from other suppliers to manage shortfalls, according to the International Food Policy Research Institute. In response to increasing demand for their fertilizer, other suppliers, such as Canada and Morocco, increased their production capacity for potash or phosphate. In addition, prices of natural gas, vital to the manufacture of fertilizer, fell in Europe, accommodating increased fertilizer production.

By March 2023, fertilizer export prices had returned to levels seen before the invasion. MOP and urea prices returned to

Global prices for fertilizers returned to 2021 levels in 2023 after surging in 2022

Price (dollars per metric ton)



Note: **DAP** = diammonium phosphate. **TSP** = triple superphosphate. **MOP** = muriate of potash. Prices not adjusted for inflation.

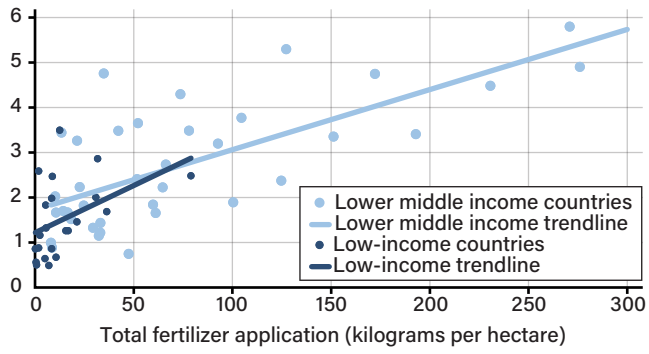
Source: USDA, Economic Research Service using data from the World Bank Commodity Price Data, 2023.

2021 levels, dropping 62 percent and 66 percent, respectively, compared with the peaks in April 2022. While the price decrease in MOP was steady, urea prices fluctuated moderately in mid-2022. Prices for DAP and TSP also declined by more than 36 percent compared with April 2022. Conversely, the phosphate rock price continued to increase.

Higher Fertilizer Prices, Lower Yields, Higher Food Prices

Fertilizer is a key input in food production, especially for staple grains, so rising prices can affect food supply. If farmers limit their use of fertilizer because of higher costs, their yields could decline. The following chart shows the relationship between fertilizer application and cereal yields, based on data from the Food and Agriculture Organization of the United Nations. The color of the dots corresponds with income categories for countries as defined by the World Bank. On average, cereal yields on fertilized acres are higher. Farmers in low- and lower-middle income countries tend to apply less fertilizer, so reducing the application may further reduce their crop yields.

Cereal grain crop yields rise with fertilizer application



Note: Fertilizer application data are for nitrogen, phosphorus, and potassium. **Country income classification** based on World Bank classifications.
Source: USDA, Economic Research Service using data from the United Nations Food and Agriculture Organization for 2020 and World Bank Income Classifications for 2022.

Russia's invasion of Ukraine drove up fertilizer prices, and grain prices also increased, reaching a peak in May 2022. The easing of export restrictions and sanctions and the partial reopening of transit through the Black Sea contributed to the resiliency of grain markets in 2022. Wheat markets withstood reductions in Black Sea exports as importers found alternative supplies from Australia, the EU, and Canada. Although grain prices have fallen, as of March 2023, they were still about 20 percent higher than 2 years earlier.

Grains prices rose along with fertilizer prices in 2022, remained above 2021 levels in 2023

Note: **Price index** based on U.S. dollars, not adjusted for inflation, in which 2010 =100. **Grains** include barley, wheat, rice, and sorghum.
Source: USDA, Economic Research Service using data from World Bank Commodity Report, April 2023.

CITATIONS

This article is drawn from ...

Zereyesus, Y.A., Cardell, L., Valdes, C., Ajewole, K., Zeng, W., Beckman, J., Ivanic, M., Hashad, R.N., Jelliffe, J., & Kee, J. (2022). *International food security assessment, 2022–32.* (Report No. GFA-33). U.S. Department of Agriculture, Economic Research Service.

You may also be interested in ...

Agricultural Market Information System. (2023, March). *Market Monitor.* No. 106.

European Council/Council of the European Union. (2023). *EU sanctions against Russia explained.*

Gillespie, J. (2023). *Commodity costs and returns.* [Data product]. U.S. Department of Agriculture, Economic Research Service.

United Nations, Food and Agriculture Organization. (2022). *Food outlook: Biannual report on global food market*s.

