USDA Economic Research Service
U.S. DEPARTMENT OF AGRICULTURE

Amber Waves

2022

YEAR IN REVIEW

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

February 2023

USDA Economic Research Service
U.S. DEPARTMENT OF AGRICULTURE

Dear Friends and Colleagues:

For nearly two decades, ERS has brought our latest research to our *Amber Waves* magazine, exploring the economic intersections of all facets of agriculture, food, the environment, and rural communities. Our timely research shines light on how ecological, environmental, health, and social forces shape the economics of our food systems. Each month, *Amber Waves* brings you the best of ERS research with timely articles delivered online and straight to your inbox.

With this print edition, *Amber Waves:Year in Review*, we are bringing you some of our most compelling articles from 2022–ones that explore major issues facing our society. These articles provide insight into topics such as the impacts of the COVID-19 pandemic, the effects of retaliatory tariffs on agricultural exports, and insight into trends in the irrigated agriculture sector. This research examines issues facing not only our policymakers but also our farmers and ranchers and everyone who shops at a grocery store or plans a meal.

Over the years, *Amber Waves* has evolved from a print magazine mailed each month to an online edition published on the ERS website and delivered to email subscribers continuously throughout the year. No matter the format, what has remained consistent has been the ERS research providing greater insight into the economics of food, farming, natural resources, and rural America. As you explore this Year in Review, I encourage you to visit our website (ers.usda.gov), bookmark it, and discover our latest reports, data products, *Amber Waves*, and Charts of Note.

I hope you enjoy this *Amber Waves:Year in Review* and visit ers.usda.gov/subscribe to receive many more ERS products delivered straight to your inbox throughout the year.

Best Wishes,

Spiro Stefanou

ERS Administrator
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Features

THE ECONOMICS OF FOOD

July 2022

Adult Obesity Prevalence Increased During the First Year of the COVID-19 Pandemic

by **Brandon J. Restrepo**

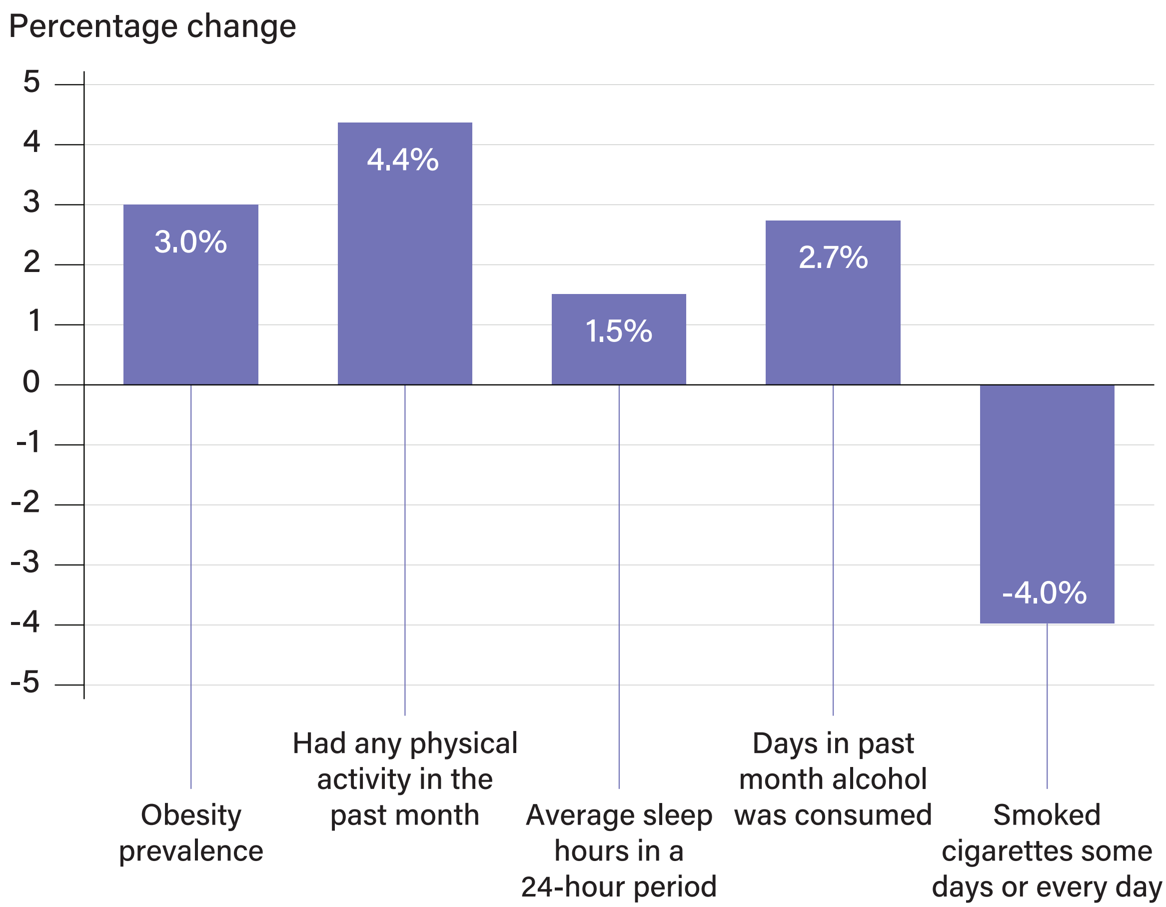
In 2017–2018, 42.4 percent of U.S. adults experienced obesity, according to data from the National Health and Nutrition Examination Survey. As the Coronavirus (COVID-19) pandemic unfolded in 2020, studies using limited online surveys found evidence of weight gain among U.S. adults, suggesting that behavior changes during the pandemic exacerbated an already existing adult obesity epidemic. However, because the pandemic surveys did not represent the overall U.S. adult population, findings derived from them did not fully show how much obesity rates changed for adults during the pandemic.

To analyze the overall change in adult obesity prevalence during the COVID-19 pandemic, a researcher at the USDA, Economic Research Service (ERS) used data from the 2011 to 2020 Behavioral Risk Factor Surveillance System, a nationally representative survey that assesses chronic health conditions and health-related risk behaviors of the U.S. population aged 18 and older. The Centers for Disease Control and Prevention (CDC) uses the Adult Body Mass Index (BMI) to define weight categories and has determined that people aged 20 and older with a BMI of 30 or higher are categorized as obese. The ERS researcher also examined four behaviors that can influence the risk of obesity—exercise, hours of sleep, alcohol use, and cigarette smoking—to help explain changes in adult obesity prevalence rates.

The study found that, compared with a pre-pandemic baseline period (January 1, 2019, to March 12, 2020), adult obesity prevalence was 3 percent higher over the period from March 13, 2020, to March 18, 2021, the first year of the COVID-19 pandemic. March 18, 2021, was the date of the last interview in the analytical sample. Findings also showed statistically significant changes in each of the four obesity-related behaviors during the COVID-19 pandemic. Participation in exercise rose 4.4 percent, and people slept 1.5 percent longer. Meanwhile, the number of days in the period of a month in which alcohol was consumed was 2.7 percent higher, and cigarette smoking dropped by 4 percent. Research shows that increased use of alcohol and reduced cigarette smoking can lead to obesity and therefore may have contributed to the higher rates of obesity among U.S. adults during the pandemic.

CDC recognition of adult obesity as an epidemic dates to 1999. Adult obesity prevalence in the United States was trending upward in the years before the onset of the COVID-19 pandemic. As the pandemic conditions improve in the United States, this ERS study's results can inform U.S. policymakers about the state of the obesity epidemic among U.S. adults as well as the contributing obesity-related behaviors.

Obesity prevalence increased among U.S. adults during the first year of the COVID-19 pandemic



Notes: Bars represent percentage changes in obesity prevalence and related risk factors among U.S. adults aged 20 and older relative to a pre-pandemic baseline period of January 1, 2019, to March 12, 2020. Percentage changes were derived from models that control for survey interview-related factors, State of residence, and demographic characteristics (age, gender, race/ethnicity, education, household income, marital status, and number of children) that could affect the risk of obesity.

Source: USDA, Economic Research Service calculations using data from the 2011–20 Behavioral Risk Factors Surveillance System.

This article is drawn from ...

Obesity Prevalence Among U.S. Adults During the COVID-19 Pandemic, by Brandon J. Restrepo, American Journal of Preventive Medicine, July 2022

Food Consumption & Demand topic page, by Abigail Okrent and Sabrina Young, ERS, February 2022

Diet Quality & Nutrition topic page, by Sabrina Young, ERS, February 2022

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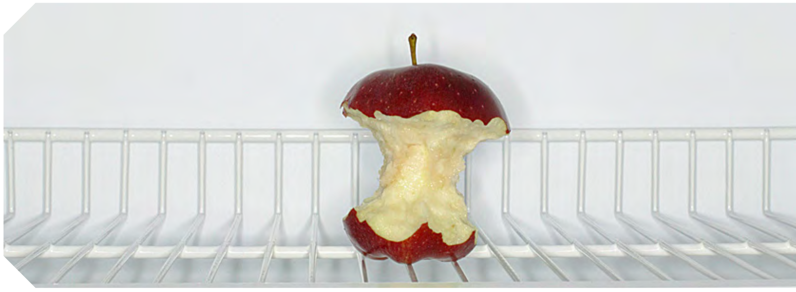
Obesity topic page, by Joanne Guthrie and Mariah Ehmke, ERS, February 2022

Food Insecurity for Households With Children Rose in 2020, Disrupting Decade-Long Decline

by **Laura Hales and Alisha Coleman-Jensen**



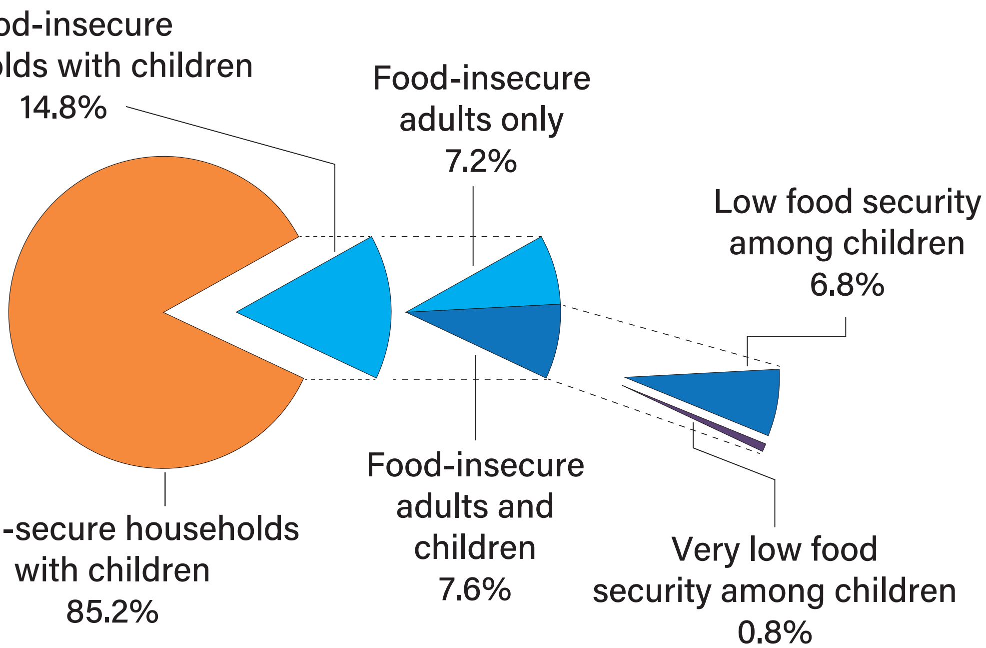
Food security is defined as having access at all times to enough food for an active, healthy life. USDA reported that a lack of food security, or food insecurity, affected 10.5 percent of all U.S. households in 2020, unchanged from 2019. Households with children, however, experienced statistically significant increases in food insecurity during the Coronavirus (COVID-19) pandemic, even as overall food insecurity stayed the same. In 2020, 85.2 percent of households with children were food secure, while 14.8 percent were food-insecure, up from 13.6 percent in 2019.

Annual Survey Measures Food Insecurity in Households With Children

Data from the Current Population Survey Food Security Supplement, sponsored by the USDA, Economic Research Service (ERS), can be used to characterize food insecurity in U.S. households. Each year, ERS provides information on the prevalence and severity of food insecurity in an annual report, Household Food Security in the United States. ERS also publishes graphics, interactive data visualizations, and a recorded webinar that are available on the ERS website.

For households with children, food insecurity is measured for the household overall as well as for adults and

In 2020, food insecurity affected 14.8 percent of households with children



Note: In most instances, when children are food insecure, the adults in the household are also food insecure.

Source: USDA, Economic Research Service using data from the December 2020 Current Population Survey Food Security Supplement, U.S. Census Bureau.

children separately. One adult respondent per household answers a series of 18 survey items that ask about experiences and behaviors pertaining to food insecurity.

The food insecurity of households with children is measured by ERS in three ways:

- food insecurity in households with children (adults, or children, or both are food insecure)
- food insecurity among children
- very low food security among children

Households are classified as food insecure if, at some time during the year, they had difficulty providing enough food for all their members because of a lack of resources. In households with children, food insecurity indicates at least one person in the household experienced reductions in dietary quality or variety and, in some cases, disrupted eating patterns and reduced food intake. However, household food insecurity may be experienced differently across household members. Among the 14.8 percent of households with children that reported food insecurity in 2020, about half reported food insecurity for only the adults in the household.

The second measurement, food insecurity among children, means both adults and children experienced food insecurity. Caregivers in this category report that they were unable to provide adequate, nutritious food for their children at times.

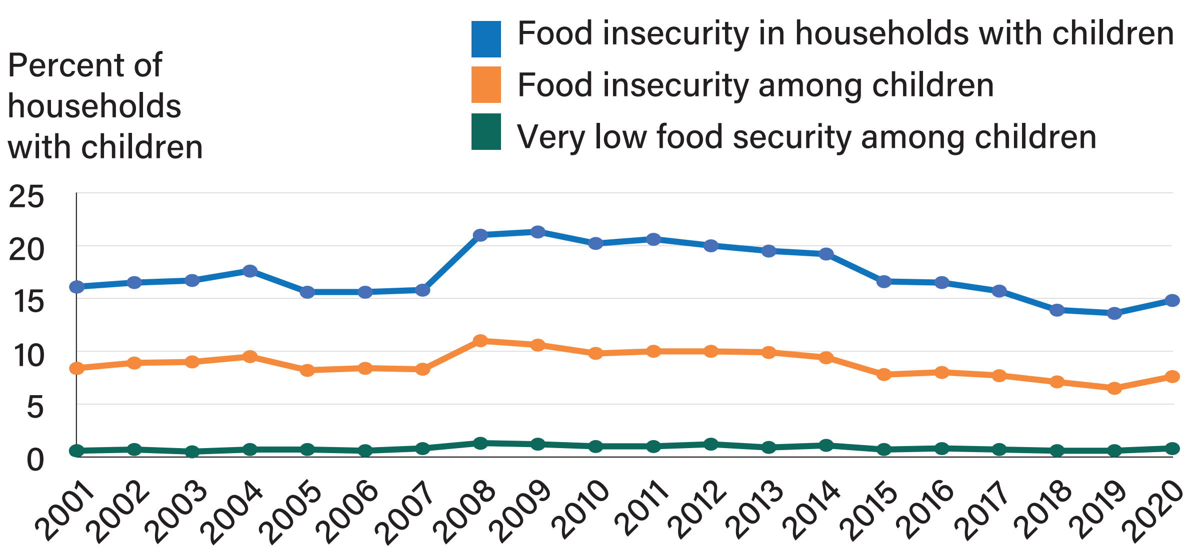
Some households report a more severe range of food insecurity, in which children were hungry, skipped a meal, or did not eat for a whole day because there was not enough money for food. This situation is described as very low food security among children.

Food Insecurity Increased in All Measurement Categories for Households With Children in 2020

All three measurement categories of food insecurity for U.S. children experienced statistically significant increases in 2020. The percent of U.S. households with children that were food insecure reached 14.8 percent in 2020, or 5.6 million households, up from 13.6 percent in 2019. This increase in food insecurity in households with children was the first increase since 2011 and disrupted a decade-long downward trend.

The prevalence of food insecurity among children, in which both adults and children were food insecure, also increased significantly in 2020 to 7.6 percent. Food insecurity among children affected about 2.9 million households, which included about 6.1 mil-

Food insecurity in U.S. households with children became more prevalent in 2020



Source: USDA, Economic Research Service using data from the December 2020 Current Population Survey Food Security Supplement, U.S. Census Bureau.

lion children, or about 8.4 percent of all U.S. children. The 2020 prevalence of food insecurity among children also interrupted a decline from a peak of 11.0 percent in 2008.

Finally, very low food security among children, the most severe range of food insecurity for children, increased significantly to 0.8 percent of households with children, up from 0.6 percent in 2019. Very low food security among children affected 322,000 households with children, which included about 584,000 children (0.8 percent of children).

Food Insecurity Varies by Household Composition

In 2020, married couples with children were the only household composition subgroup to experience a statistically significant increase in food insecurity among children. The prevalence of food insecurity among children in married-couple households with children increased to 4.6 percent from 3.2 percent in 2019. Despite this increase, the prevalence of food insecurity among children in married-couple households was still below the national average of food insecurity among children (7.6 percent in 2020).

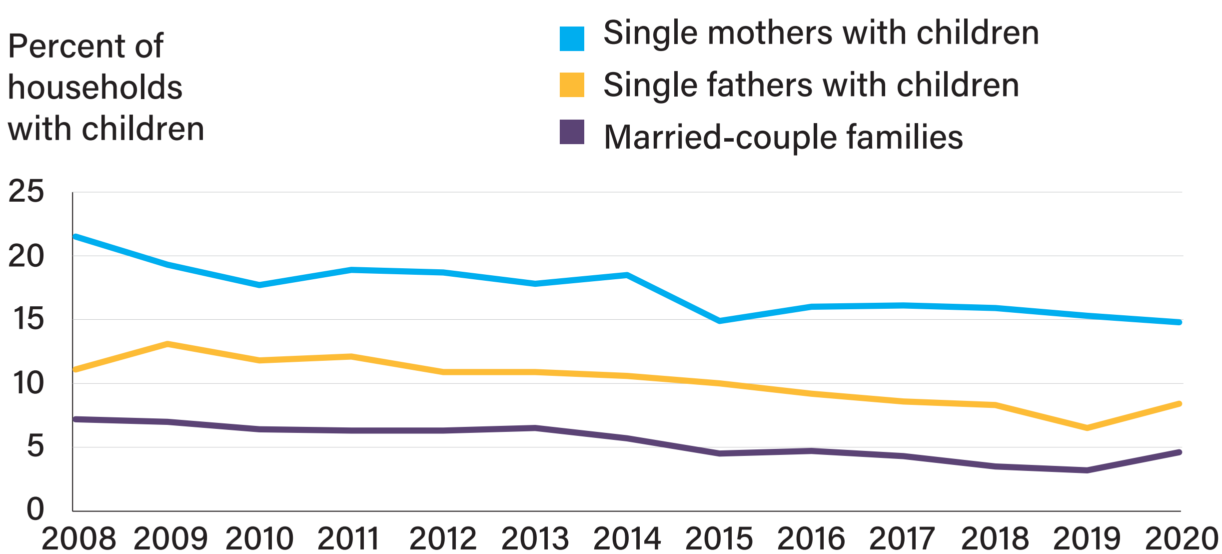
Single mothers with children have historically had the highest levels of food insecurity compared to other household compositions. The change in the prevalence of food insecurity among children in single-mother households was not statistically different from 2019 to 2020.

The prevalence of food insecurity among children in single-mother households with children in 2020 was 14.8 percent, which was significantly higher than for all households with children (7.6 percent). Single-mother households were more than three times as likely to experience food insecurity among children than married-couple households with children. Among single fathers with children, the change in food insecurity among children from 2019 to 2020 was not statistically significant.

Some Racial and Ethnic Groups Saw Increases in Food Insecurity in 2020

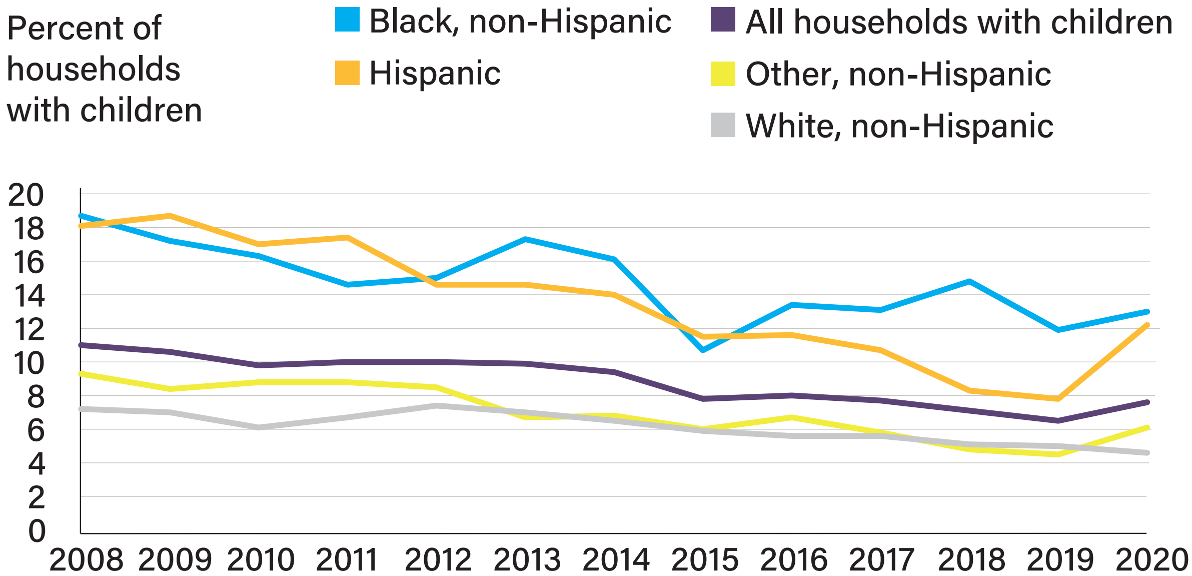
A household is classified by the race and ethnicity of the household reference person. The reference person in the survey is an adult in the household in whose name the housing unit is owned or rented. Households with children headed by Hispanic reference persons not only saw statistically significant increases in food insecurity among children in 2020 but also experienced a significantly higher prevalence of food insecurity than those for all households with children. The prevalence of food insecurity among children in Hispanic households increased to 12.2 percent in 2020 from 7.8 percent in 2019.

Food insecurity among children varies by household composition



Source: USDA, Economic Research Service using data from the December 2020 Current Population Survey Food Security Supplement, U.S. Census Bureau.

The prevalence of child food insecurity among Hispanic households with children increased significantly in 2020



Source: USDA, Economic Research Service using data from the December 2020 Current Population Survey Food Security Supplement, U.S. Census Bureau.

The prevalence of household food insecurity increased significantly from 2019 to 2020 for households with children with Black, non-Hispanic reference persons. However, the change in the measure of food insecurity among children for these households with Black, non-Hispanic reference persons from 2019 to 2020 was not statistically significant. In 2020, food insecurity among children affected 13.0 percent of these households. The prevalence of food insecurity among children in Black, non-Hispanic households has, like single mother households, been historically higher than the prevalence for all households with children.

Households that fall into the other, non-Hispanic category of race and ethnicity are headed by reference persons that identify as Native American, Asian American, multiple-race American, or other. At 6.1 percent, the 2020 prevalence of food insecurity among children in these households was not statistically different from 2019. In 2020, the only race and ethnicity category statistically significantly below the national average for food insecurity among children was White, non-Hispanic households.

This article is drawn from ...

Household Food Security in the United States in 2020, by Alisha Coleman-Jensen, Matthew P. Rabbitt, Christian A. Gregory, and Anita Singh, ERS, September 2021

Interactive Charts and Highlights, by Alisha Coleman-Jensen and Laura Hales, ERS, September 2022

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The Food and Nutrition Assistance Landscape: Fiscal Year 2020 Annual Report, by Saied Toossi, Jordan W. Jones, and Leslie Hodges, ERS, August 2021

USDA School Meals Support Food Security and Good Nutrition, by Joanne Guthrie, Amber Waves, ERS, May 2021

April **2022**

Racial and Ethnic Diversification Will Likely Shape U.S. Food Demand and Diet Quality

by **Diansheng Dong and Hayden Stewart**

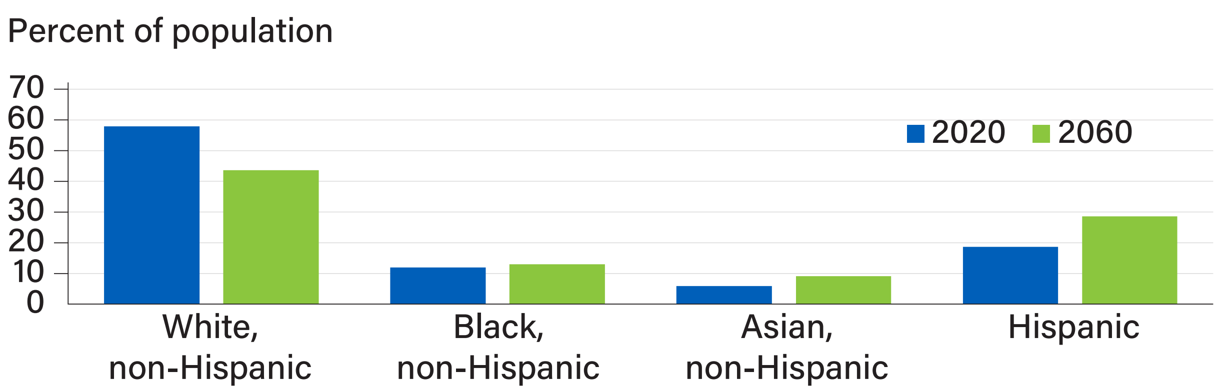
Highlights:

- U.S. demographic trends, including increased diversity brought about by immigration, may cause overall consumer demand for some types of foods to grow faster than demand for others.
- U.S. immigrants generally acculturate in their food choices, adopting eating patterns more like native-born people of their same ethnic and racial group.
- Non-Hispanic Asians may have slightly higher quality diets, on average, than other racial and ethnic groups.

The number of people who call the United States home continues to grow. Results from the most recent decennial census show that the U.S. population increased from about 309 million people in 2010 to about 331 million in 2020. Projections released by the U.S. Census Bureau put the United States on track to reach more than 400 million inhabitants by 2060. Foreign-born residents are forecast to account for about 17 percent of the total U.S. population in 2060, up from 14 percent in 2020. Native-born residents, including children of immigrants, are expected to account for 83 percent.

According to projections, as immigrants arrive from Asia and Latin America, the United States will grow more racially and ethnically diverse. Between 2020 and 2060, the Census Bureau predicts that individuals of Hispanic origin will grow from 19 percent to 29 percent of the total population. Non-Hispanic Blacks are forecast to rise from 12 percent to 13 percent. Non-Hispanic Asians are predicted to increase from 6 percent to 9 percent. And non-Hispanic Whites are

Hispanics and non-Hispanic Asians account for a growing share of the projected overall U.S. population



Note: Numbers rounded and omit individuals of other races and more than one race.

Source: USDA, Economic Research Service using data from the U.S. Census Bureau. Population estimates for 2020 are derived from Census 2020 and those for 2060 are derived from Projections of the Size and Composition of the U.S. Population: 2014 to 2060, by Sandra Colby and Jennifer Ortman, U.S. Census Bureau, 2015.

predicted to decrease from 57 percent to 44 percent of the total population.

These changes in population will likely reshape the types of foods people eat in the United States and how foods are consumed. Many factors, such as income, prices, age, household size, and nutrition knowledge, shape a household's food needs and choices. Along with these factors, race and ethnicity often play a role in food choices and may be associated with deep-rooted food customs.

The USDA, Economic Research Service (ERS) has been examining how trends in the U.S. population might reshape food consumption and diet quality since the early 2000s.

U.S. Food Demand Varies Across Racial and Ethnic Groups

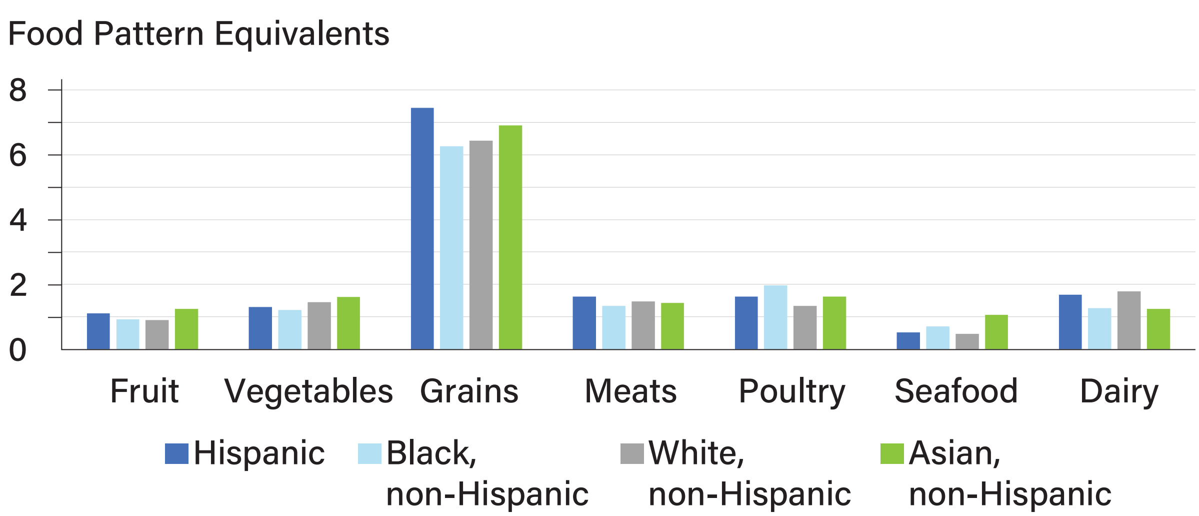
As the population diversifies, the demand for some agricultural commodities also changes. Data from the National Health and Nutrition Examination Survey (NHANES) are widely used to study U.S. food consumption patterns and trends. A USDA-supported survey component, called What We Eat in America, asks individuals to report all foods and beverages consumed over 2 nonconsecutive days.

Food consumption records provided by 2011–18 NHANES participants confirm that individuals identifying with different racial and ethnic groups vary in their food choices. On a per-person, per-day basis, non-Hispanic Asians consumed the most fruits (1.24-cup equivalents), vegetables (1.62-cup equivalents), and seafood (1.06-ounce equivalents). Hispanics consumed the most meat (1.62-ounce equivalents). Non-Hispanic Blacks ate the most poultry (1.98-ounce equivalents). Non-Hispanic Whites consumed the most dairy products (1.79-cup equivalents).

While differences in income, household size, and other factors likely drive some of the above relationships, deep-rooted food customs also appear to be a factor in these patterns. Similar to current NHANES data, a 2003 ERS study confirmed that non-Hispanic Asians consume more seafood than other racial and ethnic groups after controlling for other factors. The same study also correctly predicted that as the Asian-American population grew, the U.S. seafood demand would grow faster in the 2000s and 2010s than the demand for meat and poultry.

A 2021 ERS study used food consumption records provided by 2003–18 NHANES participants for a long-run perspective on how U.S. fluid cow's milk consumption has been changing over time. Among other findings, the researchers confirmed that non-

Food consumption varies among racial and ethnic groups



Note: Fruit, vegetables, and dairy daily per capita consumption are measured in cup equivalents while grains and protein foods consumption are measured in ounce equivalents.

Source: USDA, Economic Research Service using data from the Centers for Disease Control and Prevention, National Center for Health Statistics 2011–18 National Health and Nutrition Examination Survey and accompanying releases of the Food Patterns Equivalents Database.

Hispanic Whites drink more fluid cow's milk than other racial and ethnic groups controlling for age, gender, education, and other potentially complicating factors. The study also identified that non-Hispanic Whites account for a shrinking share of the overall population, which is a contributing factor in declining U.S. per capita milk consumption.

Immigrants Change Their Eating Habits With Time Spent in the United States

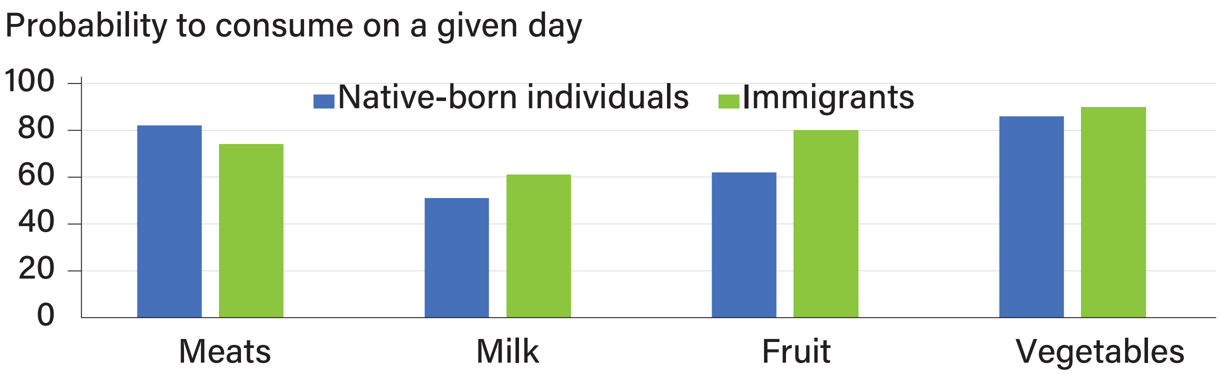
Immigrants arriving in the United States bring with them, at least initially, food consumption habits learned in their originating countries. Food consumption patterns vary between native-born individuals and recent immigrants. Using NHANES dietary intake records, an ERS researcher and a visiting scholar to ERS recently found that, on any given day, new immigrants are less likely to eat meat than native-born individuals in the same racial and ethnic group (75 percent versus 81 percent) but more likely to drink fluid cow's milk (56 percent of immigrants versus 51 percent of native-individuals), more likely to eat fruit (74 percent versus 62 percent), and more likely to consume vegetables (88 percent versus 86 percent).

The ERS researcher and visiting scholar also found that, as time goes on, immigrants acculturate in their food choices and adopt eating patterns more like native-born people of their same ethnic and racial group. In other words, differences in food demand between immigrants and native-born U.S. citizens of the same racial and ethnic background do not persist over time, unlike those between Hispanics, non-Hispanic Whites, non-Hispanic Blacks, and non-Hispanic Asians.

Food acculturation typically happens within 5 to 10 years of one's arrival in the United States. This tendency is most pronounced among non-Hispanic Asian immigrants. The probability that a non-Hispanic Asian immigrant consumes meat on a given day increases by 16 percent within 5 years of the individual's arrival in the United States and by 22 percent within 10 years.

The likelihood an immigrant consumes fruit on a given day conversely tends to fall with time spent in the United States. The probability that a non-Hispanic Black immigrant eats fruit on a given day falls by almost 8 percent in 5 years and almost 12 percent within 10 years.

U.S. immigrants are less likely than native-born individuals to eat meats on a given day but more likely to consume milk, fruits, and vegetables

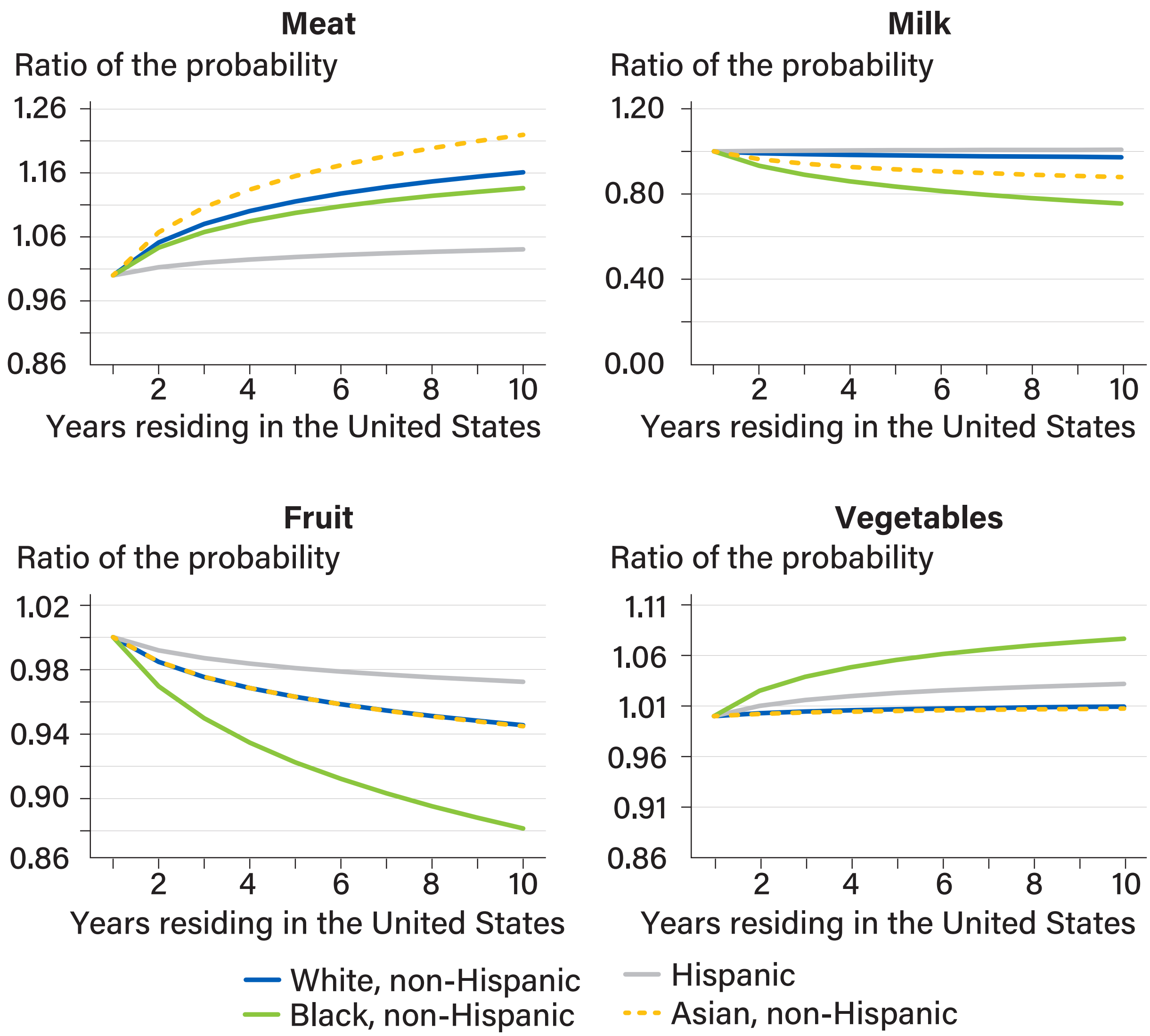


Note: Meats includes unprocessed beef, pork, poultry, and other types of meats but excludes processed varieties.

Source: "Ethnic Variation in Immigrants' Diets and Food Acculturation – United States 1999–2012," by Geir Gustavsen, Diansheng Dong, Rodolfo Nayga Jr., and Kyrre Rickertsen, *Agricultural and Resource Economics Review*, 2021.

Immigrants' diets change with time spent in the United States

Probability that an immigrant consumes ________ on a given day compared to a new arrival of the same racial and ethnic background



Note: Meats includes unprocessed beef, pork, poultry, and other types of meats but excludes processed varieties.

Source: "Ethnic Variation in Immigrants' Diets and Food Acculturation – United States 1999–2012," by Geir Gustavsen, Diansheng Dong, Rodolfo Nayga Jr., and Kyrre Rickertsen, *Agricultural and Resource Economics Review*, 2021.

Differences in Diet Quality Also Exist Among Racial and Ethnic Groups

Differences in what people eat are associated with differences in their diet quality. The Healthy Eating Index (HEI) is a tool for measuring diet quality. Specifically, it can be used to assess the degree to which a set of foods aligns with recommendations in the *Dietary Guidelines for Americans*. The HEI is updated every 5 years in concert with each new version of the Guidelines by USDA's Food and Nutrition Service (FNS). According to FNS, among participants in the 2015–16 NHANES, the average HEI score was 59 out of a possible 100 points which indicates that individuals do not in general conform to dietary recommendations. Among racial and ethnic groups, non-Hispanic Asians scored highest (65 points out of a possible 100 points). Numerous studies confirm that healthier diets, measured by higher HEI scores, are associated with improved health and reduced risk of disease.

ERS researchers have used the HEI to measure the dietary quality of foods purchased and consumed by U.S. households and individuals. A 2019 ERS study used food consumption records provided by NHANES participants from 2003 through 2016. A statistical model was estimated to identify the effects of income, age, gender, ethnicity, education, and prior history of military service, among other factors, on individuals' diet quality. While the study was focused primarily on effects of military service, ERS researchers also identified ethnicity effects. Overall, Hispanics, all else constant, were found to have HEI scores about 2.4 points higher than other individuals. The study did not consider Asians because NHANES data collected before the 2011–12 survey cycle did not identify individuals belonging to that racial group.

As the U.S. population further diversifies with a growing share of Asian, non-Hispanic and Hispanic people, domestic demand for agricultural products and overall diet quality in the Nation will likely also continue to shift. Even as new immigrants acculturate and adopt the eating patterns of native-born U.S. citizens of their same racial ethnic background, food demand and diet quality differences remain among racial and ethnic groups. Food consumption patterns and diet quality measures broken down by racial and ethnic groups continue to be informative for policymakers and other decision-makers.

This article is drawn from ...

Food and Agricultural Commodity Consumption in the United States: Looking Ahead to 2020, by Biing-Hwan Lin, Jay Variyam, Jane E. Allshouse, and John Cromartie, ERS, February 2003

Examining the Decline in U.S. Per Capita Consumption of Fluid Cow's Milk, 2003–18, by Hayden Stewart, Fred Kuchler, Diansheng Dong, and Jerry Cessna, ERS, October 2021

Ethnic Variation in Immigrants' Diets and Food Acculturation – United States 1999–2012, by Gustavsen, G., D. Diansheng, R. Nayga Jr., and K. Rickertsen, Agricultural and Resource Economics Review, 2021

An Examination of Veterans' Diet Quality, by Diansheng Dong, Hayden Stewart, and Andrea Carlson, ERS, December 2019

Spending Gap Between Full- and Quick-Service Restaurants Widened During Coronavirus (COVID-19) Pandemic

by **Keenan Marchesi**

The Coronavirus (COVID-19) pandemic sparked an unprecedented shift in the way U.S. consumers spent money on food, particularly at restaurants and other food-away-from-home (FAFH) establishments. To document changes in consumer FAFH spending, researchers from the USDA, Economic Research Service (ERS) recently worked with proprietary data from a market research organization that were collected before and throughout the pandemic.

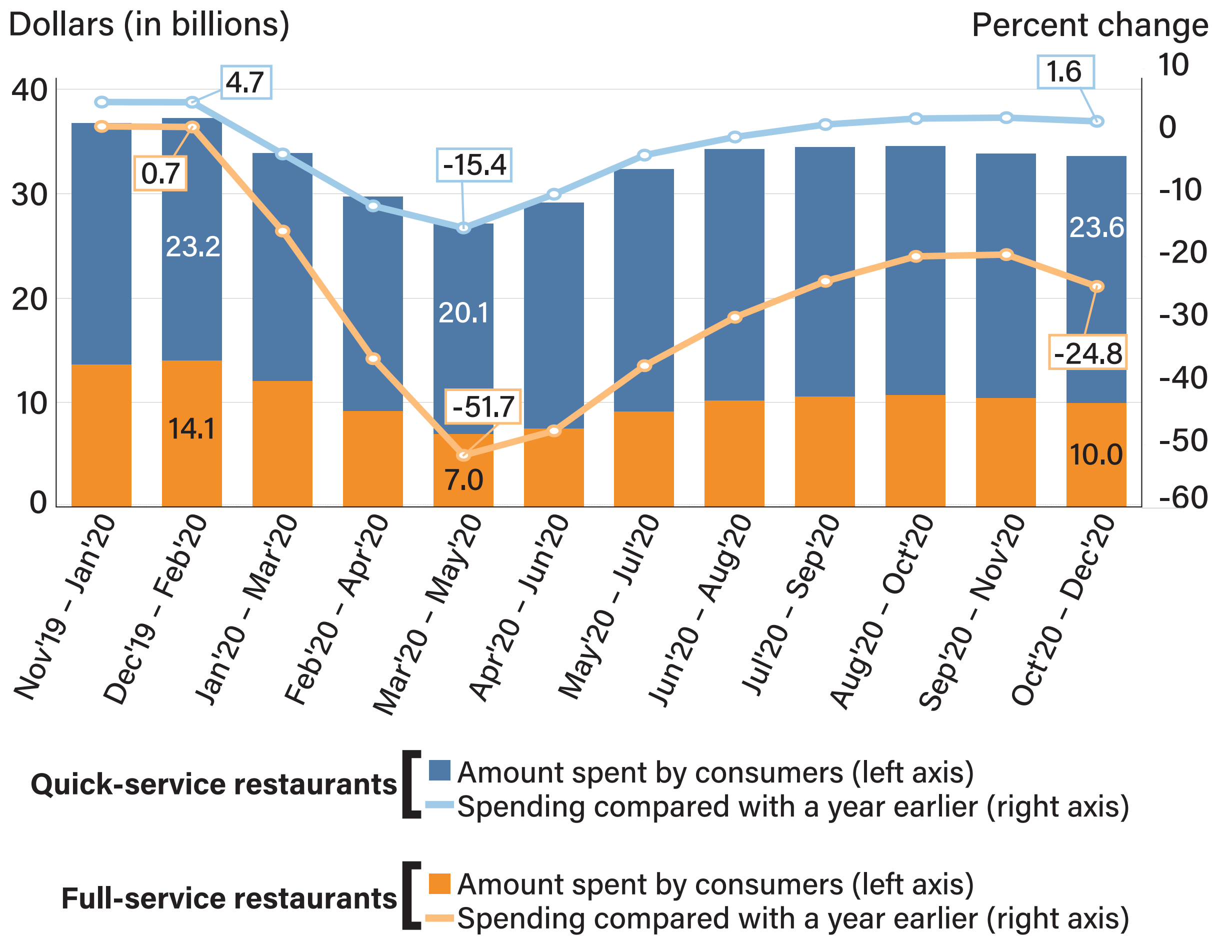
Specifically, ERS researchers used The NPD Group's Consumer Reported Eating Share Trends (CREST), which provide national estimates of dollars spent at restaurants and other FAFH retailers. In an online survey, consumers reported how much they spent at various outlets and the total spent (including tax but excluding tips) on meals, snacks, or beverages. NPD used these individual-level surveys to generate nationally representative projections of consumer expenditures on a rolling 3-month basis to better understand overall trends. Using a rolling 3-month basis also means the timing of spending patterns lags what might have been expected in a given month.

ERS researchers found that while restaurant spending dropped after the onset of the pandemic for all FAFH establishments, the reduction in sales was more pronounced for full-service restaurants than for quick-service restaurants. Quick-service establishments typically specialize in a particular type of food such as hamburgers, pizza, or chicken. At quick-service restaurants, customers usually order and pay at a counter or drive-thru before eating their food. Full-service restaurants typically offer table service and include three categories of establishments: fine dining, casual dining, and mid-scale. These categories vary according to how much an average meal costs, the size and scope of bar selections, and whether reservations are accepted.

Just before the pandemic (December 2019 to February 2020), consumer spending at quick- and full-service restaurants was near or slightly above where it had been the previous year. Average total dollars spent at quick-service restaurants during this period was $23.2 billion, nearly 5 percent higher than the same period a year earlier. At full-service restaurants, the average amount spent during the same period was $14.1 billion, about the same as the year before. For context, quick-service restaurant spending from December 2019 to February 2020 made up about 62 percent of total restaurant spending, with the remaining 38 percent spent at full-service restaurants.

From March to May 2020, the first 3-month period observed since the pandemic began, average total spending dropped for both restaurant categories. However, there were notable differences. Spending at quick-service restaurants dropped to about $20.1 billion, 15.4 percent lower than average spending from March to May 2019. Full-service restaurants experienced a more severe drop as State and local Governments across the country implemented social distancing mandates that limited in-person dining. During this time, spending at full-service establishments fell to $7.0 billion, almost 52 percent lower than a year earlier.

Spending dropped more at full-service restaurants than quick-service restaurants in 2020



Notes: Results based on the 3-month rolling average of dollars (not adjusted for inflation) spent during the time period listed. Percent change calculated as the 3-month rolling average of dollars (not adjusted for inflation) spent during the time period listed compared with the same period 1 year prior.

Source: USDA, Economic Research Service using data as of January 2022 from The NPD Group's Consumer Reported Eating Share Trends.

Quick-service restaurants recovered faster than their full-service counterparts in the latter half of 2020. As of July–September 2020 through the end of 2020, spending at quick-service restaurants exceeded that of the same period in 2019. By contrast, as of the end of 2020, spending at full-service restaurants dropped 24.8 percent from the previous year. Quick-service restaurants, such as those with drive-up service, were likely able to adapt more easily to the restrictions of the pandemic than full-service restaurants that previously primarily relied on an in-person customer base.

This article is drawn from ...

COVID-19 Working Paper: The Impact of COVID-19 Pandemic on Food-Away-From-Home Spending, by Keenan Marchesi and Patrick W. McLaughlin, ERS, March 2022

You may also be interested in ...

Food Expenditure Series, by Eliana Zeballos and Wilson Sinclair, ERS, December 2022

June **2022**

Fluid Milk Consumption Continues Downward Trend, Proving Difficult to Reverse

by **Hayden Stewart and Fred Kuchler**

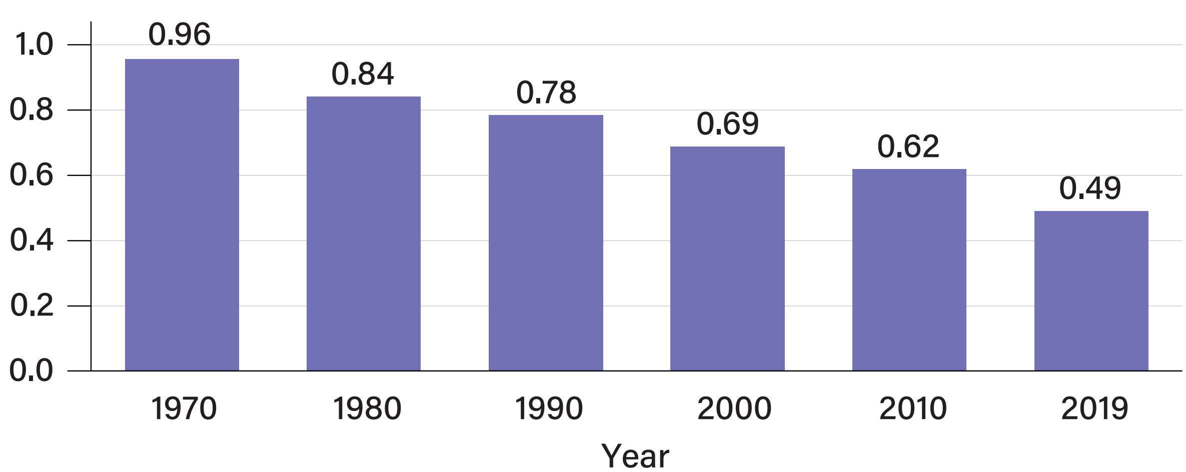
Highlights:

- U.S. per capita fluid milk consumption has been trending downward for more than 70 years and fell at a faster rate during the 2010s than in each of the previous six decades.
- From 2003 to 2018, U.S. consumers of all ages drank less milk as a beverage, the primary way in which fluid milk is consumed.
- Plant-based milk alternatives explain only a small portion of the decline in U.S. fluid milk consumption.