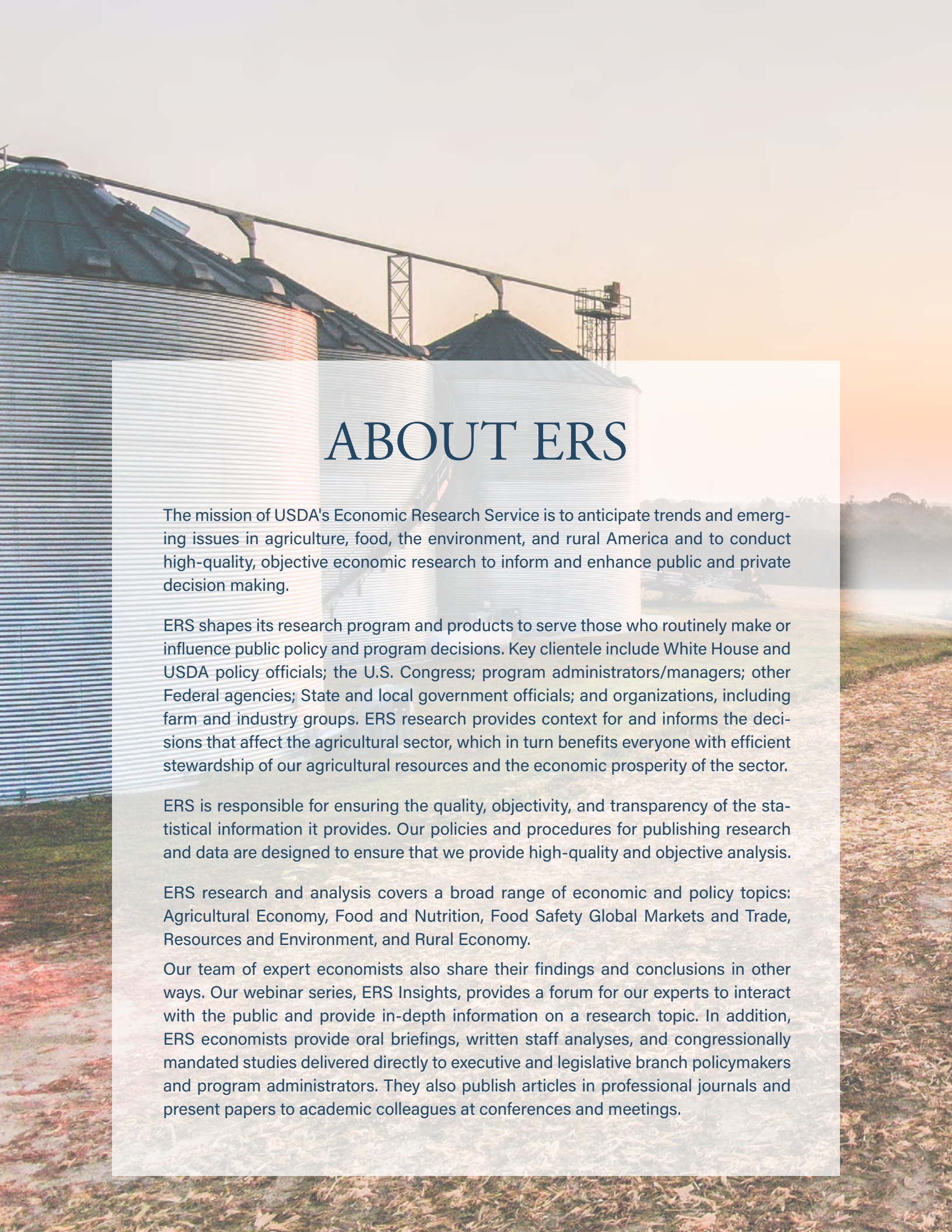
Hebebrand, C., & Glauber, J. (2023). *The Russia-Ukraine war after a year: Impacts on fertilizer production, prices, and trade flows.* International Food Policy Research Institute.

Keithly, J., & Nti, F. (2022). *Impacts and repercussions of price increases on the global fertilizer market.* U.S. Department of Agriculture, Foreign Agricultural Service.

U.S. Department of Agriculture, National Agricultural Statistics Service. (2023). *Prospective plantings.*

U.S. Department of Agriculture, National Agricultural Statistics Service. (2022). *Prospective plantings.*

World Bank. (2021). Commodity markets outlook: Urbanization and commodity demand.



ABOUT ERS

The mission of USDA's Economic Research Service is to anticipate trends and emerging issues in agriculture, food, the environment, and rural America and to conduct high-quality, objective economic research to inform and enhance public and private decision making.

ERS shapes its research program and products to serve those who routinely make or influence public policy and program decisions. Key clientele include White House and USDA policy officials; the U.S. Congress; program administrators/managers; other Federal agencies; State and local government officials; and organizations, including farm and industry groups. ERS research provides context for and informs the decisions that affect the agricultural sector, which in turn benefits everyone with efficient stewardship of our agricultural resources and the economic prosperity of the sector.

ERS is responsible for ensuring the quality, objectivity, and transparency of the statistical information it provides. Our policies and procedures for publishing research and data are designed to ensure that we provide high-quality and objective analysis.

ERS research and analysis covers a broad range of economic and policy topics: Agricultural Economy, Food and Nutrition, Food Safety Global Markets and Trade, Resources and Environment, and Rural Economy.

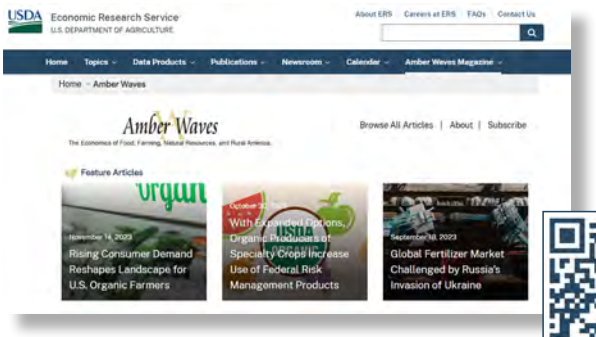
Our team of expert economists also share their findings and conclusions in other ways. Our webinar series, ERS Insights, provides a forum for our experts to interact with the public and provide in-depth information on a research topic. In addition, ERS economists provide oral briefings, written staff analyses, and congressionally mandated studies delivered directly to executive and legislative branch policymakers and program administrators. They also publish articles in professional journals and present papers to academic colleagues at conferences and meetings.

CONNECT *with* ERS

Use the QR code below to connect with ERS, follow us on social media, and subscribe to our e-mail newsletters. Our newsletters keep you up-to-date on the latest *Amber Waves* articles, Charts of Note, reports, and more.

ers.usda.gov/contact-us

Read ERS's award-winning *Amber Waves* magazine, and Charts of Note online, or have them delivered right to your email!



Amber Waves

The Economics of Food, Farming, Natural Resources, and Rural America

Read the latest *Amber Waves* articles

CHARTS of NOTE

Get the newest Charts of Note on the web or in the App

Mobile app available on Apple and Android devices.

USDA Economic Research Service
U.S. DEPARTMENT OF AGRICULTURE