Fluid cow's milk has long been a grocery staple for most U.S. households. However, as dietary habits change, individuals are drinking less milk on average. The USDA, Economic Research Service (ERS) Food Availability (Per Capita) Data System shows that U.S. daily per capita consumption of fluid milk decreased over each of the past seven decades. Between 1990 and 2000, it fell from 0.78 cup to 0.69 cup (an 11.5-percent decline). By 2010, it was down to 0.62 cup (10.1 percent lower than it had been in 2000). Compared with each of the previous six decades, U.S. daily per person fluid milk consumption fell at its fastest rate in the 2010s. In 2019, it was 0.49 cup (20.7 percent lower than in 2010).

U.S. per capita consumption of fluid cow's milk has fallen further each decade since 1970s

Cups per person per day



Source: USDA, Economic Research Service Food Availability (Per Capita) Data System.

The *Dietary Guidelines for Americans, 2020–2025*, recommend individuals consume 2- to 3 cup-equivalents of dairy products per day depending on their age, gender, and level of physical activity. One cup of fluid cow's milk, 1 cup of yogurt, 1.5 ounces of natural cheese, or 2 ounces of processed cheese each contribute 1 cup-equivalent toward meeting daily dairy recommendations. One cup of fortified soy beverage also counts as 1 cup-equivalent of dairy product. Other plant-based products bearing two-part names (almond milk, rice milk, coconut milk, oat milk, hemp milk, and others) are not included as part of the dairy group because their overall nutritional content is not similar to that of dairy milk.

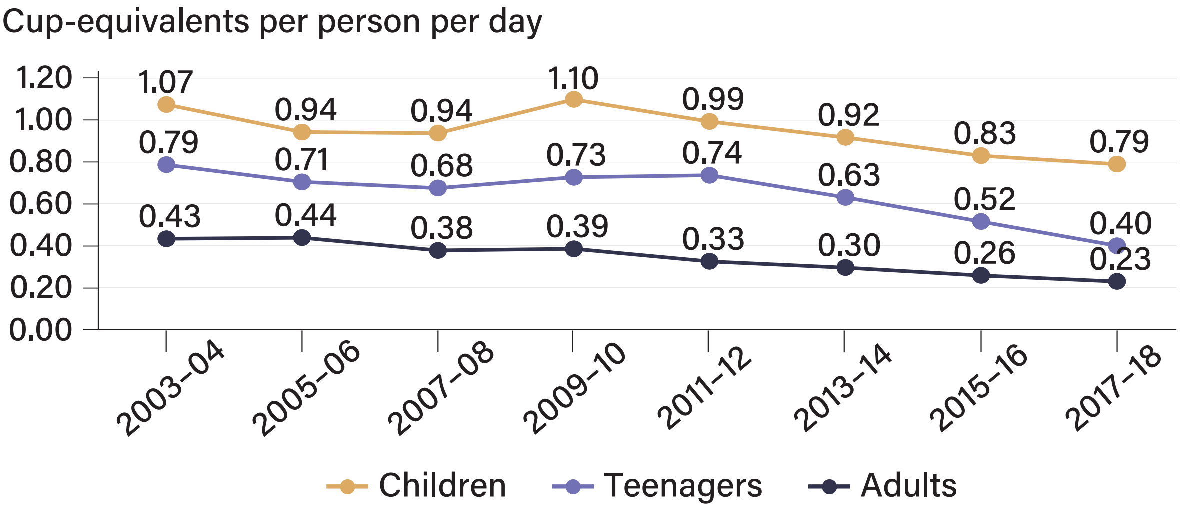
Despite Government and industry efforts, about 90 percent of the U.S. population does not meet the Dietary Guidelines' dairy recommendations. Although U.S. per capita cheese and yogurt consumption has more than tripled since 1970, U.S. per capita consumption of all dairy products peaked in 1987 at 1.57 cup-equivalents per day. People drank less milk during the 1990s and 2000s, more or less offsetting increases in consumption of other dairy products. In 2009, consumption of U.S. dairy products was 1.55 cup-equivalents per person per day. By 2019, it was 1.49 cup-equivalents, weighed down by the faster rate of declines in milk consumption.

The future of U.S. fluid milk consumption depends not just on the overall trend but also on which consumers are reducing their consumption most and how they do so. To investigate U.S. fluid milk consumption trends among age groups, ERS researchers recently examined dietary intake surveys cooperatively planned and conducted by USDA and the National Center for Health Statistics (part of the Centers for Disease Control and Prevention) between 2003 and 2018. In these surveys, participants reported their food and beverage intake during a 24-hour period. They recorded what and how much they ate and drank and whether they consumed foods and beverages as standalone items or in combination with other foods. ERS researchers also studied scanner data collected between 2013 and 2018 with detailed information about which products a panel of households bought over that time period at retail stores. This study helped to better understand the evolving relationship between households' purchases of fluid dairy milk, plant-based milk alternatives, and other potentially competing beverages.

Milk as a Beverage

Dietary intake surveys from 2003–2018 confirm that people in the United States primarily consume fluid cow's milk as a beverage. Even so, during this same

Per capita consumption of milk as a beverage fell among all age groups in the 2010s



Note: One 8-ounce glass of cow's milk is 1 full cup-equivalent.

Source: USDA, Economic Research Service analysis of National Health and Nutrition Examination Survey's What We Eat in America data, 2003–18.

period, individuals of all ages significantly decreased their consumption. This includes plain and flavored milk as well as malted milk, eggnog, and hot chocolate, among other milk-based beverages. Per capita daily consumption among children (ages 12 years and under) initially fluctuated over the 2000s. Children's consumption of milk measured 1.07 cup-equivalents in 2003–04 and 1.10 cup-equivalents in 2009–10. However, during the 2010s, per capita consumption of milk as a beverage declined steadily among children, falling to 0.79 cup-equivalent per day in 2017–18. Steady declines also occurred in per capita consumption among teenagers (ages 13 through 19) and adults (ages 20 and older) after 2011–12.

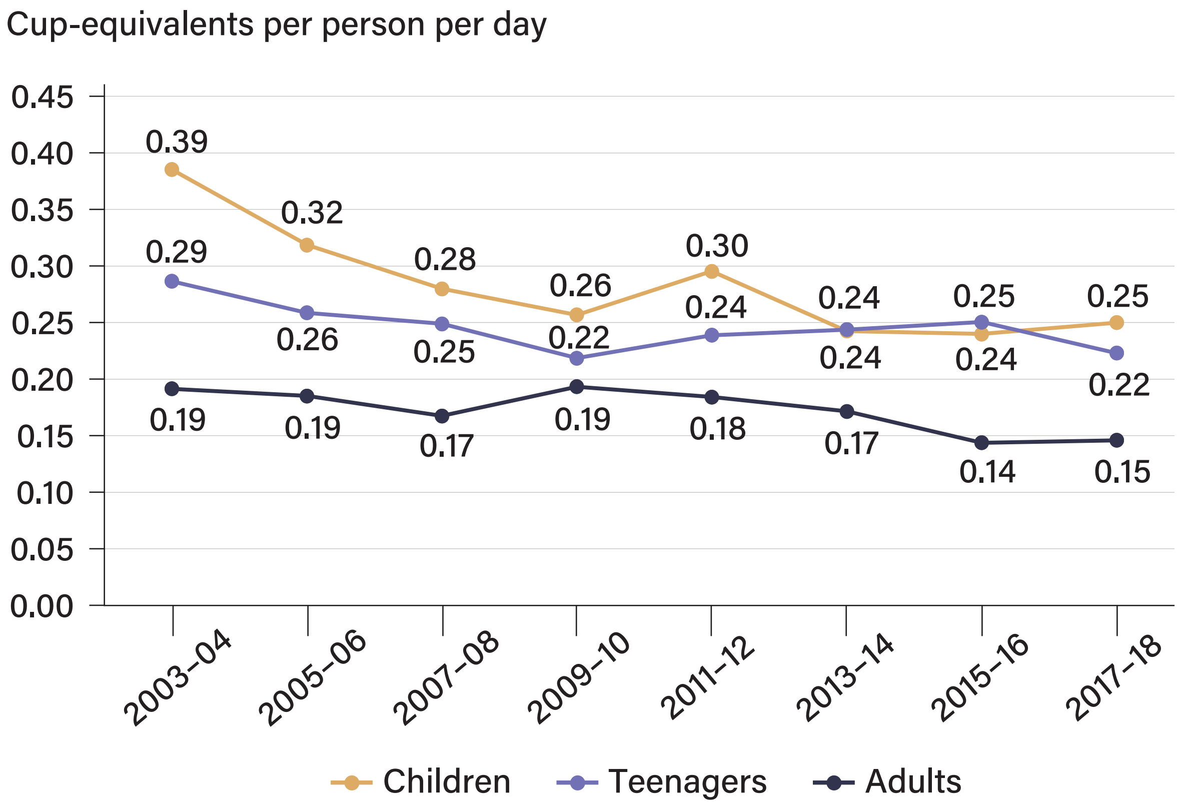
Milk with Cereal

People also pour fluid cow's milk on hot and cold cereal. Between 2003 and 2018, U.S. per person consumption of milk in this manner fell, with the steepest drop occurring among children. Among children, it fell from 0.39 cup-equivalent in 2003–04 to 0.25 cup-equivalent in 2017–18. A smaller decrease occurred among adults. Changes in consumption among teenagers were statistically insignificant.

Milk in Other Beverages

A third way people use fluid cow's milk is by adding it to beverages such as coffee and tea. No statistically significant changes were detected in the amount of milk that individuals use this way over the 2000s and 2010s. In 2017–18, adults consumed an average of about 0.09 cup-equivalent of milk with non-dairy beverages each day, much as they did in 2003–04.

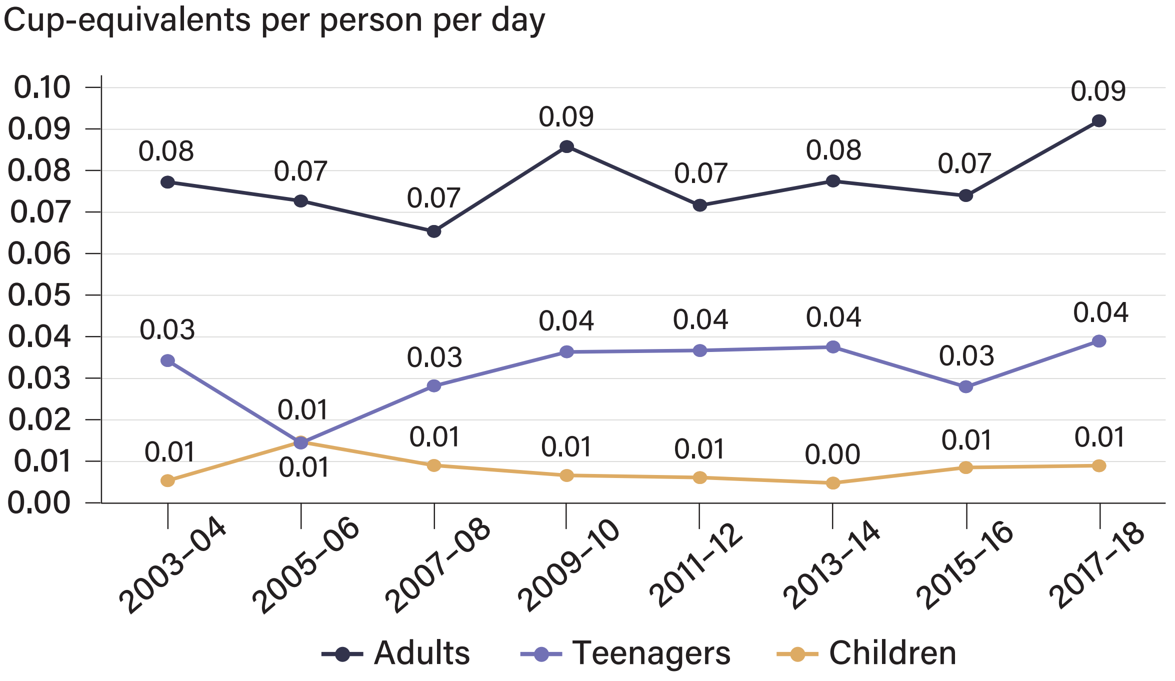
Per capita consumption of milk with cereal has fallen since the 2000s



Note: One 8-ounce glass of cow's milk is 1 full cup-equivalent.

Source: USDA, Economic Research Service analysis of National Health and Nutrition Examination Survey's What We Eat in America data, 2003–18.

Per capita consumption of milk in non-dairy beverages like tea and coffee did not significantly change over the 2000s and 2010s



Note: One 8-ounce glass of cow's milk is 1 full cup-equivalent.

Source: USDA, Economic Research Service analysis of National Health and Nutrition Examination Survey's What We Eat in America data, 2003–18.

What Has Contributed to the Downward Trend?

Underlying the long-run downward trend in milk drinking are differences in the eating and drinking habits of newer and older generations. A 2013 ERS report shows that newer generations are consuming less fluid milk than preceding generations. Individuals born in the 1970s, for example, drank less milk in their teens, 20s, and 30s than individuals born in the 1960s did at the same age points. Those born in the 1980s and 1990s, in turn, appear likely to consume even less fluid milk in their adulthood than those born in the 1970s. These differences across generations reflect in part their unique eating choices as children. Every decade brings a wider selection of beverage choices at supermarkets, restaurants, and other food outlets.

Nutritionists have pointed out that consumption of sugar-sweetened beverages such as soft drinks and juice drinks increased during the 1980s and 1990s and appeared to be replacing milk. However, in recent years, U.S. per capita consumption of sugar-sweet-

ened beverages also has declined. Using data on households' beverage choices between 2013 and 2018, ERS researchers examined households' purchases at retail grocery stores of milk, soft drinks, 100-percent juice and juice drinks, bottled water, and coffee and tea drinks. They found little evidence that consumption of one beverage was offset by consumption of another. That is, competition between milk and these other major beverage categories was found to have little effect on milk purchases over those years.

There was, however, evidence that plant-based milk alternatives, such as almond milk and soy milk, do compete with fluid cow's milk. ERS research using household scanner data confirms that sales of these beverages are negatively affecting purchases of fluid cow's milk. Still, the increase in their sales is much smaller than the decrease in sales of fluid cow's milk, so plant-based milk alternatives can explain only a small share of overall sales trends. Sales of plant-based milk alternatives may be contributing to sales trends for fluid cow's milk but are not likely to be a primary driver of those trends.

USDA Supports Dairy Consumption

Several USDA programs encourage consumption of fluid cow's milk and overall dairy consumption, including the National School Lunch and School Breakfast Programs; the Special Supplemental Nutrition Program for Women, Infants, and Children, or WIC; and the Special Milk Program. Schools participating in the National School Lunch Program, for example, must offer students 1 cup of milk with each lunch.

When analyzing the 2003–18 dietary records of teenagers and children, ERS researchers found that children aged 6 through 12 years obtained 35 percent of their fluid milk at schools while teenagers aged 13 through 18 years obtained 25 percent of their fluid milk at schools. Consumption of fluid milk was also higher for both groups on weekdays, when schools are generally in session, than on weekends.

Dairy farmers and fluid milk processors also invest in checkoff programs that operate with oversight from USDA's Agricultural Marketing Service. The Fluid Milk Processor Promotion Program, funded by fluid milk processors, was designed to maintain and expand markets and uses for fluid milk products produced in the United States through generic advertising (designed to promote a general product rather than a particular brand). The National Dairy Promotion and Research Board, funded by dairy farmers and dairy product importers, seeks to increase sales of, and demand for, all types of dairy products and ingredients.

ERS research in 2017 found that thousands of new beverage products are introduced in the U.S. market each year, which may compete with fluid milk. This mix of new products includes a variety of milks, carbonated soft drinks, fruit drinks, juices, energy drinks, sports drinks, and waters with fruit flavoring, among others. Competition among these products is based in part on price. Product packaging may also highlight attributes, including flavor or whether the product is USDA Organic certified, is natural in origin, contains probiotics, contains calcium, is lactose-free, is non-GMO, or is without artificial sweeteners. Future milk-drinking trends in the United States may be shaped by the abilities of milk processors and other beverage manufacturers to gauge and anticipate the mix of attributes most appealing to consumers.

This article is drawn from ...

Examining the Decline in U.S. Per Capita Consumption of Fluid Cow's Milk, 2003–18, by Hayden Stewart, Fred Kuchler, Diansheng Dong, and Jerry Cessna, ERS, October 2021

Why Are Americans Consuming Less Fluid Milk? A Look at Generational Differences in Intake Frequency, by Hayden Stewart, Diansheng Dong, and Andrea Carlson, ERS, May 2013

Is Competition Among Soft Drinks, Juices, and Other Major Beverage Categories Responsible for Reducing Americans' Milk Consumption? by Hayden Stewart, Fred Kuchler, and William Hahn, Agribusiness: An International Journal, 2021

Plant-Based Products Replacing Cow's Milk, But the Impact is Small, by Hayden Stewart, Amber Waves, ERS, December 2020

An Assessment of Product Turnover in the U.S. Food Industry and Effects on Nutrient Content, by Stephen Martinez and David Levin, ERS, November 2017

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September **2022**

Pandemic-Related Program Changes Continued to Shape the U.S. Food and Nutrition Assistance Landscape in Fiscal Year 2021

by **Saied Toossi, Jordan W. Jones, and Leslie Hodges**

Highlights:

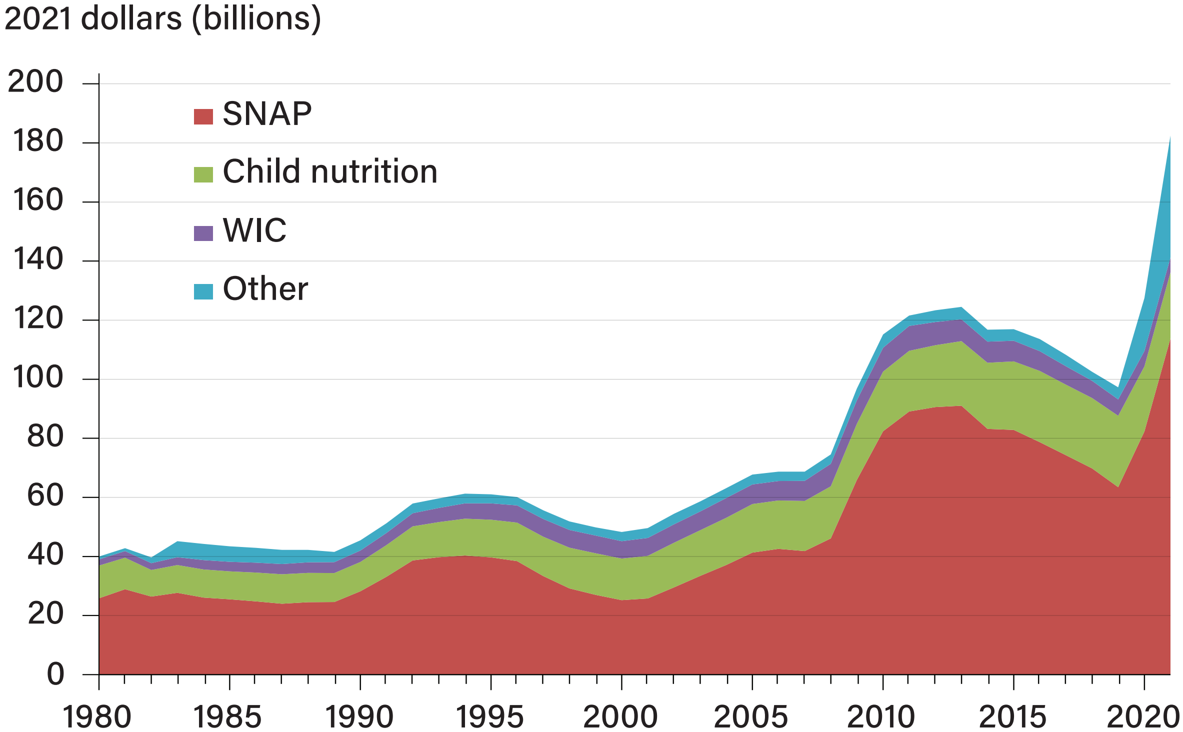
- The COVID-19 pandemic led to significant changes to existing USDA food and nutrition assistance programs and the creation of two temporary food assistance programs.
- USDA's continued response to the pandemic in fiscal year (FY) 2021 (October 2020 through September 2021) pushed expenditures on food and nutrition assistance to a historic high of $182.5 billion for the second year in a row.
- The U.S. food and nutrition assistance landscape continued to evolve in FY 2022 with further pandemic-related adjustments to Federal programs.

The Coronavirus (COVID-19) pandemic led to an economic downturn and rising unemployment in fiscal year (FY) 2020 (October 1, 2019, to September 30, 2020), resulting in an increased need for food and nutrition assistance. In response, the U.S. Government expanded USDA's food and nutrition assistance programs, adjusted program operations, and created additional, temporary programs. Throughout FY 2021 (October 1, 2020, to September 30, 2021), the Government continued to develop its food and nutrition assistance policy as the pandemic and its impacts persisted. Accordingly, annual USDA food and nutrition assistance spending nearly doubled from $92.5 billion in FY 2019 to a record $182.5 billion in FY 2021.

Researchers at USDA, Economic Research Service (ERS) document trends in food and nutrition assistance program participation and spending each fiscal year using data collected by USDA's Food and Nutrition Service and Agricultural Marketing Service. ERS's latest Food and Nutrition Assistance Landscape report describes participation and spending in USDA's largest food and nutrition assistance programs during FY 2021, the first full fiscal year of the pandemic. The report documents how the Federal food assistance landscape continued to evolve in response to Federal legislation and economic conditions.

In both FY 2020 and FY 2021, changes to existing food and nutrition programs included increased benefits, expanded coverage, and ways to make program administration more flexible. In addition, Congress authorized USDA to create the Pandemic Electronic Benefit Transfer (P-EBT) program, which reimburses eligible families for the value of school meals their children miss because of the pandemic. USDA also created the Farmers to Families Food Box Program (Food Box Program), now expired, which facilitated the delivery of U.S. agricultural commodities to food banks and other charitable organizations.

USDA inflation-adjusted spending on food and nutrition assistance rose to record $182.5 billion in fiscal year 2021



Notes: **SNAP** = Supplemental Nutrition Assistance Program. **WIC** = Special Supplemental Nutrition Program for Women, Infants, and Children. **Child nutrition** includes cash payments and commodity costs for the National School Lunch, School Breakfast, Child and Adult Care Food, Summer Food Service, and Special Milk programs. It does not include the Federal share of State administrative expenses. **Other** includes all other food and nutrition assistance programs, including Pandemic Electronic Benefit Transfer (P-EBT) and the Farmers to Families Food Box Program, and administrative expenses not elsewhere classified in fiscal years 2020 and 2021. Dollars are adjusted for inflation using the Personal Consumption Expenditures Price Index from the U.S. Department of Commerce, Bureau of Economic Analysis. Data are as of April 2022 and are subject to revision.

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

A Look at Food and Nutrition Assistance and Relevant Legislation in FY 2020 and FY 2021

Typically, the largest food and nutrition assistance programs administered by USDA include the:

- Supplemental Nutrition Assistance Program (SNAP),
- Special Supplemental Nutrition Program for Women, Infants, and Children (WIC),
- National School Lunch Program (NSLP),
- School Breakfast Program (SBP), and
- Child and Adult Care Food Program (CACFP).

The largest program is SNAP, which provides low-income households with resources to buy food and reaches tens of millions of people each month. 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 NSLP, SBP, and CACFP, provide nutritious meals and snacks at low or no cost to children in participating schools and child-care providers (and some adults in day care facilities through the CACFP).

Timeline of Federal food assistance policy developments, FY 2021

October 2020 · November 2020 · December 2020 · January 2021 · February 2021 · March 2021 · April 2021 · May 2021 · June 2021 · July 2021 · August 2021 · September 2021

10/1: **Continuing Appropriations Act, 2021 and Other Extensions Act**
- P-EBT expanded to cover children aged under 6 and children in Puerto Rico, Northern Mariana Islands, and American Samoa.

12/27: **Consolidated Appropriations Act, 2021**
- Beginning 1/1, maximum SNAP benefit temporarily increased 15 percent for 6 months.

1/22: P-EBT benefits increased 15 percent going forward.

3/11: **American Rescue Plan Act of 2021**
- P-EBT expanded to cover summer 2021 and authorized for any school year with a COVID-19 public health emergency declaration.
- WIC agencies temporarily allowed to increase the CVV amount for fruits and vegetables up to $35 per participant for up to 4 months.
- $390 million provided for WIC outreach, innovation, and program modernization through FY 2024.
- Temporary 15 percent SNAP benefit increase extended 3 months.

4/1: SNAP emergency allotments revised; households previously receiving no emergency allotment or an emergency allotment of less than $95 will now receive a $95 monthly emergency allotment.
4/20: Waiver established for school year 2021–22 to allow reimbursement of SSO meals and snacks at higher SFSP rate.

5/31: Farmers to Families Food Box Program ends.

7/1: Reimbursement of SSO meals at higher SFSP rate begins.

8/16: USDA announces reevaluation of the Thrifty Food Plan, which will increase the maximum SNAP benefit 21 percent beginning 10/1/21.

9/29: USDA announces $1.5 billion to help school districts obtain agricultural commodities for school meal programs.
9/30: 15 percent maximum SNAP benefit increase expires.
9/30: WIC CVV increase expires.
9/30: **Extending Government Funding and Delivering Emergency Assistance Act**
- Beginning October 1, 2021, WIC CVV amounts temporarily increase to $24 (child participants), $43 (pregnant and postpartum women), or $47 (breastfeeding women) for 3 months.

Notes: **FY** = fiscal year; **P-EBT** = Pandemic Electronic Benefit Transfer; **WIC** = Special Supplemental Nutrition Program for Women, Infants, and Children; **CVV** = cash-value voucher; **SNAP** = Supplemental Nutrition Assistance Program; **SSO** = National School Lunch Program and School Breakfast Program's Seamless Summer Option; **SFSP** = Summer Food Service Program.

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

In response to the pandemic, Congress passed two bills in March 2020 that transformed the food and nutrition assistance landscape. The Families First Coronavirus Response Act authorized SNAP emergency allotments to temporarily raise SNAP benefits, increased WIC appropriations, and gave USDA authority to launch P-EBT and the Food Box Program. The bill also authorized USDA to waive certain program requirements to support access to benefits while allowing for social distancing. The Coronavirus Aid, Relief, and Economic Security Act (known as the CARES Act) provided about $8.8 billion in additional funding for the child nutrition programs and an additional $15.8 billion for SNAP.

In FY 2021, two additional Federal spending bills also addressed nutrition assistance programs. One, which passed in October 2020, expanded P-EBT to cover more children, and another, passed in December 2020, temporarily increased maximum SNAP benefit levels. In March 2021, Congress passed the American Rescue Plan Act, which authorized P-EBT to cover the summer months, provided additional funding for WIC, and extended the temporary SNAP benefit increase through September 2021.

SNAP Benefits Continued to Rise in FY 2021

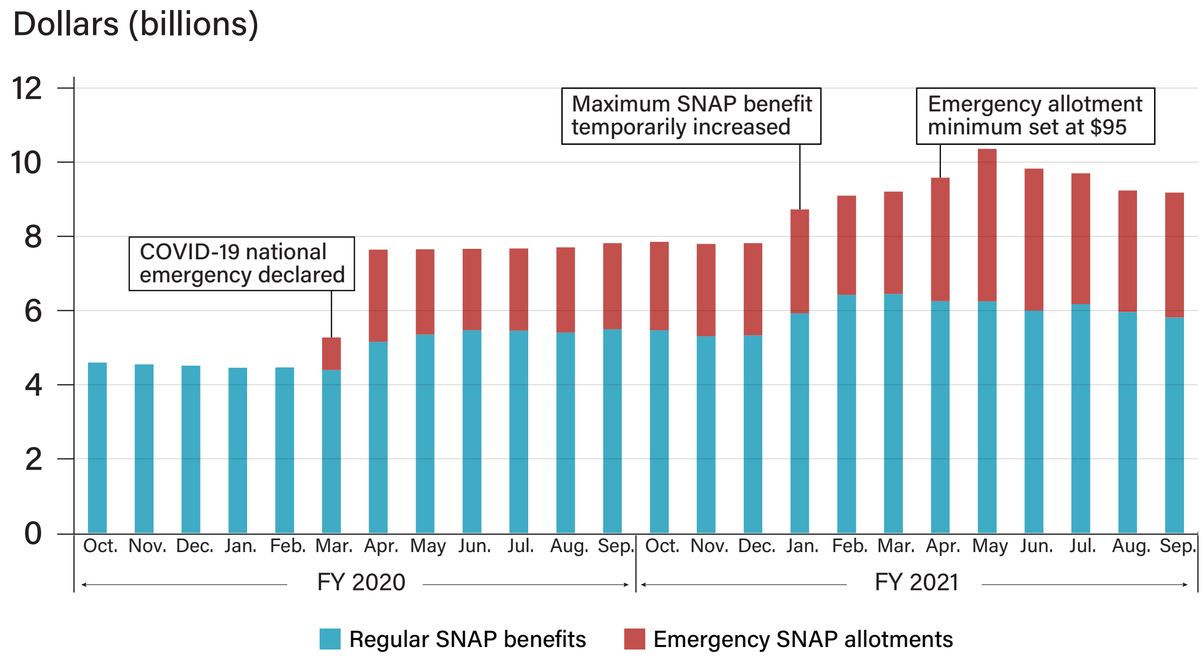
In FY 2019 and the first half of FY 2020 leading up to the pandemic, the number of SNAP participants and Federal spending for SNAP benefits continued a steady decline from the Great Recession-induced peaks of FY 2013. From October 2019 through February 2020, average monthly participation had fallen to 37.3 million and monthly benefits averaged $4.5 billion (including only regular ongoing benefits and disaster supplements).

The Families First Coronavirus Response Act increased SNAP benefits for those households not already receiving the maximum benefit—roughly 60 percent of households—through monthly emergency allotments. Regular SNAP benefits are determined based on household size and net income. Emergency allotments supplemented these benefits by providing all SNAP households with the maximum benefit amount for their household size, regardless of income. USDA also suspended work-related time limits on receiving SNAP benefits. These policy changes along with increased eligibility related to the economic downturn led to increases in the amount of monthly benefits issued. Total SNAP benefits increased from $4.5 billion in February 2020 to $7.7 billion in June 2020. SNAP participation also increased, peaking at 43.0 million in June 2020.

Spending on benefits remained at about the same level through the first 3 months of FY 2021 (October through December). A temporary 15-percent increase in the maximum SNAP benefit began in January 2021 and remained in effect through the end of FY 2021. Following this increase, total benefits grew to $8.7 billion in January 2021 from $7.8 billion a month earlier.

Benefits increased further in April 2021 when USDA revised emergency allotments to provide all participating households with a minimum monthly supplement of $95, increasing benefits of those previously receiving the regular maximum benefit or close to it. Total benefits peaked at $10.4 billion in May 2021, dropping off afterward. Overall, SNAP spending increased to a record $113.8 billion in FY 2021, 44 percent more than in FY 2020.

Total SNAP benefits rose in FY 2021 after temporary benefit increase, emergency allotment revision



Notes: **FY** = Fiscal year. **SNAP** = Supplemental Nutrition Assistance Program. SNAP benefit totals include only regular ongoing benefits and disaster supplements. Emergency SNAP allotments are grouped with other disaster supplements issued to ongoing SNAP recipient households, although emergency allotments account for almost all this category in March 2020 through September 2021. Data are as of April 2022 and are subject to revision.

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

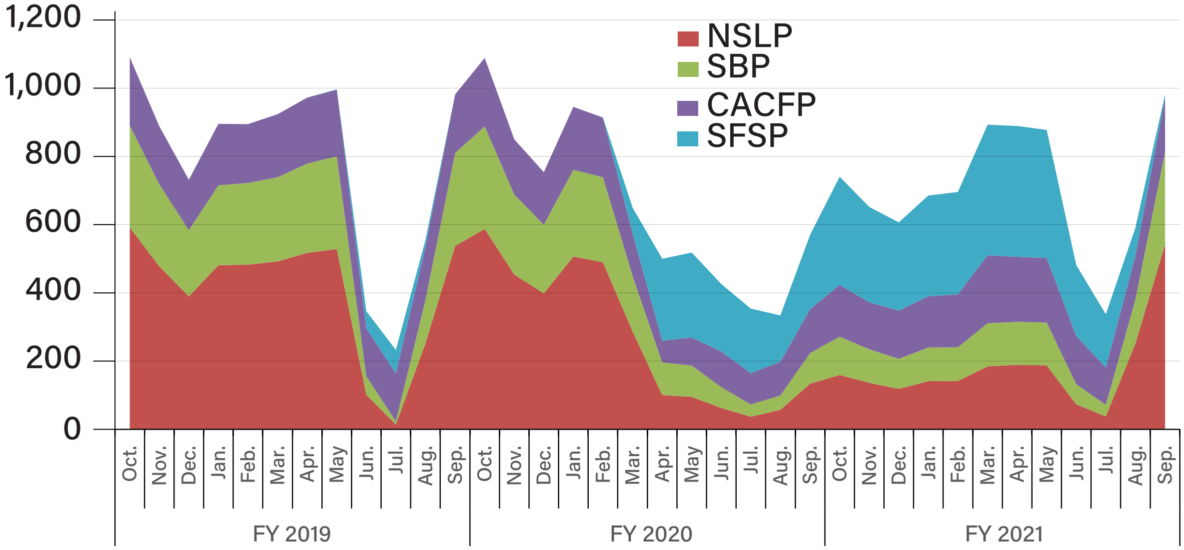
Total Meals Served Through USDA's Child Nutrition Programs Rebounded in FY 2021

Disruptions for schools and childcare providers hindered the distribution of meals through the National School Lunch Program, the School Breakfast Program, and the Child and Adult Care Food Program, especially early in the pandemic. The Families First Coronavirus Response Act allowed USDA to adjust program operations to meet rising food needs. Subsequent legislation provided funding to support these adjustments. One set of waivers suspended requirements that meals be served in group settings at specific times and instead allowed for "grab and go" meals that children's parents or guardians could pick up at schools or other locations.

Other 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 latter half of FY 2020 and all of FY 2021. Beginning in July 2021, USDA also temporarily raised the amount by which it reimbursed organizations providing meals through the SSO. Under the change, the cost of meals served through the SSO would be reimbursed at the higher rate received by organizations serving meals through the SFSP.

Summer Food Service Program led growth in USDA child nutrition programs in most of FY 2021

Meals (millions)



Notes: **FY** = Fiscal year. **NSLP** = National School Lunch Program. **SBP** = School Breakfast Program. **CACFP** = Child and Adult Care Food Program. **SFSP** = Summer Food Service Program. Data are as of April 2022 and are subject to revision.

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

Before the pandemic, most meals were served through the largest child nutrition programs during the school year in the months of August through May. Fewer meals were served over the summer months of June and July when most schools are closed for instruction. This pattern also held during the pandemic, but more meals were served in June and July in FY 2020 and FY 2021, compared with the same months in FY 2019.

While most meals were served through the NSLP, SBP, and CACFP before the pandemic, the child food and nutrition assistance safety net pivoted toward providing meals through summer meal programs beginning in March 2020. From April 2020 through June 2021, the Summer Food Service Program served more meals than any of the other programs. As schools transitioned to serving meals through the SSO in July 2021, the number of meals served under the NSLP and SBP rebounded to near pre-pandemic levels beginning in September 2021.

The number of meals served through the NSLP, SBP, CACFP, and SFSP combined increased to 8.4 billion in FY 2021 from 7.9 billion in FY 2020, but it was still fewer than the 9.5 billion total meals served in FY 2019. However, total spending on the four programs rose to $26.8 billion in FY 2021, up from $21.2 billion in FY 2020 and $23 billion in FY 2019. The increase in spending was driven by the greater number of Summer Food Service Program meals served in FY 2021, which were reimbursed at higher rates than NSLP and SBP meals, and by an increase in SSO meals after July 2021.

More Children Participated in WIC in FY 2021

Throughout FY 2021, State WIC agencies continued to use waivers issued in FY 2020 to offer flexibilities to enable participants' continued access to WIC services. Waivers allowed for alternative modes of service delivery (such as remote certification and recertification), deferrals of medical documentation requirements for applicants, and food package substitutions necessary because of food shortages. WIC food benefits include a cash-value voucher, which is a fixed dollar amount that can be used to buy a variety of fruits and vegetables. Under the American Rescue Plan Act, WIC State agencies could increase the cash-value voucher amount for fruit and vegetable purchases from $9 for adults and $11 for children to a maximum of $35 per participant for up to 4 months through September 30, 2021. All State agencies elected to increase the cash-value voucher to $35 and most did so between June and September 2021.

Unlike USDA's other food and nutrition assistance programs, WIC did not see substantial changes in participation over the course of the pandemic. Overall, WIC served an average of 6.2 million participants per month in FY 2021, about the same as in FY 2020 and down from 6.4 million in FY 2019.

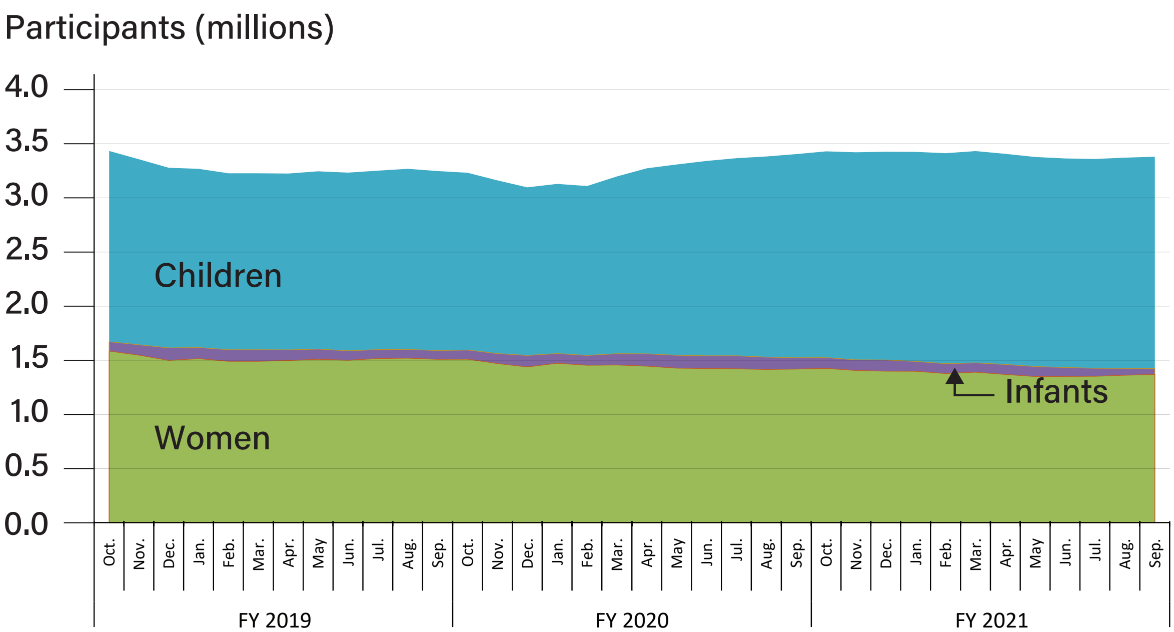
Trends in participation varied across groups eligible for WIC. The number of women and infants participating trended downward from FY 2019 through FY 2021, consistent with declines in the number of U.S. births over the same period. On the other hand, the number of children up to age 5 participating in WIC rose in FY 2021. Child participation trended downward from the early months of FY 2019 through February 2020, much like trends for infant and women participants. However, child participation began to increase in March 2020 with the onset of the pandemic, continued to rise through October 2020, and remained steady (around 3.4 million children a month) from October 2020 through September 2021.

Trends in USDA spending on WIC food benefit redemptions also differed from trends in spending for USDA's other food and nutrition assistance programs. Monthly WIC food costs decreased from $262 million in FY 2019 to $240 million in FY 2020, and further declined to $221 million in FY 2021.

Temporary Programs Continued to Operate in FY 2021

In 2020, the Families First Coronavirus Response Act authorized the 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. Benefit distribution schedules also differed as some States issued benefits in a lump sum to cover an entire period of missed meals while others issued multiple smaller payments.

Child participation in WIC program increased during the pandemic



Notes: **FY** = Fiscal year. **WIC** = Special Supplemental Nutrition Program for Women, Infants, and Children. Data are as of April 2022 and are subject to revision.

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

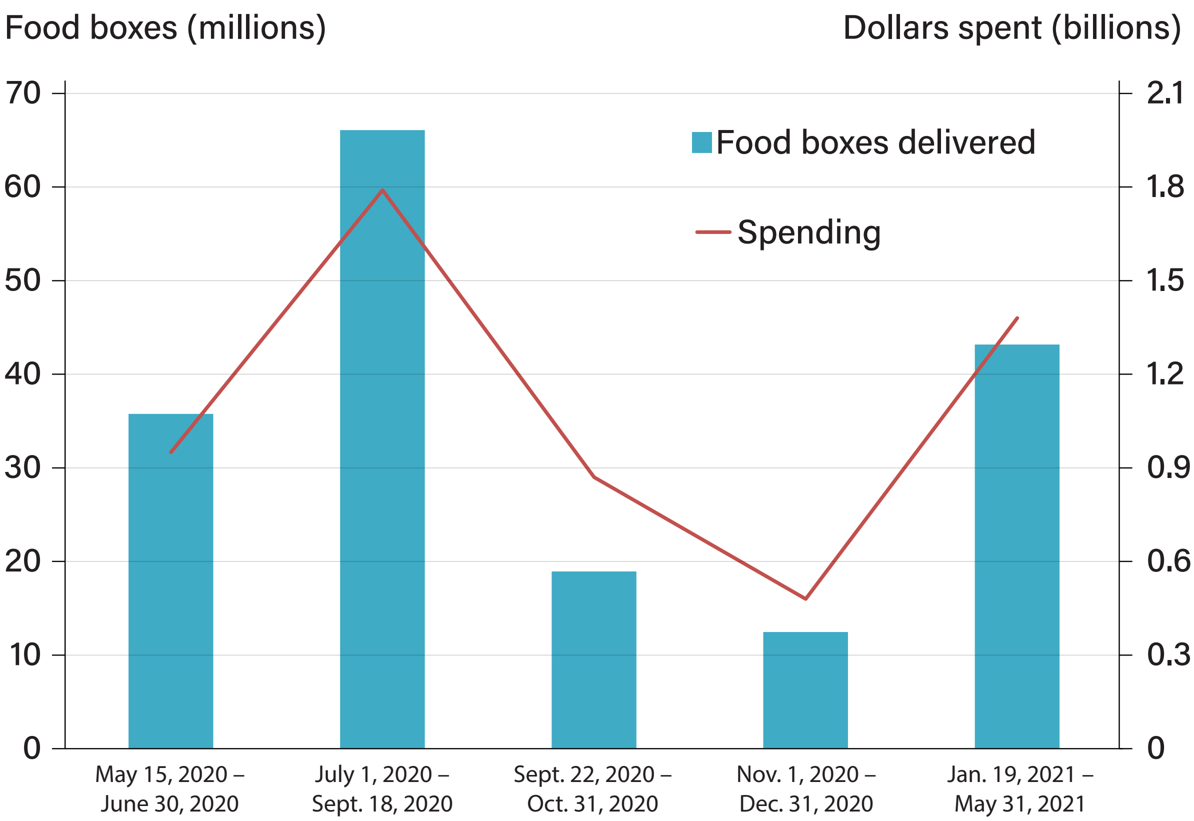
The Federal Government expanded P-EBT several times in FY 2021. In October 2020, P-EBT was expanded to include eligible children under age 6 and to operate in Puerto Rico, the Northern Mariana Islands, and American Samoa. In January 2021, the program's benefits were increased by about 15 percent to include the value of school snacks.

In March 2021, the American Rescue Plan Act authorized the P-EBT program for summer 2021 and any future school year with a COVID-19 public health emergency declaration in place. Overall, the Federal Government spent a total of about $39.1 billion on P-EBT in FY 2020 and FY 2021.

The pandemic also disrupted the food supply chain and changed consumer behavior. To support the agricultural industry as well as families in need, the Families First Coronavirus Response Act granted USDA authority to create the Food Box Program.

Through the program, USDA bought boxes of produce, dairy products, meat, and other agricultural commodities for delivery to food banks and other charitable organizations. The program launched in May 2020 and was allowed to expire in May 2021. Over the course of its operation, the program distributed 176.4 million food boxes at a cost of $5.5 billion.

Farmers to Families Food Box Program distributed millions of food boxes nationwide during pandemic



Notes: Figure based on U.S. Government Accountability Office report GAO–21–353. USDA, Agricultural Marketing Service implemented the program in five rounds of various lengths.

Source: USDA, Economic Research Service, using data from the U.S. Government Accountability Office and USDA, Agricultural Marketing Service.

USDA's Domestic Food and Nutrition Assistance Programs Continued to Change Beyond FY 2021

In response to the ongoing pandemic, legislative and policy changes to U.S. food and nutrition assistance programs continued into FY 2022. The temporary increase in SNAP benefits expired in September 2021 but was replaced with a permanent 21-percent increase beginning in October 2021 after a reevaluation of the Thrifty Food Plan on which benefit amounts are based. As some did in FY 2021, States continued to end SNAP emergency allotments. The WIC cash-value voucher increase expired at the end of FY 2021 but was temporarily replaced with an increase to $24 for child participants, $43 for pregnant and postpartum women, and $47 for breastfeeding women beginning October 2021 and continuing through September 2022. USDA also announced $2.5 billion in aid to help school districts obtain food and supplies as pandemic-related supply chain disruptions continued to hamper the meal provision of schools, and Federal legislation in June 2022 temporarily extended some child nutrition waivers, which were set to expire at the end of that month. ERS researchers will continue to track how these and other developments, such as rising food costs, affect the domestic food and nutrition assistance landscape.

This article is drawn from ...

The Food and Nutrition Assistance Landscape: Fiscal Year 2021 Annual Report, by Jordan W. Jones, Saied Toossi, and Leslie Hodges, ERS, June 2022

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COVID-19 Working Paper: Supplemental Nutrition Assistance Program and Pandemic Electronic Benefit Transfer Redemptions During the Coronavirus Pandemic, by Jordan W. Jones, ERS, March 2021

COVID-19 Working Paper: Filling the Pandemic Meal Gap: Disruptions to Child Nutrition Programs and Expansion of Free Meal Sites in the Early Months of the Pandemic, by Saied Toossi, ERS, October 2021

Supplemental Nutrition Assistance Program Online Purchasing Expanded in First Two Years of Pandemic

by **Jordan W. Jones**

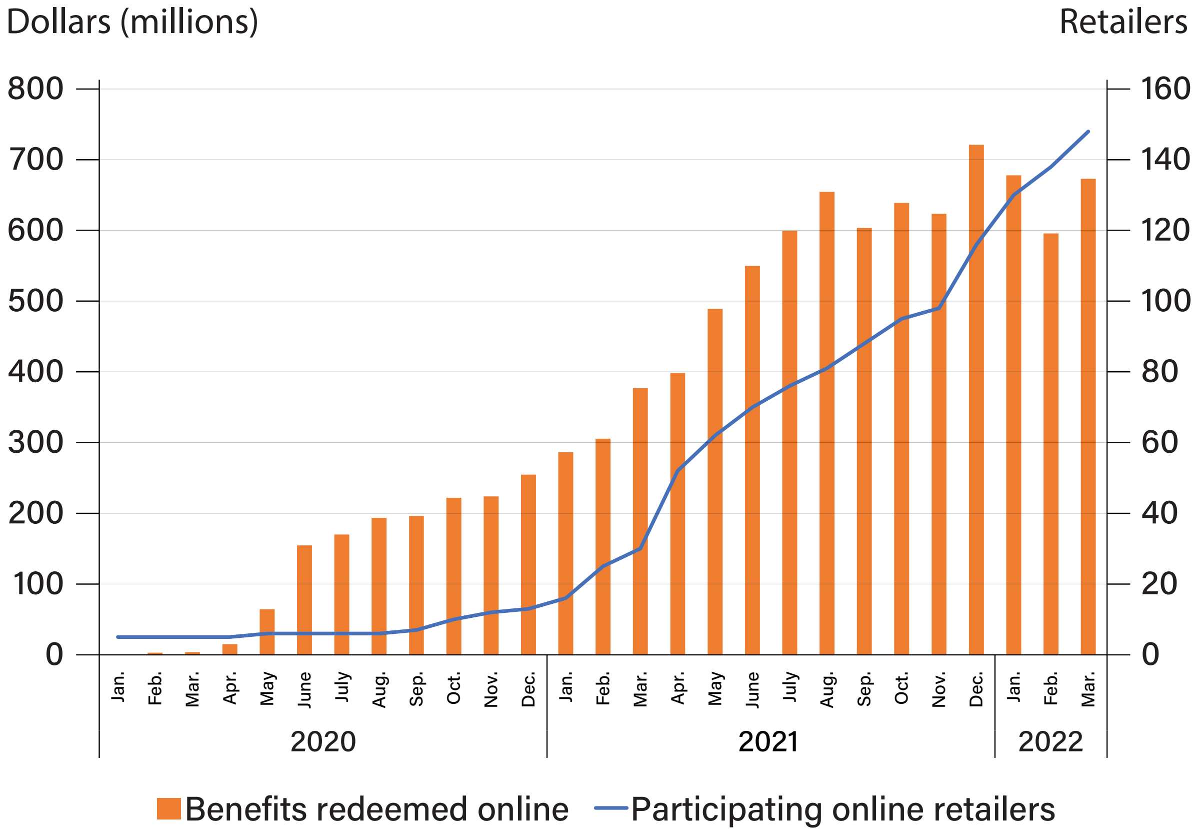
The USDA's Supplemental Nutrition Assistance Program (SNAP) Online Purchasing Pilot allows households in participating States to use their SNAP benefits to buy groceries online from authorized, participating retailers. As with in-person redemption, benefits can be used online only for food items and cannot be used for additional expenses tied to online grocery shopping, such as tips or fees. Online SNAP grocery purchases can be delivered or picked up onsite as with other online grocery purchases. Pandemic Electronic Benefit Transfer (P-EBT) benefits issued during the Coronavirus (COVID-19) pandemic are similarly redeemable online.

The 2014 Farm Bill mandated a pilot to test the feasibility of secure online SNAP benefit redemptions with a few pilot retailers before eventual nationwide implementation, later mandated by the 2018 Farm Bill. The pilot launched with several food retailers in New York in April 2019 before expanding to five other States by April 1, 2020. In response to the pandemic, USDA, Food and Nutrition Service quickly expanded the pilot to incorporate additional States and retailers. By the end of September 2020, online SNAP and P-EBT benefit redemption was available in 45 States and Washington, DC. By the end of March 2022, it was available in all States except Alaska.

Early in the pilot's rollout, relatively few retailers were authorized to accept benefits online, which required compliance with SNAP online purchasing protocols. Large online retailers Walmart and Amazon were among the first authorized for online benefit redemption at the time of implementation in all participating States except Hawaii and Washington, DC. The number of other participating retailers grew significantly in 2021 and 2022. In December 2020, FNS had authorized 13 retailers (each of which may include delivery or pickup from many individual stores under a single chain or retailer "banner"). This number grew to 116 in December 2021 and to 148 in March 2022. As more retailers participated, SNAP and P-EBT recipients gained more options for redeeming their benefits online.

During this pilot expansion period, the value of online benefits redeemed also grew. From February 2020 (the earliest month for which data are available) through December 2020, 1.7 percent of all SNAP and P-EBT benefit redemptions occurred online. This amounted to $1.5 billion in online redemptions. In 2021, the share of redemptions online nearly tripled to 4.5 percent, and the dollar amount of these redemptions more than quadrupled to $6.2 billion. The share of redemptions occurring online has continued to grow in 2022. From January through March 2022, 5.7 percent of redemptions occurred online, representing $1.9 billion in benefits

Online SNAP and P-EBT benefit redemptions and the number of participating online retailers grew in 2020 through 2022



Notes: **SNAP** = Supplemental Nutrition Assistance Program. **P-EBT** = Pandemic Electronic Benefit Transfer. **Benefits redeemed online** does not include the value of transactions made online in which benefits are redeemed in-person at time of grocery pickup. **Participating online retailers** denotes the number of nationwide "Internet Retailers" authorized to accept benefits online, often including multiple locations from which groceries can be picked up or delivered.

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

This article is drawn from...

COVID-19 Working Paper: Supplemental Nutrition Assistance Program and Pandemic Electronic Benefit Transfer Redemptions During the Coronavirus Pandemic, by Jordan W. Jones, ERS, March 2021

Online Supplemental Nutrition Assistance Program (SNAP) Purchasing Grew Substantially in 2020, by Jordan W. Jones, Amber Waves, ERS, July 2021

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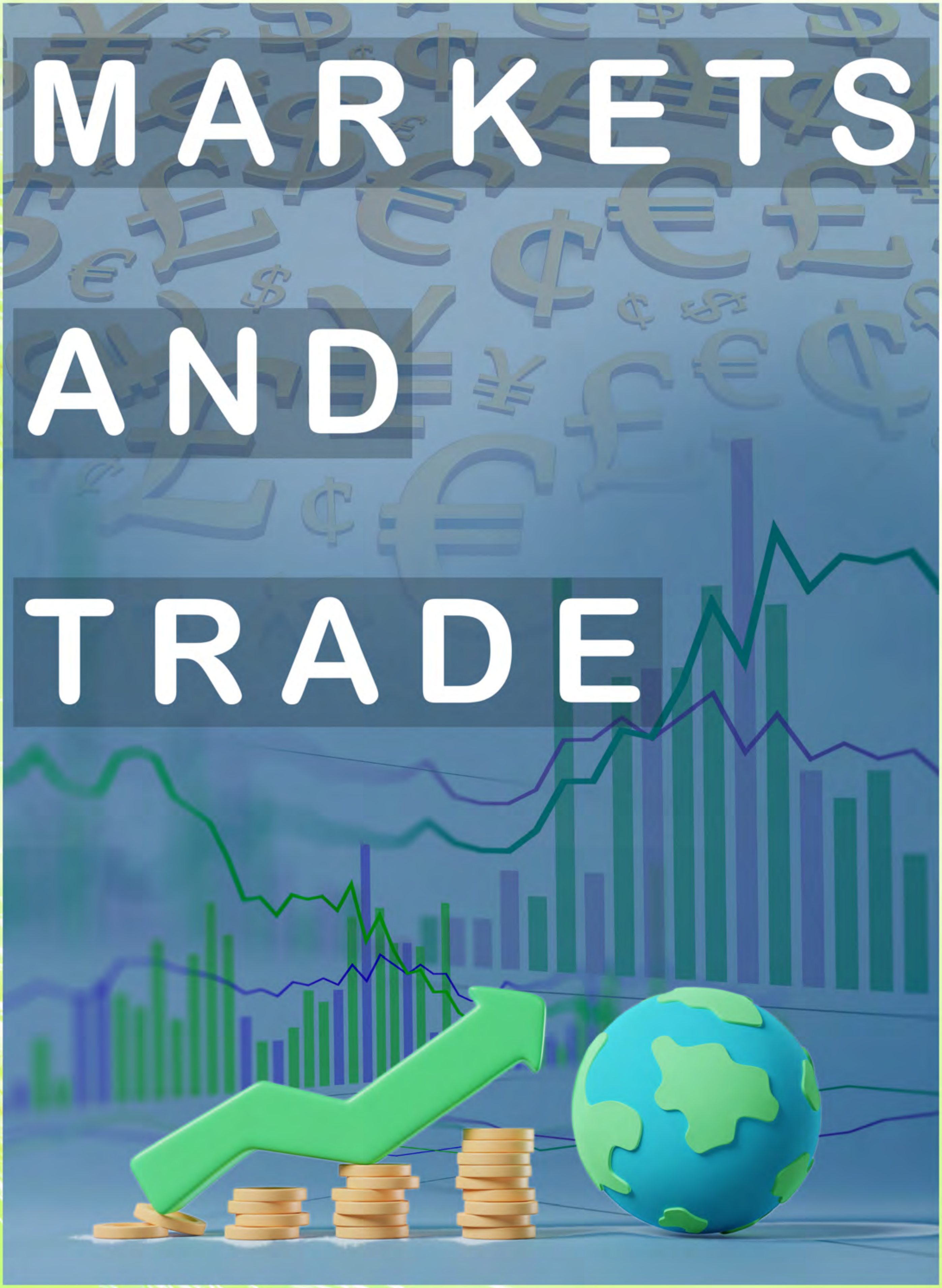
MARKETS AND TRADE



Innovations in Seed and Farming Technologies Drive Productivity Gains and Costs on Corn Farms

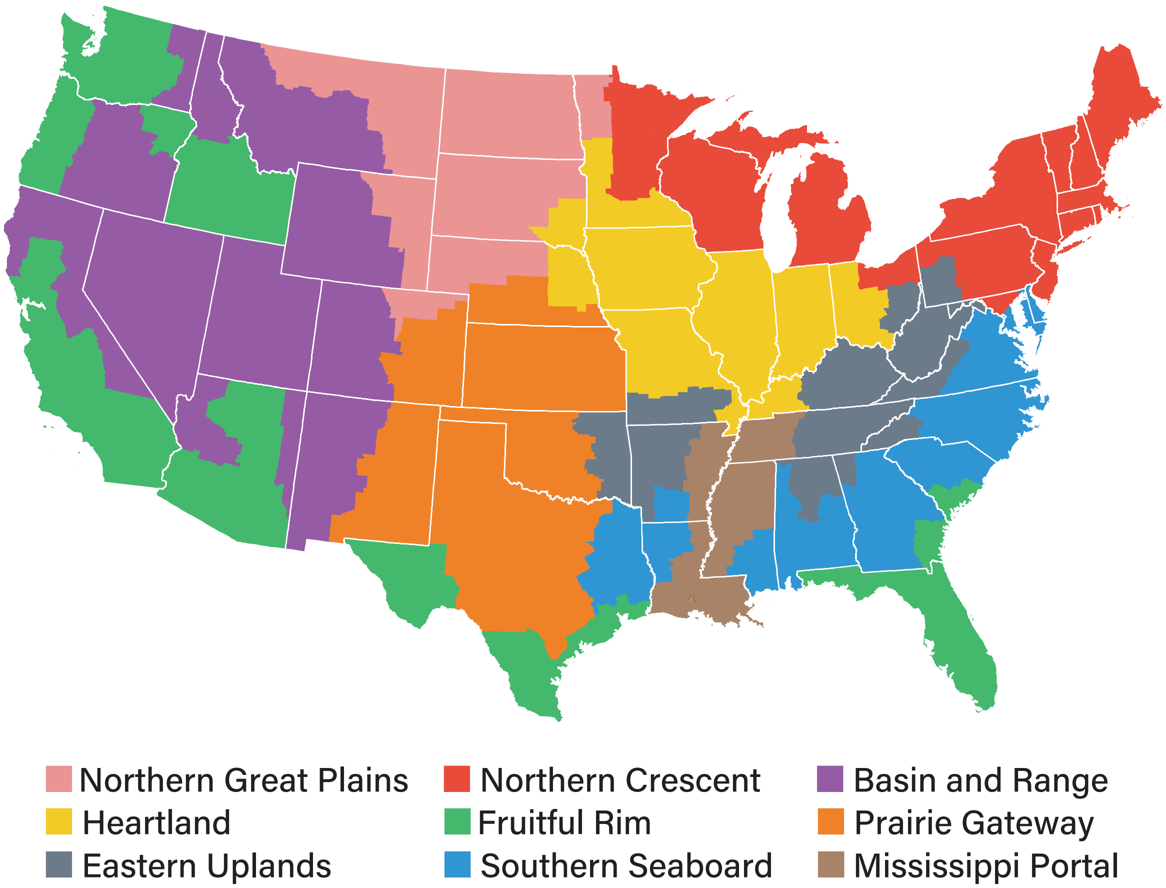
by **Anne Effland, Monica Saavoss, Tom Capehart, William D. McBride, and Amy Boline**

Highlights:

- Corn yields and planted acres have risen substantially in recent decades as farmers have adopted new technologies, particularly genetically engineered seeds and precision farming systems, that have supported higher yields and expansion into new areas.
- The cost of genetically engineered seed and related increases in costs for fertilizers and herbicides contributed to operating costs per acre of corn more than doubling between 1996 and 2016. However, average total costs per bushel and per acre of corn fell, reflecting the effects of larger farm sizes and greater productivity.
- Characteristics of high-productivity and low-productivity corn farms reflect the effects of farm size and differing natural endowments, and also show regional concentrations.

Corn is a major source of livestock feed, fuel, exports, and derivative products such as starch and sweeteners, as well as paper and bioproducts like plastics and cosmetics. To supply this broad and growing market over the past several decades, U.S. corn production has expanded. Since 1996, the area of corn planted in the United States has risen more than 10 percent, with increases reaching as high as 40 percent in the Northern Great Plains region (see map on next page). At the same time, average corn yields have increased more than 40 percent. A USDA, Economic Research Service (ERS) report published in July 2021 identified and examined technological and structural changes in U.S. corn production since 1996, focusing on how these changes have affected production costs, net returns, productivity, and yields. To track these trends in corn production, researchers used data covering 1996 to 2016 from the Agricultural Resource Management Survey (ARMS), produced by ERS and USDA's National Agricultural Statistics Service (NASS), and the NASS Census of Agriculture.

USDA, Economic Research Service groups its nine Farm Resource Regions according to geographical commodity specializations



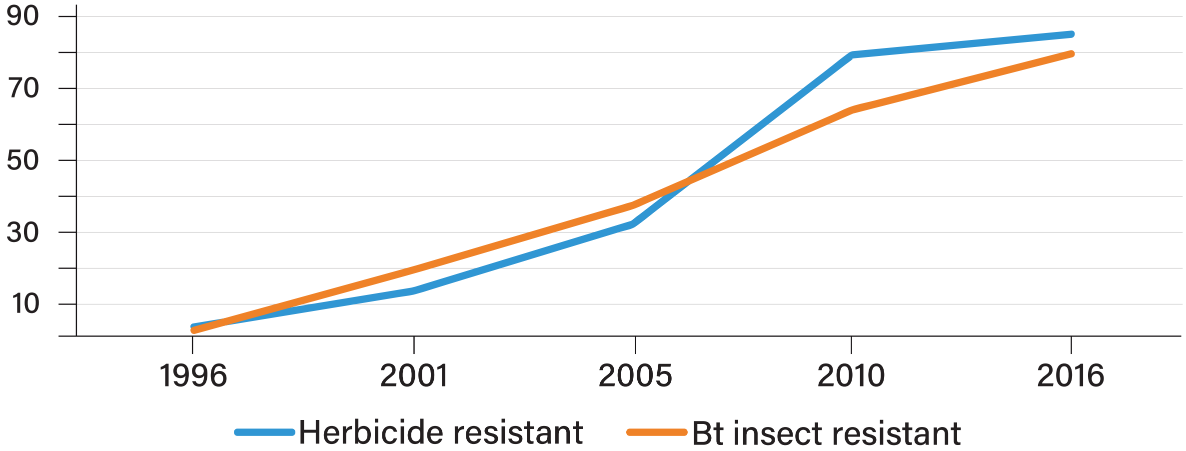
Source: USDA, Economic Research Service Farm Resource Regions

New Seed Technologies Help Increase Corn Acreage and Yields

An analysis of responses to the ARMS survey of corn farms from 1996 to 2016 indicated new and expanded technologies over the two decades factored into acreage and yield changes. In particular, adoption of genetically engineered seed varieties progressed rapidly. For example, plantings of single-pest resistant varieties containing proteins from Bacillus thuringiensis (Bt), a bacterial insecticide, rose from 2 percent of corn acres in 1996 to 21 percent in 2001 and to 78 percent by 2016. Similarly, herbicide-tolerant varieties appeared on 3 percent of acres in 1996 and expanded to 16 percent in 2001 and 84 percent in 2016. In 2016, producers planted 91 percent of corn acres with some form of genetically engineered seed, many of them "stacked" varieties offering three or more protective traits such as resistance to multiple pests, herbicide tolerance, and drought tolerance.

New seed technologies helped increase corn production in several ways. Farmers were able to plant corn seed more densely and earlier in the growing season. In addition, producers expanded corn acreage as pest resistance and drought tolerance allowed for profitable production in previously challenging regions. Genetically engineered seeds led to changes in other production practices as well. For example, increased use of drought-tolerant seed has coincided with a slight decline in irrigated acreage, and greater use of insect-resistant seed with changes in chemical applications.

Use of genetically modified seed varieties on U.S. corn farms rose from 1996 to 2016



Note: **Bt** = Bacillus thuringiensis, a type of bacteria found in soil.

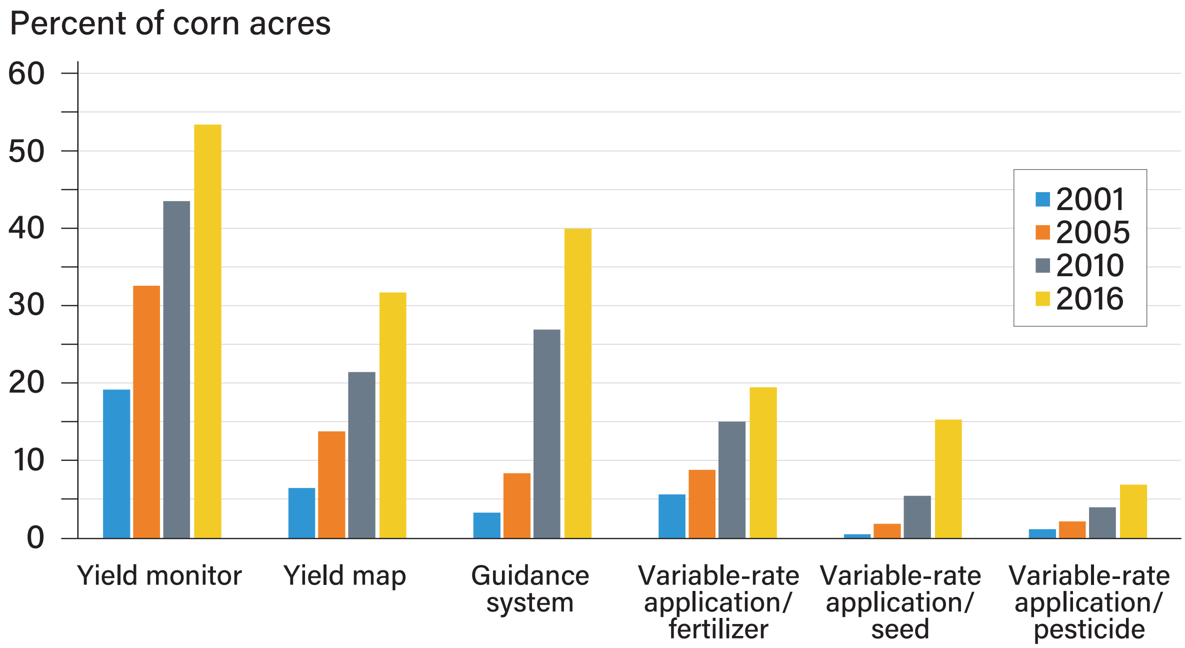
Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service Agricultural Resource Management Survey.

Precision Farming Technologies Increase Efficiency

"Precision farming" refers to technologies that allow producers to make operating decisions on a site-specific basis, tailoring their methods according to conditions within and between fields. For instance, yield monitors track how much corn is harvested from specific zones in each field. Farmers put this information into a yield map, which visualizes the data from the monitor and lets them address issues such as poor drainage or low nutrient levels in low-yield areas of the field. Soil maps provide site-specific information about soil type and soil quality. Variable-rate technology allows farmers to apply the appropriate amount of seed, fertilizer, or pesticides for a particular site. Guidance systems use GPS technologies to provide tractor operators with visual directions toward rows, or in some instances, automatically steer the tractor to drive directly over rows. This can reduce the number of passes required over the field, reducing fuel costs and wear and tear on machinery.

Adoption of precision production technologies by corn producers has steadily increased over the past few decades. From 2001 to 2016, the use of yield monitors increased from 19 percent of corn acres to 52 percent and the use of yield maps from 6 percent to 31 percent. Use of self-propelled machinery with guidance systems rose from 3 percent of corn acres to 39 percent. Variable-rate fertilizer application grew from 6 to 19 percent, variable-rate seeding from less than 1 to 15 percent, and variable-rate pesticide application from 1 to 7 percent. ERS and NASS added questions on the use of newer technologies such as drones and crop condition sensors to the 2016 ARMS survey; data indicated use of these technologies was limited to 1 to 4 percent of corn acres.

From 2001 to 2016, the use of precision farming technologies on U.S. corn acreage increased



Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service Agricultural Resource Management Survey.

As the use of emerging technologies grew, irrigated corn acres as a share of total corn acres declined slightly. In 1996, 15 percent of U.S. corn acres were irrigated. By 2016, that share had fallen to 11 percent, although that national shift obscures significant regional differences. In the Prairie Gateway, irrigated acreage dropped to 39 percent of corn acres in 2016 from 77 percent 20 years earlier. In the Northern Great Plains regions, the share of irrigated corn acreage fell to 10 percent from 39 percent. In both cases, increasing costs of pumping irrigation water from the depleting Ogallala Aquifer were cited as a contributing factor. In addition, the adoption of drought-tolerant seed varieties reduced the need for irrigation. In contrast, irrigated corn acres increased in the Southern Seaboard region—from none in 1996 to 21 percent in 2001, then falling to 13 percent in 2005 and rising to 18 percent by 2016. Contributing factors to the differences in regional irrigation use include repeated drought conditions, relatively low-cost groundwater access, and rising commodity prices.

New Seed Varieties Lead to Changes in Chemical Applications and Costs Per Corn Acre

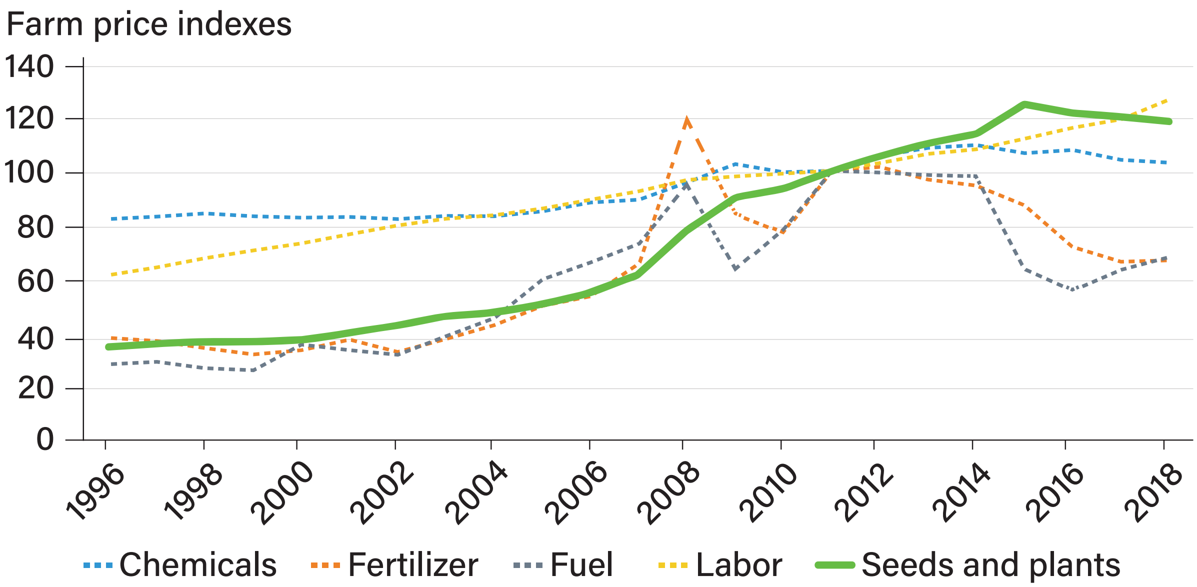
Along with the adoption of new genetically engineered corn seed varieties, seeding rates increased about 15 percent between 1996 and 2016. Nutrient application rates also changed. For example, the share of corn acres treated with nitrogen fertilizer was stable (around 95 percent), but the average amount applied per acre rose from 107 to 125 pounds. In contrast, phosphorus and potassium applications declined between 1996 and 2016, from 86 to 76 percent of acres for phosphorus and 80 to 70 percent for potassium. Applications of herbicides and insecticides fluctuated, with herbicide use rising alongside adoption of herbicide-tolerant seed varieties. Insecticide use fell as farmers used more insect-resistant seed varieties. In addition, from 2005 to 2016, the use of conservation tillage practices increased slightly from 60 to 65 percent. These practices reduce tillage costs while conserving soil and water.

Adoption of new seed technologies and the related rise in fertilizer and herbicide use increased operating costs on corn farms over the 1996–2016 period. Costs per acre (not adjusted for inflation) more than doubled, from $161 to $341. Average seed costs increased 263 percent on a steady upward trend from $27 per acre to $98, while fertilizer costs rose 149 percent, from $51 per acre to $127. Costs of applying chemicals such as pesticides, growth regulators, and harvest aids grew by 30 percent. Costs per acre varied regionally, from the highest in 2016 of $712 in the Heartland to $565 in the Northern Great Plains.

similar proportion, from 189 acres in 1996 to 278 acres in 2016, with much of the expansion occurring between 1996 and 2010. The number of acres planted to corn generally plateaued after 2010, with regional variation. In the Heartland, average acreage planted to corn fell slightly (313 to 302 acres), while average corn planted area grew by more than 50 percent in the Northern Great Plains and Eastern Uplands.

Productivity on corn farms also increased between 1996 and 2016. Based on a 5-year moving average, corn yields increased from 130 bushels to 183 bushels per

Rising seed prices were a key contributor to rising corn farm operation costs from 1996 to 2018



Note: Changes in cost are determined using the Prices Paid indexes compiled by USDA, National Agricultural Statistics Service (NASS), using 2011 as the base year. Prices are not adjusted for inflation.

Source: USDA, Economic Research Service using data from NASS's Prices Paid Surveys and Indexes.

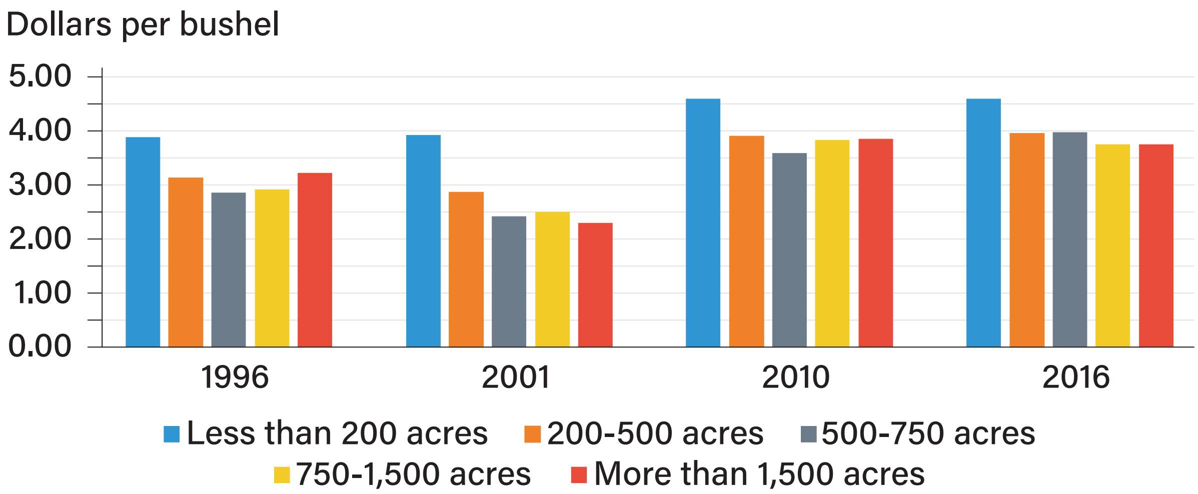
Farm Sizes Grow Along With Productivity

Just as total average acreage planted to corn rose over recent decades, so also did the size of farms that planted corn. Based on data from the Census of Agriculture, the average acreage of farms planting corn increased 45 percent, from 501 acres in 1997 to 725 acres in 2017. According to data from the ARMS, average acres devoted to corn on those farms also rose by a

acre over the period, an average annual growth rate of 1.7 percent. Over the same period, inflation-adjusted production costs per bushel, unlike nominal costs per acre, fell from $5.07 to $3.64 per acre in all regions.

Total costs per bushel were higher for smaller farms and declined as farm size increased, ranging from $4.66 per bushel for farms with fewer than 200 planted acres of corn to $3.75 per bushel for farms with more than 1,500 planted acres of corn. This pattern of lower costs

From 1996 to 2016, corn production costs were higher for smaller farms and lower for larger operations



Note: Costs are adjusted for inflation.

Sources: USDA, Economic Research Service (ERS) and USDA, National Agricultural Statistics Service Agricultural Resource Management Survey and ERS's Commodity Cost and Returns data product.

per bushel on larger farm sizes, is known as "economies of size," in which the cost to produce one unit of a commodity declines as the size of operation increases. Other than a spike in 2001 associated with the introduction of genetically engineered seeds on the market, this pattern remained fairly stable from 1996 to 2016.

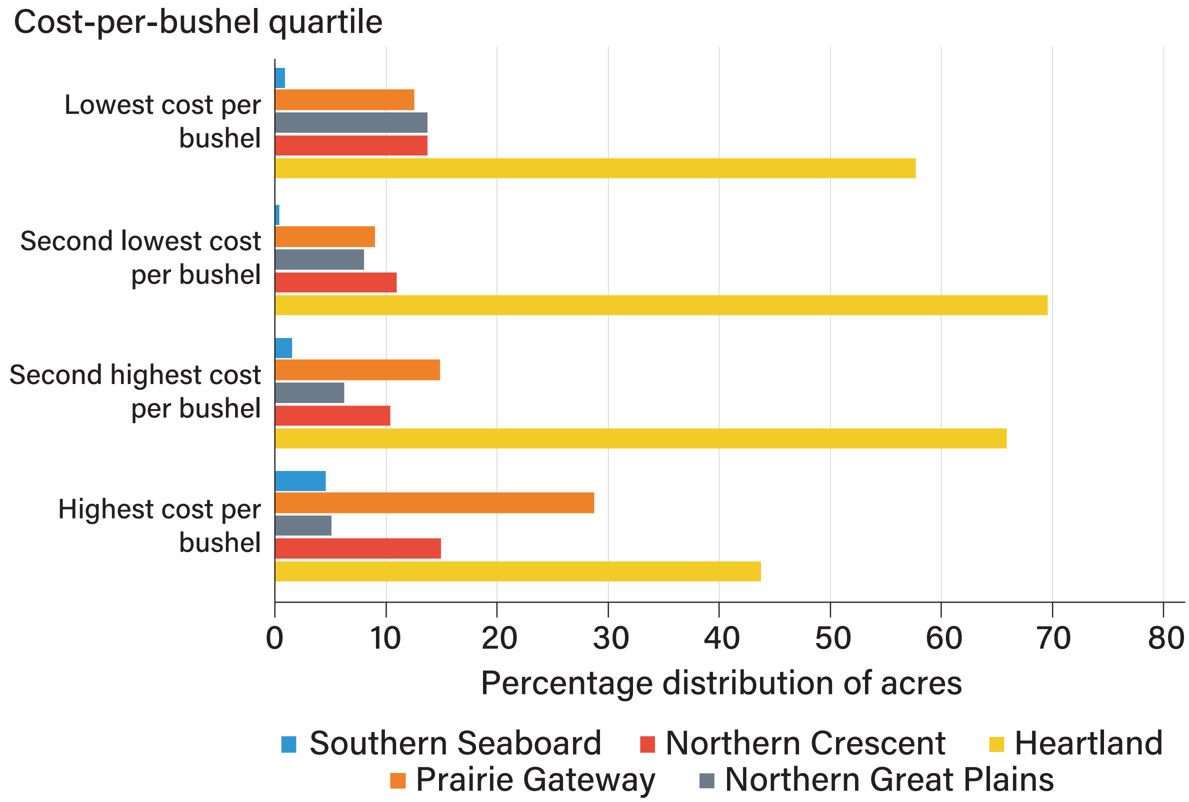
Corn Farm Productivity Varies by Size and Region

To determine the distinguishing characteristics of high- and low-productivity farms, ERS researchers divided corn farms into four groups (referred to as quartiles) according to their cost per unit:

- Lowest cost, highest productivity (top 25 percent): Average cost was $2.83 per bushel;
- Upper middle (25 percent): Average cost was $3.46 per bushel;
- Lower middle (25 percent): Average cost was $4.04 per bushel; and
- Highest cost, lowest productivity (bottom 25 percent): Average cost was $6.32 per bushel.

Higher productivity farms demonstrated consistently lower operating costs per acre than the next lowest productivity group. Economies of size and variations in natural endowments that might require greater use of some inputs—such as irrigation— both affected operating costs. For example, more farms with lower productivity irrigated their land. Yields tended to be below average for the two lowest productivity farm groups. Productivity also varied across regions. The Heartland accounted for a disproportionately large share of the total acres in the three higher productivity groups (58, 70, and 66 percent) and only 44 percent in the lowest productivity quartile. The Prairie Gateway and Southern Seaboard made up smaller shares of corn acres and together accounted for 34 percent of the lowest productivity group and less than 14 percent of the highest.

Corn farms with the highest productivity spent $2.83 to produce a bushel of corn in 2016, while the lowest productivity farms spent $6.32 a bushel



Note: Costs are adjusted for inflation.

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service

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Trends in Production Practices and Costs of the U.S. Corn Sector, by Monica Saavoss, Thomas Capehart, William D. McBride, and Anne Effland, ERS, July 2021

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AGRICULTURAL TRADE MULTIPLIER INFOGRAPHIC

Poultry Expected To Continue Leading Global Meat Imports as Demand Rises

by **Matthew Miller, Adam Gerval, James Hansen, and Grace Grossen**

Highlights:

- Global poultry imports are projected to reach 17.5 million metric tons in 2031.
- Sub-Saharan Africa is projected to remain the top global importer of poultry.
- Brazil is projected to remain the top global exporter of poultry.
- The United States' share of the world's poultry exports is projected to decline from 26 percent in 2021 to 24 percent in 2031.

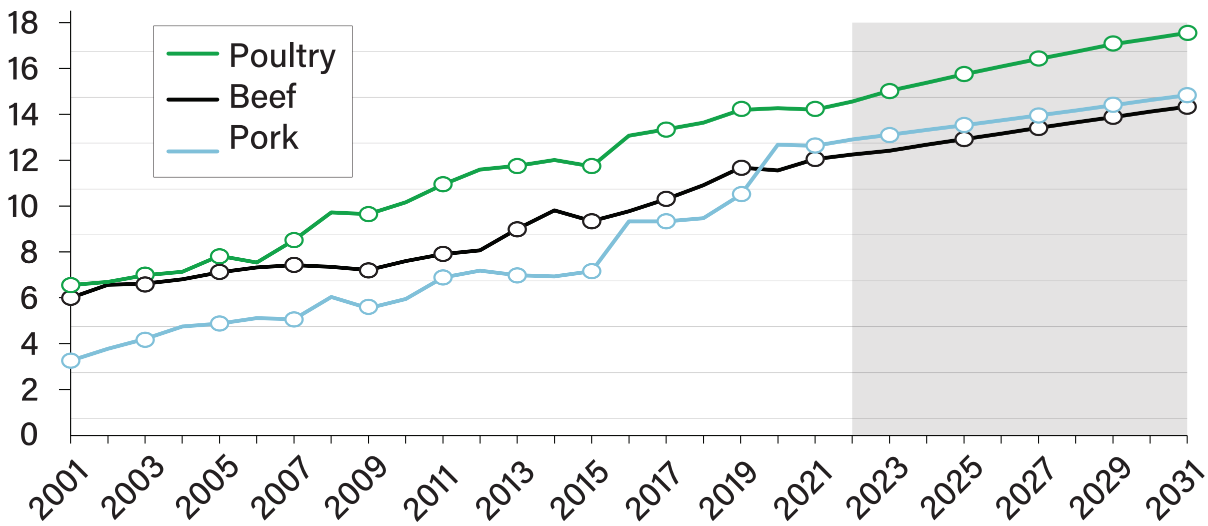
Over the past two decades, poultry has become the most consumed livestock commodity in the world, especially in developing and emerging markets where production prospects have been relatively limited. As demand for poultry products grew in these markets during the period from 2001 to 2021, global imports increased. Poultry is expected to remain the world's largest imported livestock commodity by volume over the next 10 years. To meet rising demand, a number of countries increased domestic poultry production. Brazil, the United States, the European Union, and Thailand emerged as major poultry exporters. Brazil is the world's leading poultry exporter and is projected to remain in the top position through 2031. The United States, however, is expected to lose market share throughout the coming decade.

The impact of global integration of commodity markets on agriculture is especially visible in live stock commodities. Meat trade—including poultry imports—has expanded significantly since 2001. Total imports of livestock commodities, including poultry, pork, and beef increased 117 percent from 2001 to 2021 and are projected to continue to grow through 2031. USDA's 10-year Agricultural "Baseline" Projections, based on the release of the October 2021 *World Agricultural Supply and Demand Estimates* (WASDE), indicate that by 2031 total meat imports will increase to 46.7 million metric tons.

From 2001 to 2021, global poultry imports rose an average of 4 percent a year, reaching 14.2 million metric tons in 2021. USDA projects poultry imports to grow to 17.5 million metric tons by 2031. In comparison, pork imports are projected to increase to 14.8 million metric tons by 2031, and beef imports are expected to rise to 14.3 million metric tons.

Total global meat imports projected to continue to increase through 2031

Million metric tons



Note: The shaded region denotes USDA's 10-year projections.

Source: USDA, Economic Research Service using data from USDA, Interagency Agricultural Projection Committee, October 2021.

Explaining Poultry's Recent Growth

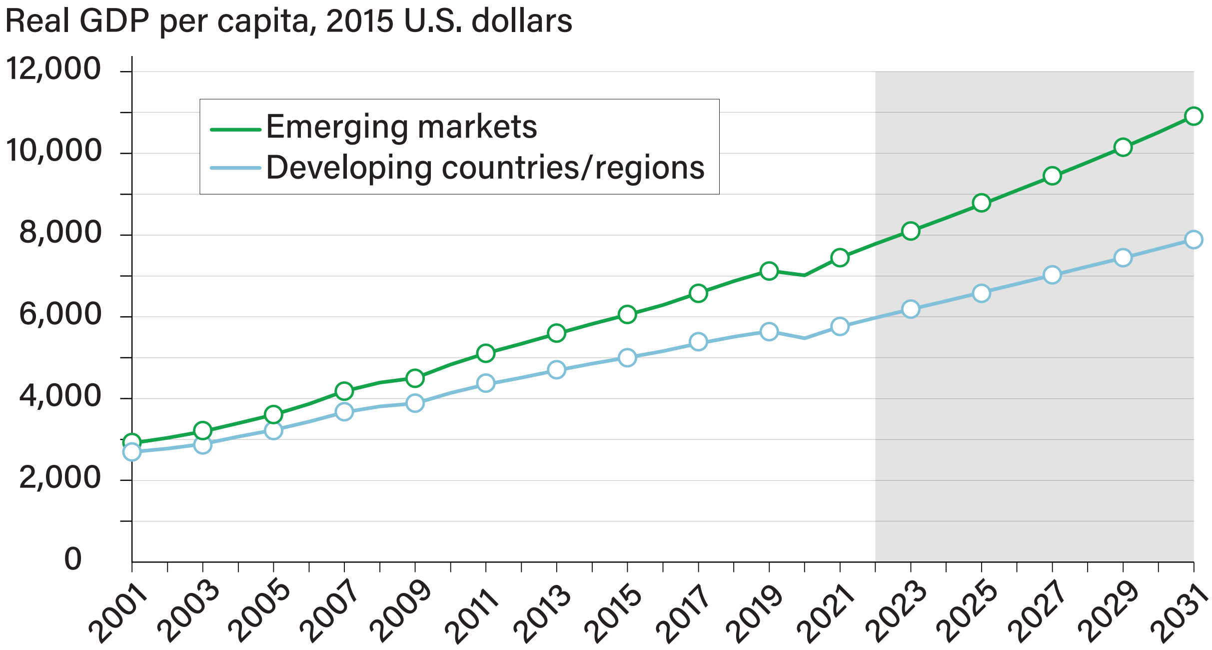
Chickens mature and reach market weight more quickly than other livestock and convert feed to meat more efficiently than larger animals. In addition, chickens can be raised in small spaces, so producers can raise poultry in a variety of environments including small plots of land. These advantages help make poultry production more feasible and affordable than beef and pork for farmers in developing countries and emerging markets.

However, poultry production has not kept up with the rise in consumption in many countries, particularly in sub-Saharan Africa. The discrepancy between production and consumption has driven demand for poultry meat from 69 million metric tons in 2001 to almost 128 million metric tons in 2021. This represents almost an 86-percent increase—averaging 3 percent a year—in global consumption during those 20 years. Over the past 10 years, however, growth in demand slowed to 2 percent annually and is projected to continue at that rate through 2031.

Developing and emerging markets have led most of the growth in poultry consumption over the past 10 years. Consumption increased by 5 percent in West Africa, 4 percent in North Africa, 3 percent in Mexico, and 4 percent in the Republic of the Philippines. These annual growth rates are projected to remain near these levels over the next 10 years and are expected to contribute to the largest increase in poultry import demand and trade.

Rising demand for poultry products and the related increase in poultry imports can be attributed to a variety of factors. A central component is a rise in real Gross Domestic Product (GDP) per capita in emerging and developing economies. Real GDP is GDP adjusted for inflation, and real GDP per capita is a proxy for income. As incomes have risen, consumers have bought more animal-based proteins. Poultry, particularly chicken, provides an efficient solution to evolving patterns in consumption. Additional factors influencing poultry's import growth include population and urbanization trends in many developing economies and emerging markets such as Southeast Asia and sub-Saharan Africa. As urban areas in these regions grow denser in population, poultry provides consumers an affordable protein source that is more readily available than other meats.

Rising real Gross Domestic Product per capita, considered a proxy for income, helps explain increased poultry demand in some markets



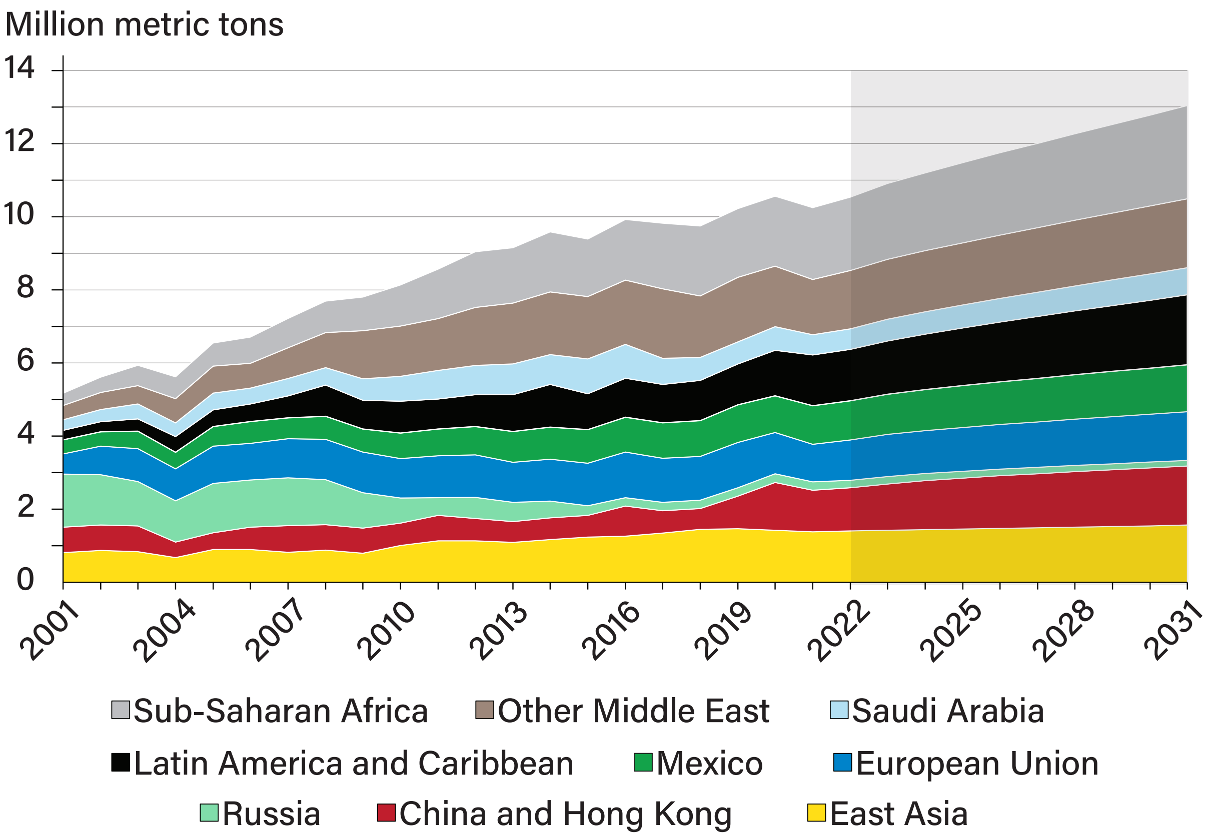
Note: **GDP** = Gross Domestic Product. Chart shows real (inflation-adjusted) GDP. The shaded region denotes USDA's 10-year projections.

Source: USDA, Economic Research Service (ERS) using data from ERS' International Macroeconomic Data Sets.

Where Poultry Imports Increased and Where They Are Projected to Grow

From 2001 to 2021, poultry imports increased most in sub-Saharan Africa, expanding from 0.33 million tons to 1.96 million metric tons. Latin American and Caribbean countries accounted for the second-largest increase in poultry imports, increasing a total of 1.13 million metric tons. A similar increase in imports accompanied growth in poultry consumption for the "Other Middle East" region, led by the United Arab Emirates and Iraq. Conversely, Russia's poultry imports dropped by 1.22 million metric tons in the 20-year period.

Volume of poultry imported by select countries and regions projected to increase 27 percent between 2021 and 2031



Note: The shaded region denotes USDA's 10-year projections. The markets represented in this chart are select importing countries and regions and do not represent a global total. **East Asia:** Japan, South Korea, and Taiwan.

Source: USDA, Economic Research Service using data from USDA, Interagency Agricultural Projection Committee, October 2021.

From 2022 to 2031, poultry import volumes by select major importers are projected to increase 24 percent. The regions exhibiting the strongest projected increases are developing countries and emerging markets, including sub-Saharan Africa (up 27 percent), the Other Middle East region (up 18 percent), Mexico (up 21 percent), Latin America and the Caribbean (up 36 percent), and China and Hong Kong (up 37 percent).

Russia is the only select importer showing a projected decrease (25 percent) in poultry imports even though poultry accounted for more than 50 percent of Russian meat consumption in 2020. This is primarily due to an import quota set in 2021 aimed at combating declining production after an avian flu outbreak.

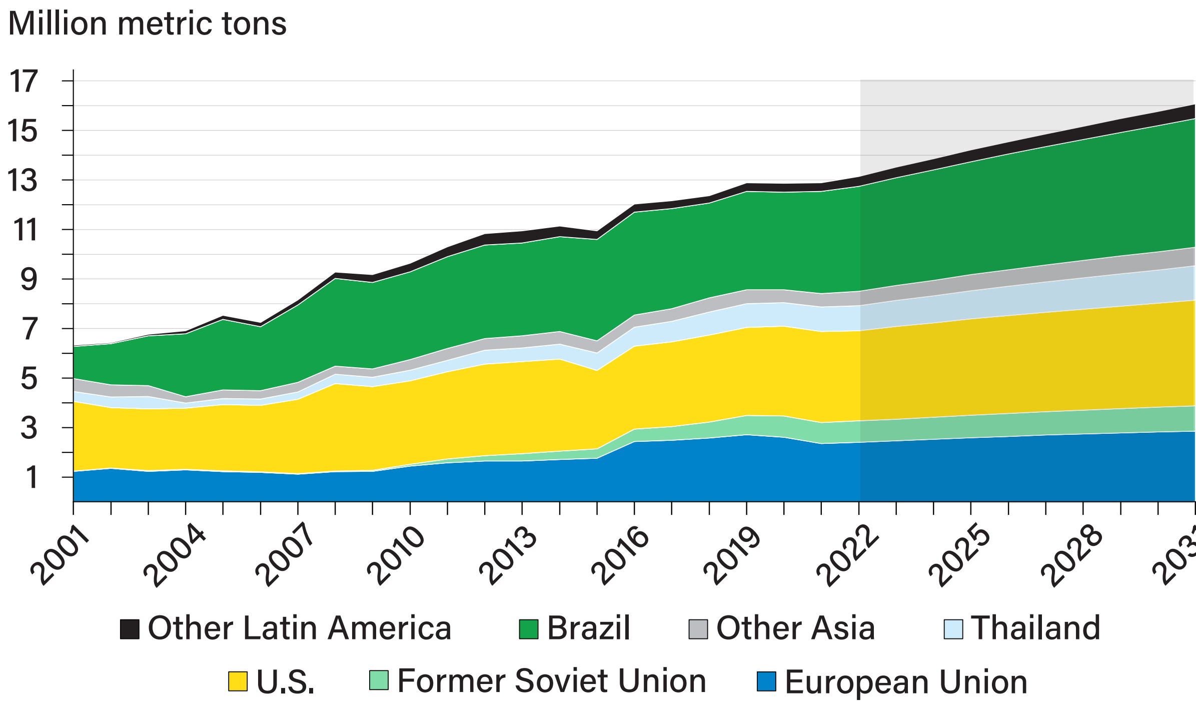
Sub-Saharan Africa is projected to remain the top global importer of poultry at 2.54 million metric tons annually by the year 2031. Characterized by growing populations, increasing urbanization, and rising per capita income, sub-Saharan Africa is an increasingly significant poultry importer. Countries such as South Africa, Ghana, and Angola—some of the most highly urbanized countries in the region—account for more than half of poultry imports to the region. In 2021, the region accounted for 19 percent of the global trade, and USDA projects that to increase to 20 percent by 2031. The rise in imports has been driven by the affordability of poultry meat as a protein source, but also the collapse of poultry production for many countries. Before 2001, Ghana and Angola had strong poultry sectors, but the 26-year civil war in Angola and surges in production costs for items such as feed and energy in both countries led to a decline in production capacity. Since the collapse of the Angola and Ghana poultry sectors, foreign supplies have satisfied about 90 percent of poultry meat demand in both countries. In South Africa, the government, seeking to protect domestic producers from cheaper imports, placed duties on poultry meat entering the country. That move curtailed poultry exports to South Africa, particularly those from the United States. In 2015, South Africa replaced the duties with a tariff-rate quota, which led to an 18-percent increase in South African poultry imports from 2015 to 2020.

Where Poultry Exports Are Projected to Increase

The three largest exporters (by volume) are Brazil, the United States, and the European Union (EU). Together, they accounted for 71 percent of world poultry exports in 2021, a share that is projected to remain mostly stable by 2031. The other four major export regions, “Other Latin America,” “Other Asia,” Thailand, and the former Soviet Union, accounted for 19 percent of world poultry exports in 2021. Their share is projected to increase slightly by 2031.

Brazil’s poultry exports grew rapidly between 2001 and 2021, and the country regained the title of the world’s largest poultry exporter in 2007. Increased domestic production of feedstuffs for poultry (feed grains and soybeans) helped boost Brazil’s expansion of poultry production. From 2015 to 2019, China accounted for an annual average of 13 percent of Brazilian poultry exports. By comparison, the United States shipped 1 percent of its poultry exports to China during that time. Brazil exports also have increased to European and Middle Eastern markets. Brazil is projected to remain the world’s leading poultry exporter, expanding to 5.2 million metric tons by 2031.

Volume of poultry exported by select countries and regions projected to increase 25 percent between 2021 and 2031



Notes: The shaded region denotes USDA’s 10-year projections. The exporting countries and regions represented in this chart are select exporters and do not represent a global total.

Source: USDA, Economic Research Service using data from USDA, Interagency Agricultural Projection Committee, October 2021.

Similar to Brazil, the EU's poultry export market grew from 2001 to 2021, although the region remains the world's third-largest exporter. This growth is primarily due to import demand in sub-Saharan African markets such as Ghana and the Democratic Republic of Congo, as well as Hong Kong and Saudi Arabia.

Despite losing some export market share to Brazil, the United States remains the second-largest poultry exporter and is expected to remain so for the next 10 years. While U.S. poultry exports are expected to increase through 2031, the U.S. share of world poultry exports is projected to decrease slightly to 24 percent from 26 percent in 2021. The United States saw significant declines in exports to China during its 2018–19 trade dispute, with an average annual decline of 37 percent between 2015 and 2019 before rebounding in 2020. However, U.S. exports to Latin American countries, particularly Cuba, Guatemala, and Colombia, have expanded over the last decade. Exports to South Africa likewise increased as trade restrictions have eased since 2015. U.S. exports of chicken meat are principally in the form of dark meat, specifically leg quarters (the uncut leg and thigh).

This article is drawn from...

USDA Agricultural Projections to 2031, by Erik Dohlman, James Hansen, and David Boussios, ERS, February 2022

USDA Agricultural "Baseline" Projections

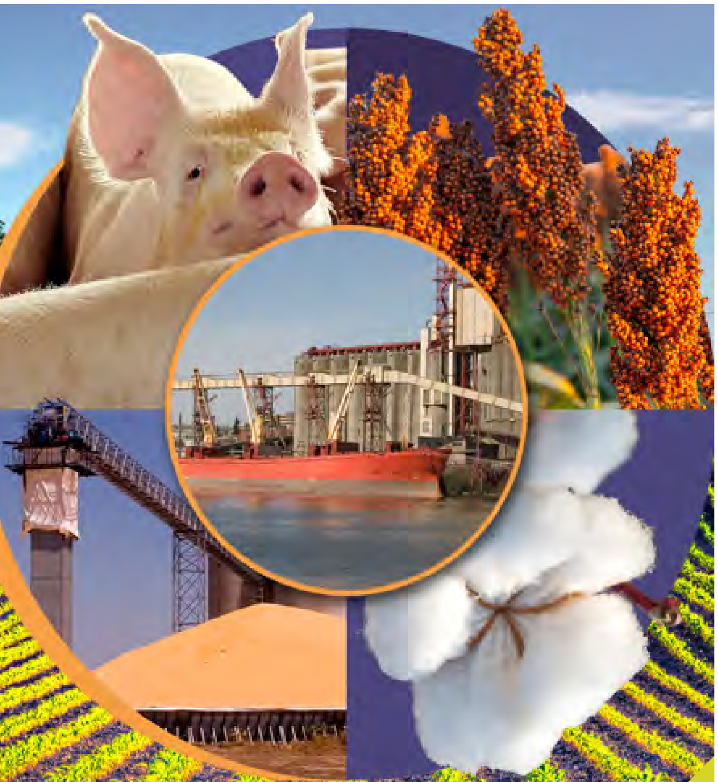
Each year, economists with USDA's Economic Research Service, along with colleagues of USDA's Interagency Agricultural Projections Committee, develop projections for supply, demand, and trade for major agricultural commodities for select countries or regions. These 10-year projections provide international country- and regional-level detail supporting the annual USDA Agricultural "Baseline" Projections report. The projections for poultry trade used to develop this article are based on conditions as they existed upon the release of the October 2021 *World Agricultural Supply and Demand Estimates* (WASDE) report. The projections also are based on specific assumptions about macroeconomic conditions, policy, weather, and international developments, with no domestic or external shocks to global agricultural markets.

Once the projections have been developed, they are used to predict farm program expenditures within the President's annual budget proposal released by the Office of Management and Budget, including outlays on agricultural programs such as marketing assistance loans, the Price Loss Coverage program, and the Agriculture Risk Coverage program. Releasing these projections publicly makes the information available for planning and investment decisions, as well as domestic and international marketing decisions throughout the agribusiness supply chain.

March **2022**

Retaliatory Tariffs Reduced U.S. States' Exports of Agricultural Commodities

by **Stephen Morgan**



Highlights:

- In 2018, the United States imposed tariffs on steel and aluminum imports from major trading partners and separate tariffs on imports from China.
- Six trading partners imposed retaliatory tariffs: Canada, China, the European Union (EU, including the United Kingdom), India, Mexico, and Turkey imposed retaliatory tariffs on many U.S. exports, including a wide range of agricultural and food products.
- Across all commodities and States, annual U.S. losses from retaliatory tariffs were estimated to be $13.2 billion.
- Losses from retaliatory tariffs were concentrated among Midwestern States, with the largest losses among producers of soybeans, sorghum, and pork.

Taxes on imports, also called tariffs, are typically used to protect domestic industries or raise government revenue. However, tariffs may also be implemented in response to unfavorable policy actions taken by trading partners. In these cases, the import tax is typically referred to as a retaliatory tariff (see highlights box, "Retaliation in trade policy"). Retaliatory tariffs increase the price of imports for foreign consumers relative to alternatives that are either domestically produced or available from competing international sources. Producers in exporting countries may find opportunities to sell their products to other non-retaliating trade partners, but retaliatory tariffs typically reduce an exporting nation's overall sales for targeted commodities.

In 2018, the United States imposed tariffs on steel and aluminum imports from major trading partners and separately placed tariffs on a broad range of imports from China. In response, Canada, China, the European Union (EU, including the United Kingdom), India, Mexico, and Turkey imposed retaliatory tariffs on many U.S. exports, including a wide range of agricultural and food products.

USDA, Economic Research Service (ERS) researchers studied how these tariffs affected U.S. farmers across different States and commodities in an economic research report, The Economic Impact of Retaliatory Tariffs on U.S. Agriculture. Using data from the ERS State Exports, Cash Receipts Estimates, researchers estimated losses from retaliatory tariffs and analyzed how the recent trade dispute affected farm cash receipts from exports by State and commodity. Researchers found total losses were concentrated among Midwestern States, with the largest losses among producers of soybeans, sorghum, and pork. Across all commodities and States, annual U.S. losses from retaliatory tariffs were estimated to be $13.2 billion from mid-2018 through 2019.

Six Trading Partners Implemented Retaliatory Tariffs Affecting U.S. Agricultural Exports

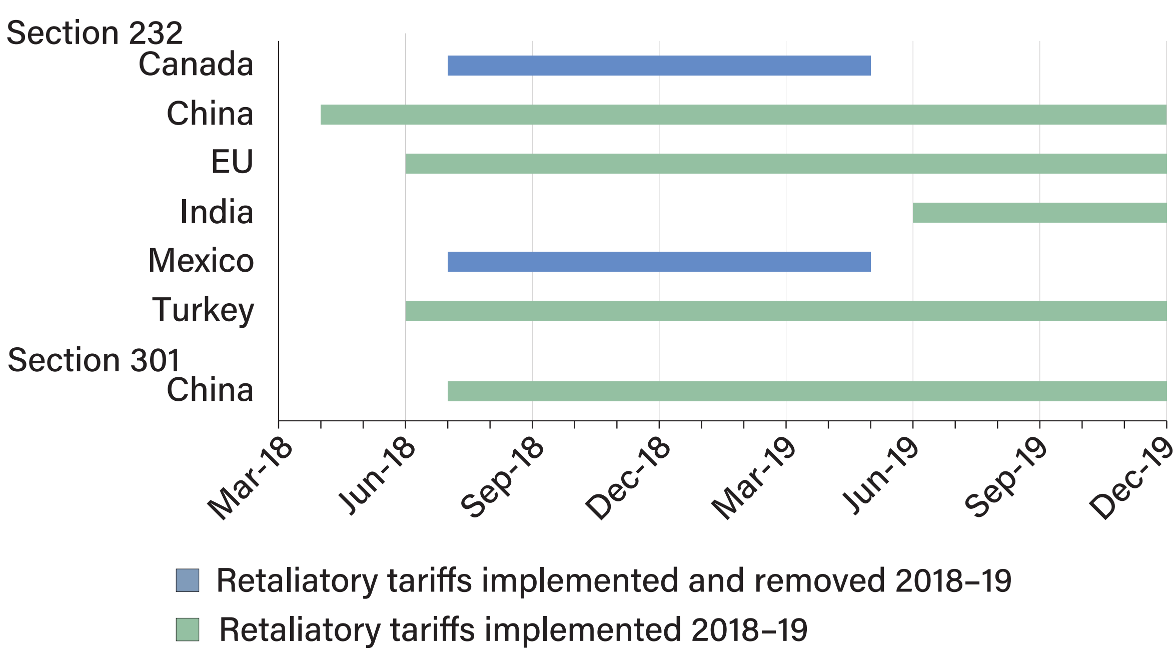
Beginning in 2017, the United States initiated two trade actions. In April 2017, the U.S. Department of Commerce initiated an investigation under Section 232 of the Trade Expansion Act of 1962 to determine whether aluminum and steel were being imported in such quantities or under such circumstances to affect U.S. national security. In August 2017, the U.S. Trade Representative initiated a Section 301 investigation to determine whether China's policies related to intellectual property and technology transfer were actionable under U.S. trade law. As a result of the Section 232 investigation, the United States applied tariffs of 25 percent on steel imports and 10 percent on aluminum imports from all suppliers, although exceptions were made for certain countries. Additionally, the Section 301 investigation found China's policies were actionable, and the United States imposed a 25-percent tariff on a broad range of goods from China.

In April 2018, China responded to the tariffs on steel and aluminum by implementing retaliatory tariffs affecting U.S. exports (see chart below). This round of retaliatory tariffs covered several U.S. agricultural products, including fruit, pork, and tree nuts. In July 2018, China responded to the United States' action against Chinese imports stemming from the Section 301 investigation by imposing additional tariffs ranging from 5 to 25 percent on thousands of agricultural products worth $22.5 billion.

Also in June 2018, the EU imposed retaliatory tariffs of 25 percent on U.S. agricultural products, including whiskies, corn, and processed fruits and vegetables. At the same time, Turkey imposed tariffs ranging from 10 to 70 percent on tree nuts, rice, prepared foods, whiskey, and tobacco products. Turkey would later double its retaliatory tariffs, before lowering them back to June 2018 levels.

In July 2018, Canada and Mexico also imposed retaliatory tariffs on U.S. agricultural products. Canada imposed tariffs of 10 percent on goods including pre-

Retaliatory tariffs against U.S. agricultural exports first began in mid-2018



Notes: **EU**=European Union. In October 2021, the United States and the EU reached agreements to address global steel and aluminum excess capacity that include replacement of Section 232 tariffs with a tariff-rate quota and lifting of the EU's retaliatory tariffs.

Source: USDA, Economic Research Service using data from U.S. Department of Commerce, International Trade Administration, 2020.

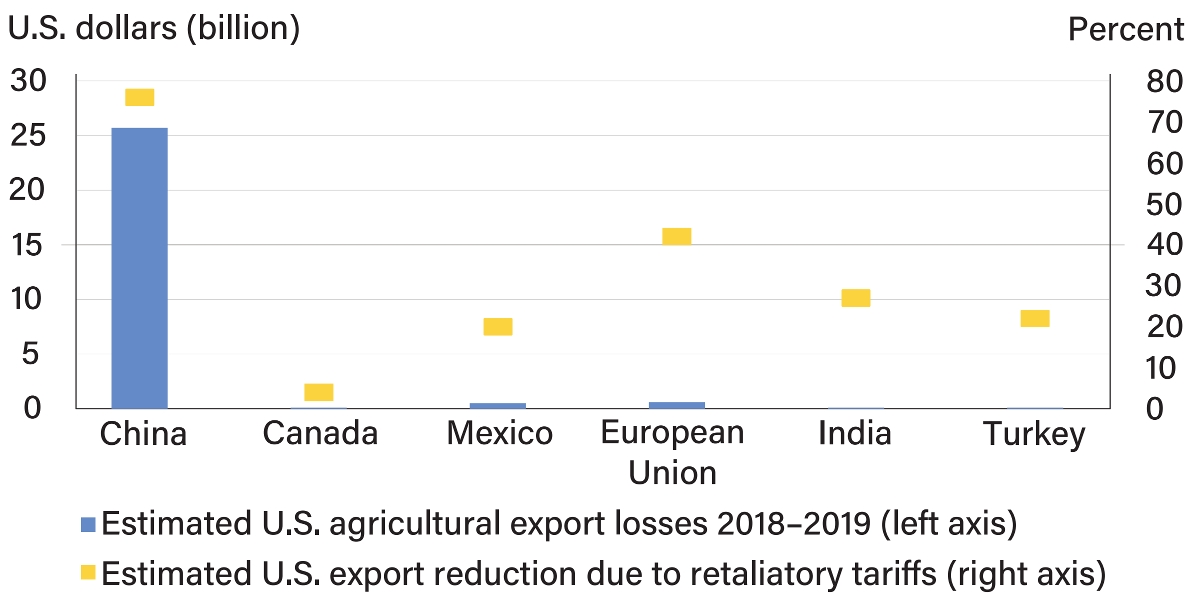
pared food products, coffee, and orange juice. Mexico imposed tariffs ranging from 15 to 25 percent on products including pork, fresh and processed fruit, and processed vegetables. Leading up to the signing of the United States-Mexico-Canada Agreement (USMCA, formerly the North American Free Trade Agreement), the three trading partners reached a deal to have an import-monitoring mechanism for steel and aluminum. In turn, Canada and Mexico lifted their retaliatory tariffs in May 2019.

In June 2019, India imposed tariffs on U.S. almonds, walnuts, apples, chickpeas, lentils, and brine shrimp. The additional tariff rates ranged from 2 to 20 percent. India's retaliatory tariffs were implemented after the United States removed India's duty-free access to the U.S. market for a wide range of products, both agricultural and non-agricultural.

In total, the estimated value of U.S. agricultural export losses associated with retaliation by the six trading partners was more than $27 billion from mid-2018 through the end of 2019. The chart below shows the value of losses by trading partner. China's retaliatory tariffs were estimated to reduce U.S. agricultural exports by nearly $26 billion, followed by the EU ($600 million) and Mexico ($500 million) with other partners resulting in smaller losses.

USDA researchers also report the reduction in the value of U.S. agricultural exports by trading partner from mid-2018 through the end of 2019. While China's tariffs resulted in a 76-percent reduction in the value of U.S. agricultural exports, the value reductions for other trading partners were also significant (see chart below). For example, the retaliatory tariffs imposed by the EU reduced the value of targeted U.S. exports to the EU by 42 percent.

China's retaliatory tariffs resulted in largest losses for U.S. agricultural exports in mid-2018 to the end of 2019



Notes: Estimates are based on the 2017 value of targeted agricultural commodities and the duration of tariffs imposed from mid-2018 through the end of 2019. Total estimated U.S. agriculture export losses do not include the trade losses on U.S. exports to China from April–June 2018 due to Section 232 retaliatory tariffs on $2 billion worth of products.

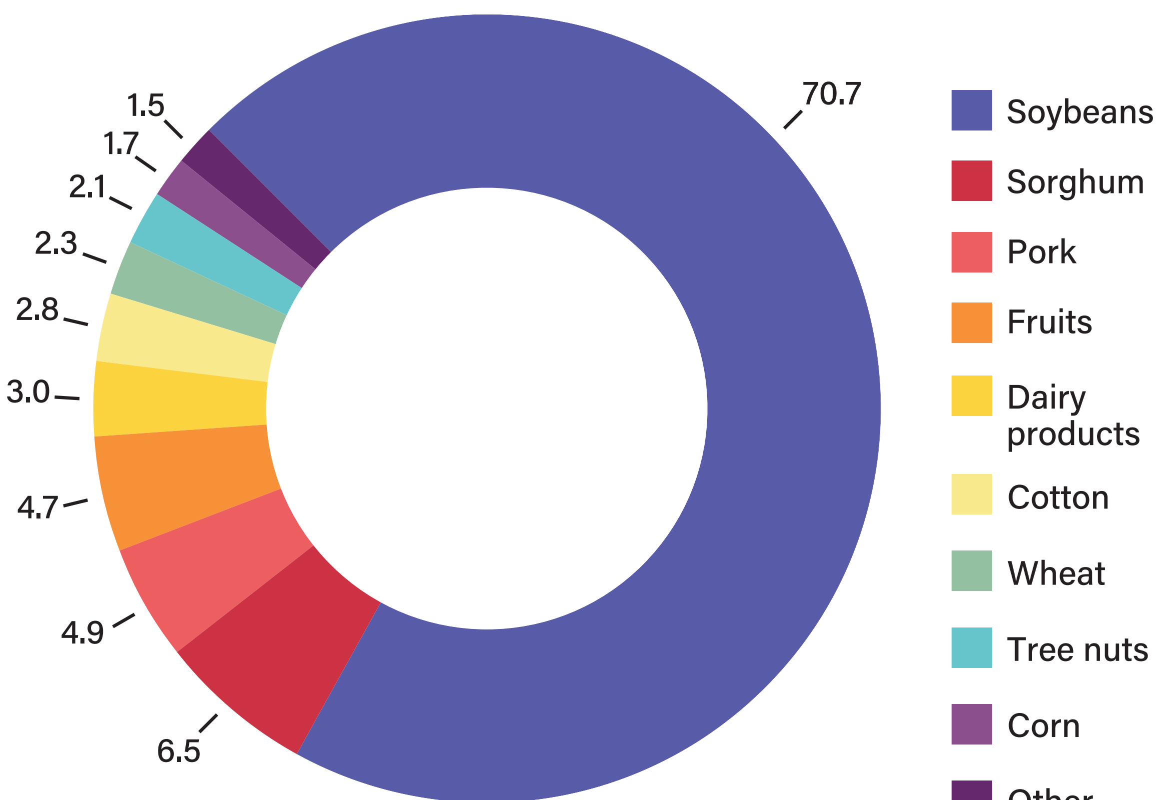
Source: USDA, Economic Research Service using estimates from "Agricultural Exports and Retaliatory Trade Actions: An Empirical Assessment of the 2018/2019 Trade Conflict," *Applied Economic Perspectives and Policy*, 2021.

Trade Losses Varied Across Commodity Groups

Differences in the timing, tariff rates, and product lines affected by retaliatory tariffs across different trading partners led to a variety of losses for different commodity groups. To estimate the effects of retaliatory tariffs on producers, ERS researchers gathered data on the value of commodities produced by each State that were sold to other countries in 2017 as a base for estimates of trade values. The year 2017 was selected because it preceded the start of the trade actions, thus serving as a proxy for what U.S. agricultural exports may have been without the retaliatory tariffs.

Estimated annual U.S. losses from retaliation totaled $13.2 billion, spread across 17 different commodity groups. The chart below shows the share of loss for each commodity group.

Soybeans showed the largest losses, by percent share, in export value among commodity groups from retaliatory tariffs



Note: Estimates reflect annualized losses calculated using data from mid-2018 through the end of calendar year 2019.

Source: USDA, Economic Research Service (ERS) using data from "State Exports, Cash Receipts Estimates" in the ERS topic page U.S. Agricultural Trade; Trade Data Monitor (2021); and "Agricultural Exports and Retaliatory Trade Actions: An Empirical Assessment of the 2018/2019 Trade Conflict," Applied Economic Perspectives and Policy, 2021.

Several patterns emerged across commodities. Soybeans accounted for the largest share of total trade loss, making up nearly 71 percent ($9.4 billion) of annual losses. Soybeans account for around 13 percent of the value of total U.S. exports, the highest export value for a single U.S. commodity. China typically imports the most U.S. soybeans. Similarly, China imposed a 25-percent tariff on U.S. sorghum affecting the 2018 marketing year (September through August), accounting for more than 6 percent ($854 million) of annual losses from retaliatory tariffs.

Pork represented nearly 5 percent ($646 million) of estimated annual losses and was a target for retaliation by both China and Mexico. However, some of the losses from retaliation by Mexico may have been mitigated by a duty-free tariff-rate quota for 350,000 tons of pork product that was implemented alongside the retaliatory tariffs. Beef and veal products accounted for a small share of losses (one-tenth of a percent). Trade values were already low since China banned U.S. beef import in 2003 and only recently agreed to new import conditions in 2017.

Retaliatory tariffs also affected U.S. fruits, vegetables, and tree nuts. Trade losses were valued at $618 million in the fruit category (more than 4 percent), including $424 million in processed fruit (about 3 percent) and $194 million in fresh fruit (more than 1 percent). There were also $219 million in losses for tree nuts (nearly 2 percent). For fresh vegetables, retaliatory tariffs resulted in annualized losses of $0.4 million. Within these categories, however, some specific commodities may have experienced particularly high losses because they lack alternative markets and therefore rely more heavily on export markets than other commodities. Perishability is also a factor for some of these crops.

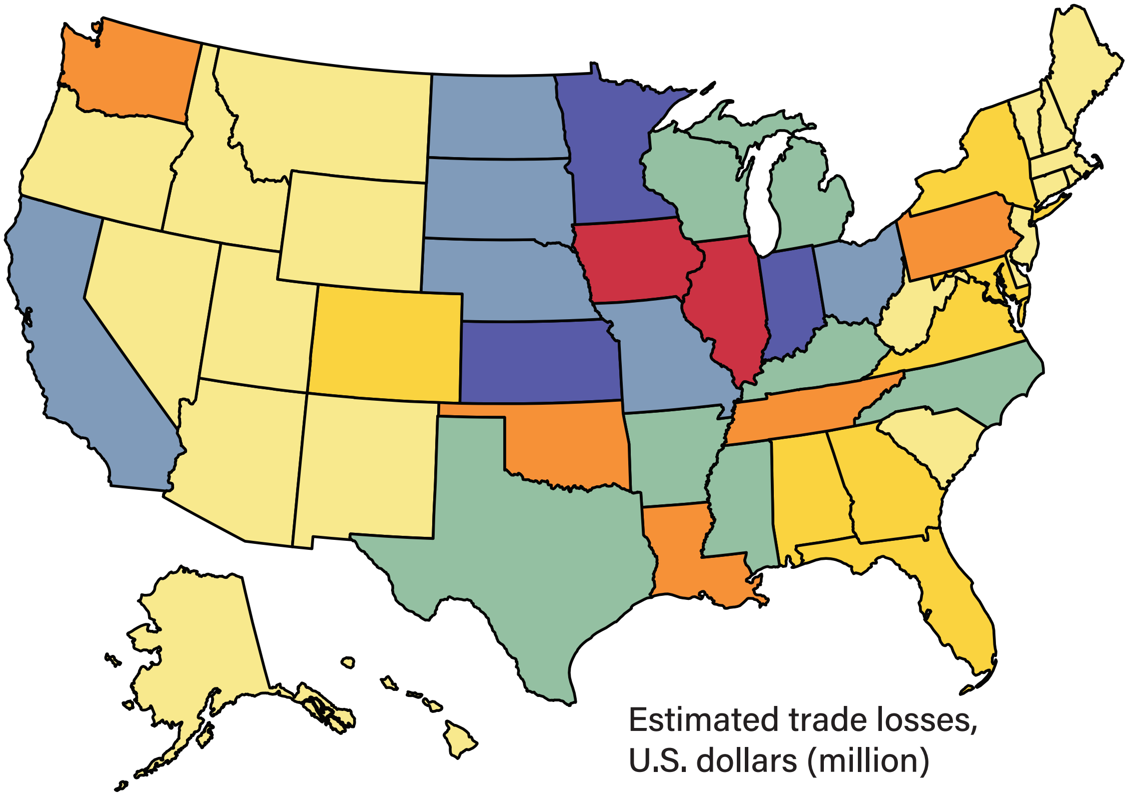
Canada and China placed retaliatory tariffs on dairy representing just under 3 percent ($391 million) of the losses. These 2 countries were the second and third largest destinations for U.S. dairy product exports in 2017, accounting for 24 percent of total exports. Cotton represented just under 3 percent ($366 million) of the total amount of export losses, although China was the only country that placed tariffs on cotton.

Tariff retaliation against wheat and corn accounted for more than 2 percent ($309 million) and more than 1 percent ($198 million) of annualized tariff losses, respectively. Wheat products and corn were targets of China's tariffs, while the EU and Turkey imposed tariffs on U.S. rice exports, which amounted to less than 1 percent ($46 million) of total losses.

Retaliatory Tariff Export Losses Were Concentrated in the Midwest

While retaliatory tariffs affected a broad array of agricultural products across the country, the share of losses for individual States from mid-2018 through 2019 varied based on the geographic distribution of commodity production (see figure on next page). Losses were largely concentrated in the Midwest with Iowa, Illinois, and Kansas incurring annualized losses of $1.46 billion, $1.41 billion, and $955 million, respectively.

Losses in export value resulting from retaliatory tariffs were concentrated in the Midwest

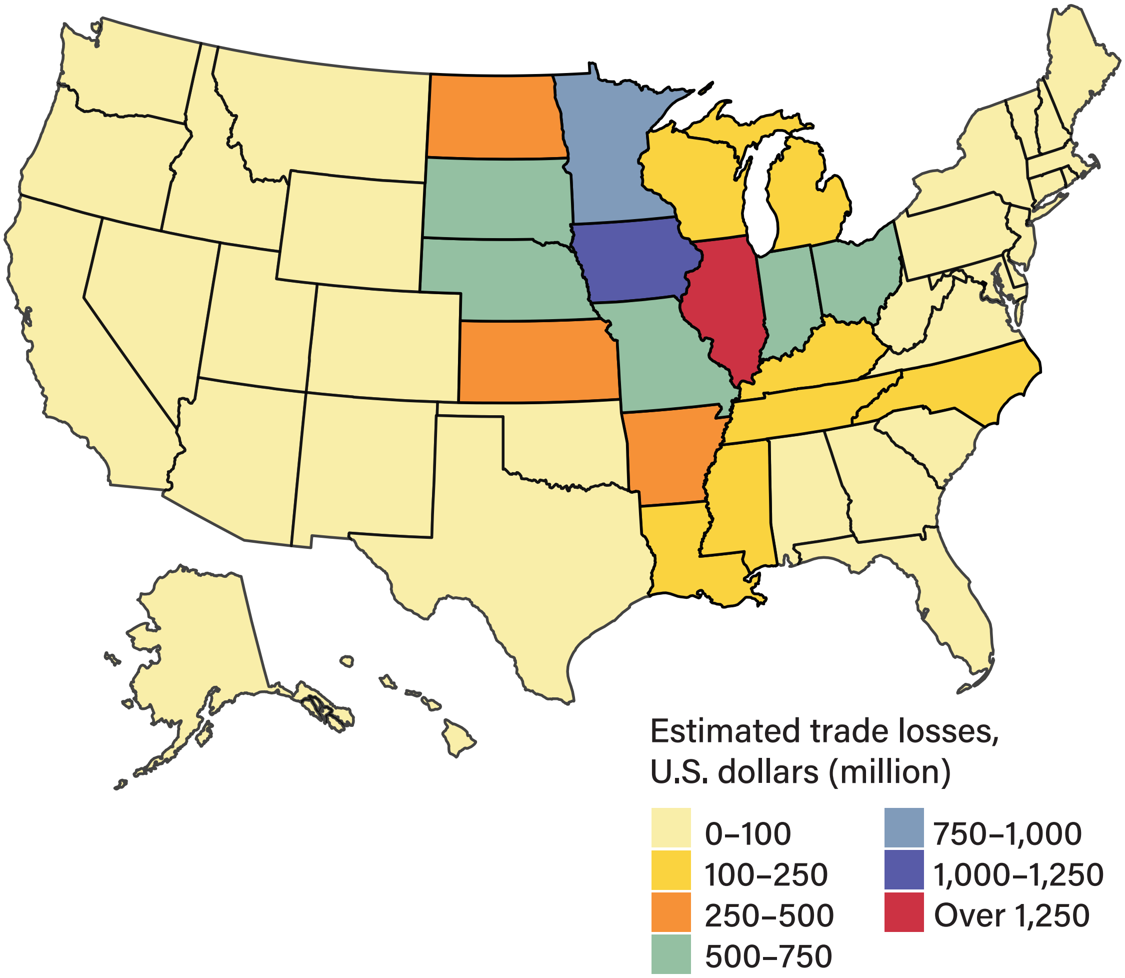


Notes: Totals calculated over selected commodities as reported in appendix of the USDA, Economic Research Service report "The Economic Impacts of Retaliatory Tariffs on U.S. Agriculture," published January 11, 2022. Annualized losses estimated for retaliatory tariffs that were in place from June 2018 through December 2019.

Source: USDA, Economic Research Service (ERS) estimations using data from ERS State Exports, Cash Receipts Estimates, Trade Data Monitor (2021), and "Agricultural Exports and Retaliatory Trade Actions: An Empirical Assessment of the 2018/2019 Trade Conflict," Applied Economic Perspectives and Policy, 2021.

ERS researchers analyzed the geographic distribution of estimated tariff losses by commodity to indicate how much different States were affected by losses. The figure on the next page illustrates the distribution of losses for the two most affected commodities: soybeans and sorghum. Soybean losses were distributed across the Midwest with losses in Illinois and Iowa valued at $1.3 billion and $1.2 billion, respectively. Retaliatory tariffs on sorghum had a large impact on Kansas ($478 million) and Texas ($244 million). For processed fruits, California ($257 million) and Washington ($70 million) experienced the largest share of losses. Losses associated with retaliatory tariffs on tobacco were concentrated in North Carolina ($81 million) and Kentucky ($40 million).

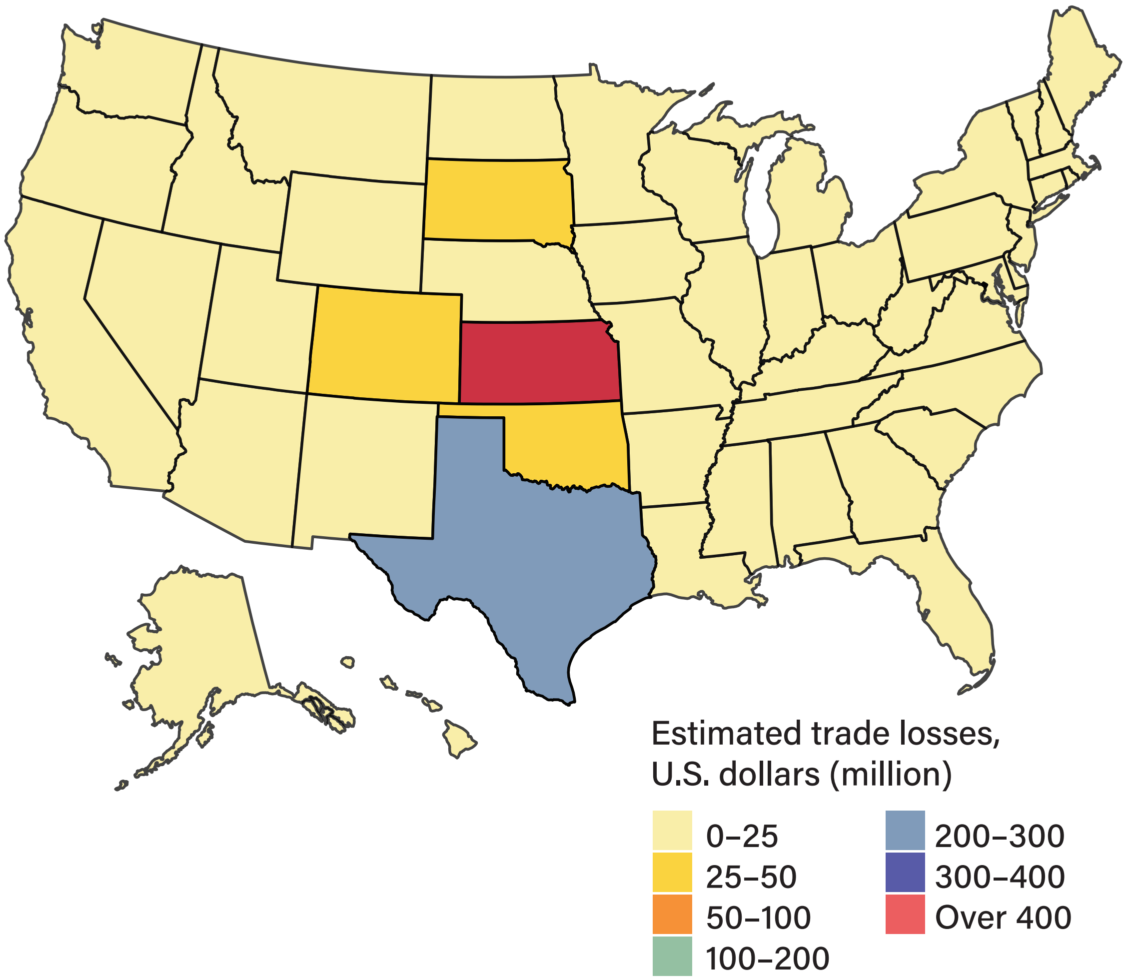
Effects on U.S. States of retaliatory tariffs on soybeans



Note: Estimates reflect annualized losses calculated using data from mid-2018 through the end of calendar year 2019.

Source: USDA, Economic Research Service (ERS) using data from "State Exports, Cash Receipts Estimates" in the ERS topic page U.S. Agricultural Trade; Trade Data Monitor (2021); and "Agricultural Exports and Retaliatory Trade Actions: An Empirical Assessment of the 2018/2019 Trade Conflict," *Applied Economic Perspectives and Policy*, 2021.

Effects on U.S. States of retaliatory tariffs on sorghum



Note: Estimates reflect annualized losses calculated using data from mid-2018 through the end of calendar year 2019.

Source: USDA, Economic Research Service (ERS) using data from "State Exports, Cash Receipts Estimates" in the ERS topic page U.S. Agricultural Trade; Trade Data Monitor (2021); and "Agricultural Exports and Retaliatory Trade Actions: An Empirical Assessment of the 2018/2019 Trade Conflict," Applied Economic Perspectives and Policy, 2021.

Retaliatory tariffs on U.S. agricultural exports are costly for U.S. States and ultimately affect the revenue that U.S. farmers receive. ERS researchers estimated $13.2 billion in revenues lost annually from 2018–19, with most losses felt by producers in the Midwest and by soybean producers. However, many retaliatory tariffs are still in place and continue to affect U.S. producers. Continued analysis is needed to assess the total costs of retaliatory tariffs to U.S. producers over time.

This article is drawn from ...

The Economic Impacts of Retaliatory Tariffs on U.S. Agriculture, by Stephen Morgan, Shawn Arita, Jayson Beckman, Saquib Ahsan, Dylan Russell, Philip Jarrell, and Bart Kenner, ERS, January 2022

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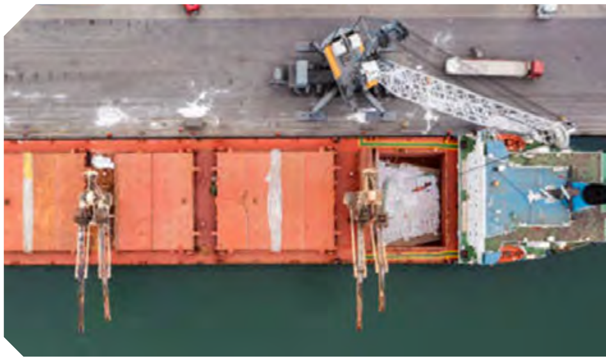
Retaliation in Trade Policy

There are two types of retaliatory tariffs. The first type, and the focus of this study, is a unilateral action implemented under existing trade authorities. In other words, a country observes a trade policy action it disagrees with and implements retaliatory tariffs on products imported from the offending partner. The second type is linked to the World Trade Organization (WTO) dispute settlement process. When two trading partners cannot agree on compensation to resolve a dispute, a complainant can request approval to implement countermeasures against another WTO member.

Different retaliatory tariffs on the same commodity are cumulative. This means that retaliatory tariffs are added on top of the most favored nation (MFN) rate—the tariff rate applied to all World Trade Organization members. For instance, U.S. fresh strawberries imported into China have a total tariff rate of 59 percent, after adding MFN rate of 14 percent plus a cumulative 45-percent rate that includes 3 rounds of tariff retaliation.

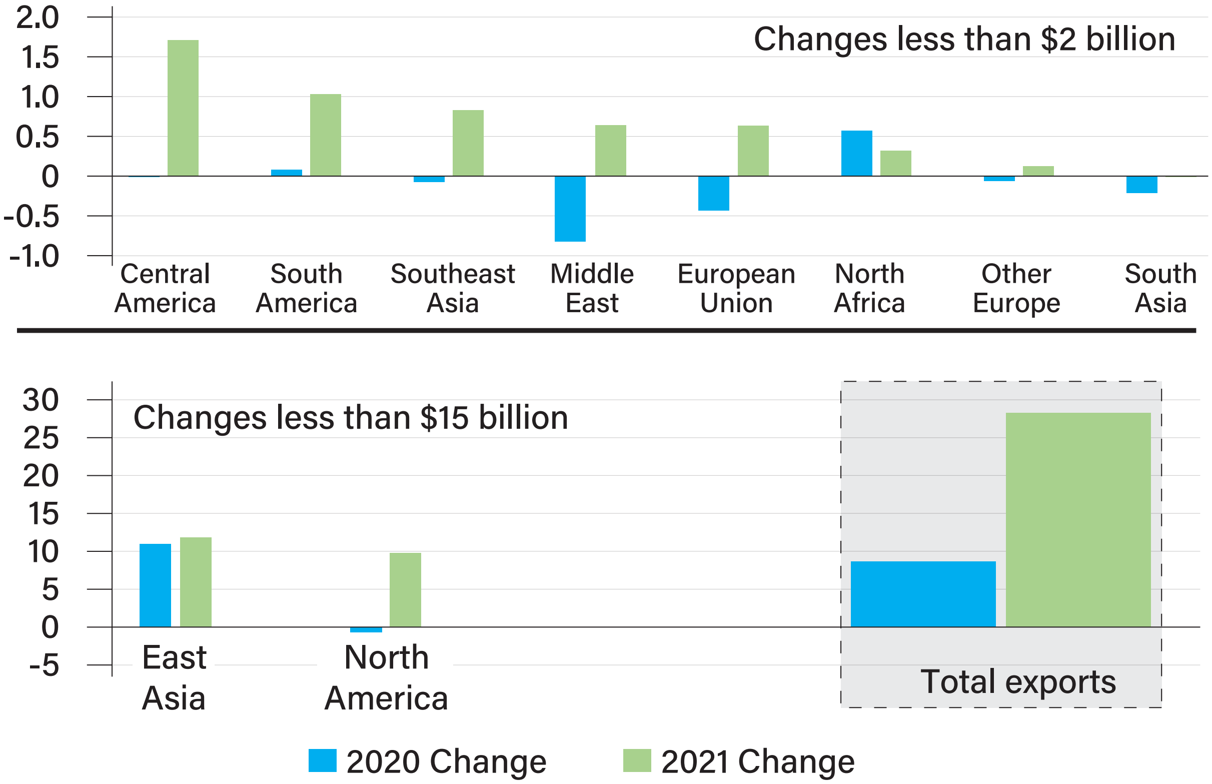
U.S. Agricultural Trade Showed Resiliency Through COVID-19 Pandemic

by **Adam Gerval**



The overall value of U.S. agricultural trade increased in 2020 and 2021, despite global economic downturns from the Coronavirus (COVID-19) pandemic. In 2020, the United States exported $149.7 billion in agricultural exports, 6.1 percent more than the previous year and a 5-year high. The next year (2021), the value of U.S. agricultural exports rose an additional 18.9 percent to $177.0 billion. Soybean exports to China accounted for much of the increase in 2020, concentrated in the final 3 months of 2020 and offsetting declines in the value of many other U.S. agricultural exports in the early months of the pandemic.

Value of U.S. exports expanded from 2020 to 2021 after decreases in 2020



Notes: Data are in U.S. dollars, not adjusted for inflation. Data show changes in U.S. agricultural exports from the previous year. Value data for Central America and South Asia, at less than $10 million, may not appear because of scaling.

Source: USDA, Economic Research Service using data from Global Agricultural Trade System.

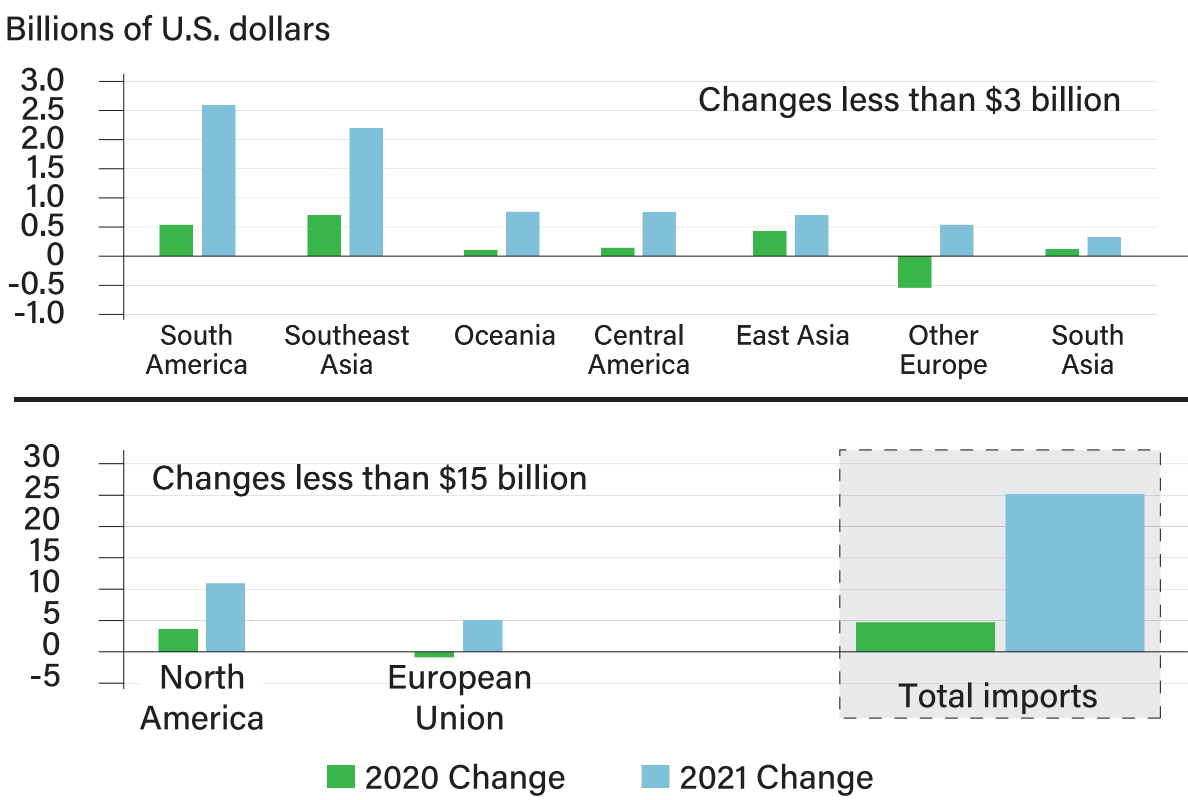
Even with the net increase in agricultural exports in 2020, the value of U.S. exports declined in all but three regions—East Asia, South America, and North Africa. The high cost of shipping containers early in the pandemic weighed on overseas trading partners—such as the European Union (EU), South Asia, and Southeast Asia—who depend on maritime transport in international trade. In addition, a drop in oil prices limited demand in many oil-producing countries, primarily in the Middle East and Africa.

Conversely, imports from all but two regions (the EU and non-EU European countries) rose an average of 3.3 percent in 2020. Despite downturns early in the pandemic, the annual increase in imports from some regions, such as North and South America, was consistent with long-term trends seen before the pandemic. The decline in imports from the EU and other European countries was attributed to reduced imports of alcoholic beverages after the United States implemented a 25-percent tariff on imports of alcoholic beverages from the EU in 2019. Alcoholic beverages constitute the largest commodity group imported from Europe.

The value and share of U.S. exports of agricultural products to China continued to rebound and supported the export rise in 2021, similar to 2020. Growth in recent years follows a sharp drop-off during 2017–18 when a trade dispute between the United States and China resulted in retaliatory tariffs and a significant reduction in soybean exports. When the trade conflict was rectified, total U.S. soybean exports began to recover. In 2021, more than half of U.S. soybean exports were bound for China.

Growth in U.S. soybean exports to China is supported, in part, by increased feed demand as China's hog herd expands after a period of losses from an African swine fever outbreak. U.S. corn exports to China rose from $55.5 million in 2019 to $5.1 billion in 2021, also fueled by higher demand for feed. In addition to surges in soybean and corn exports during the latter part of 2020, exports of other U.S. agricultural goods began

Value of U.S. imports increased from 2020 to 2021 by 17 percent



Notes: Data are in U.S. dollars, not adjusted for inflation. Data show changes in U.S. agricultural imports by region from the previous year.

Source: USDA, Economic Research Service using data from Global Agricultural Trade System.

to rebound, especially to North and Central American countries, as well as to sub-Saharan Africa.

As with exports, the value of U.S. imports trended higher in 2021, rising 17.2 percent from the previous year. The rate of increase in the value of imports from the United States' North American partners, Canada and Mexico, more than doubled from the previous year, led by fruits, vegetables, and alcoholic beverages. Likewise, imports expanded for products from South and Central America, including fresh fruit, coffee products, nursery products, and sugar and sweetener products. Imports also rose for miscellaneous food and beverage products from Southeast Asia. In addition, imports from the EU rebounded to pre-COVID trading levels in 2021 on the strength of renewed imports of alcoholic beverages, which were up more than 18 percent from 2020.

While it is impossible to predict the course of COVID-19's impact on the global economy and agricultural trade, empirical data provide evidence of a sustained recovery in agricultural trade, according to USDA, Economic Research Service. The value of U.S. agricultural exports is expected to grow at an annual rate averaging 0.8 percent per year from 2021 through 2031. The value of imports is projected to increase by an average annual rate of 6 percent over that period, based on projections for domestic consumer spending. Other major agricultural exporters have likewise shown resilience in the face of the COVID-19 pandemic, suggesting that the recovery to agricultural trade from the pandemic is widespread.

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World Agricultural Output Growth Continues to Slow, Reaching Lowest Rate in Six Decades

by **Stephen Morgan, Keith Fuglie, and Jeremy Jelliffe**

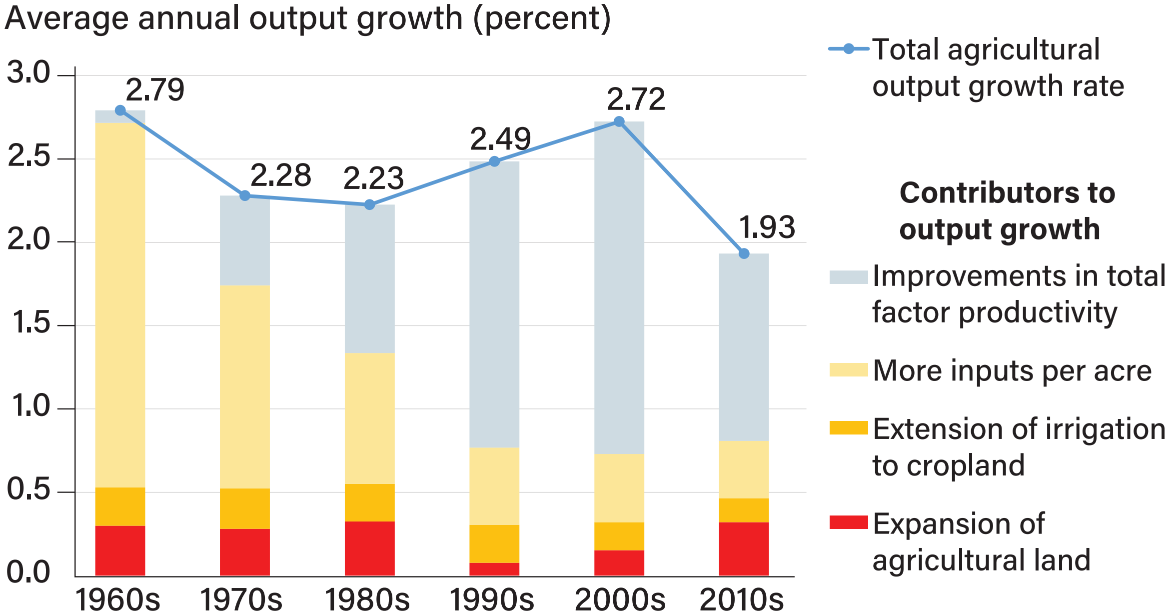
Highlights:

- Data collected and analyzed for 1961–2020 by USDA's Economic Research Service showed that average annual agricultural output growth has slowed to its lowest rate in 6 decades and is linked to a slowdown in agricultural productivity growth.
- Total factor productivity (TFP), which measures the overall efficiency with which agricultural inputs are combined to produce output, grew globally at an average annual rate of 1.12 percent in the 2010s, down from 1.99 percent in the 2000s.
- The slowdown in agricultural output is primarily observed in developing countries, where TFP growth fell by more than half from an average of 2.20 percent in the 2000s to 1.06 percent in the 2010s.
- A slowdown in productivity growth suggests that producers will need to use more land and apply other agricultural inputs more intensively to maintain growth in agricultural output.

Agricultural productivity growth helps farmers meet the food and fiber demands of growing global populations while using relatively fewer resources. One of the most informative measures of agricultural productivity is total factor productivity (TFP), which measures the efficiency with which agricultural inputs are combined to produce output. Unlike single factor productivity measures, such as output per acre (yield) for land, total factor productivity compares total crop, livestock, and aquaculture output to the full set of inputs used in agricultural production. When the total value of agricultural output grows faster than the total amount of inputs used, then TFP increases. (see box on page 64)

In its International Agricultural Productivity data product, USDA's Economic Research Service (ERS) estimates annual indexes for global, regional, and national agricultural output and productivity starting in 1961. In 2022, ERS updated its estimates and extended the series to include 2020 data. The update shows the growth rate for global output was nearly a third slower in the 2010s compared with the 2000s, falling to 1.93 percent per year in 2011–20 from 2.72 percent a year in 2001–10. In the most recent decade, global agricultural output increased at the slowest pace of the 6 decades covered in the data series (see chart on following page).

Global agricultural output growth rate slowed over the past decade along with declines in agricultural productivity growth



Source: USDA, Economic Research Service (ERS) using data from the ERS International Agricultural Productivity data product.

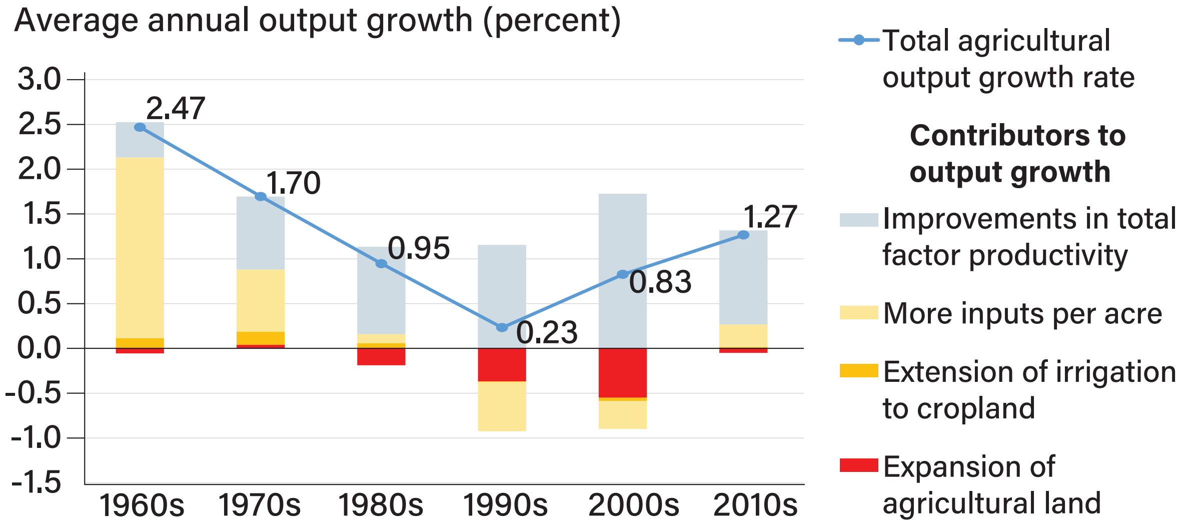
Productivity growth also has started to decline, contributing to the slowdown in agricultural output growth. During the 1960s and 1970s, input intensification or the increasing use of labor, capital, and fertilizers per acre drove global agricultural output growth. This period also includes the early years of the "Green Revolution," when the benefits from agricultural research and development (R&D), such as the adoption of high-yielding crop varieties, led to productivity gains in cereal grains. Over time, TFP growth also began to accelerate and has represented the largest component of agricultural output growth since the 1980s. However, during the past decade of decelerating output growth, slowing agricultural productivity growth accounted for most of the decline. In the 2010s, average TFP growth averaged 1.12 percent per year compared with 1.99 percent per year in the 2000s. TFP was not the only component of agricultural output growth changing in the most recent decade. Comparing the last two decades, growth in output that was associated with the intensified use of inputs (labor, capital, and materials) per acre and irrigation declined, but the rate at which land was brought into production or converted into cropland more than doubled. Even so, slowing TFP growth was the most dominant factor weighing on output growth. Overall, a slowdown in global productivity growth suggests that farmers will need to use more land and apply other inputs more intensively to maintain growth in output.

Where Has Agricultural Productivity Been Slowing?

Agricultural output growth accelerated in developed countries over the past decade but slowed among developing countries, although the rate of output growth in developing countries is still faster.

In developed countries, agricultural output growth increased from an average of 0.83 percent in the 2000s to 1.27 percent in the 2010s (see following chart). Average annual TFP growth in developed countries was 1.05 percent in the 2010s and remained the largest component of output growth. Additional growth was driven by stabilization in the amount of land being used in production and an increase in the rate of inputs used per acre.

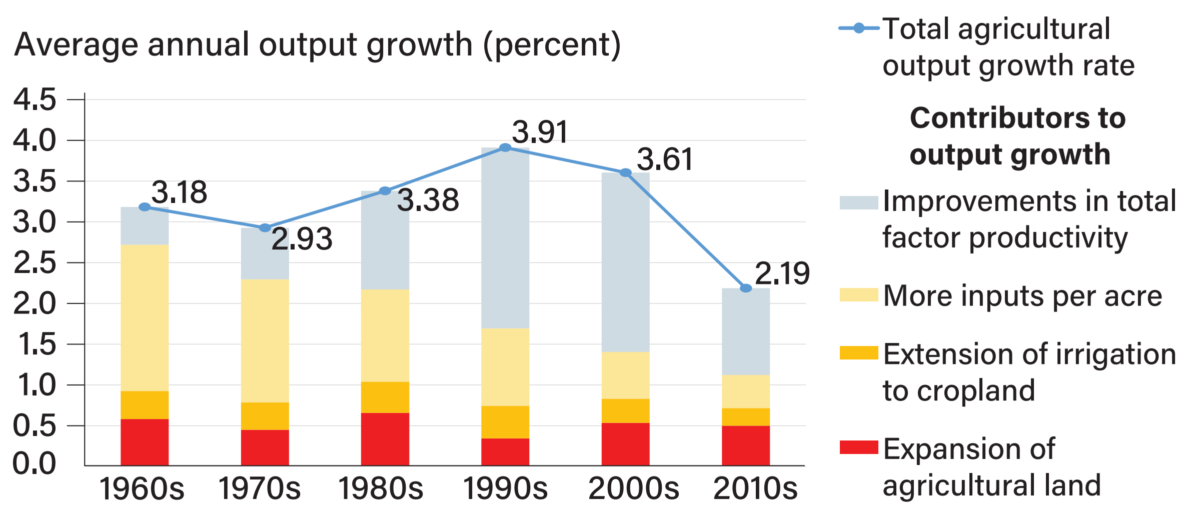
Developed countries: Growth of agricultural output and productivity both increased in the 2010s



Source: USDA, Economic Research Service (ERS) using data from the ERS International Agricultural Productivity data product.

In developing countries, the output growth rate declined from an annual average of 3.61 percent in the 2000s to 2.19 percent in the 2010s. This reduction was largely driven by a slowdown in TFP growth, which fell by more than half from an average of 2.20 percent in the 2000s to 1.06 percent in the 2010s. The growth rate of irrigation and input use in developing countries also declined in the 2010s, while the rate of land expansion remained about steady.

Developing countries: Agricultural output slowed in the 2010s as the rate of productivity growth declined



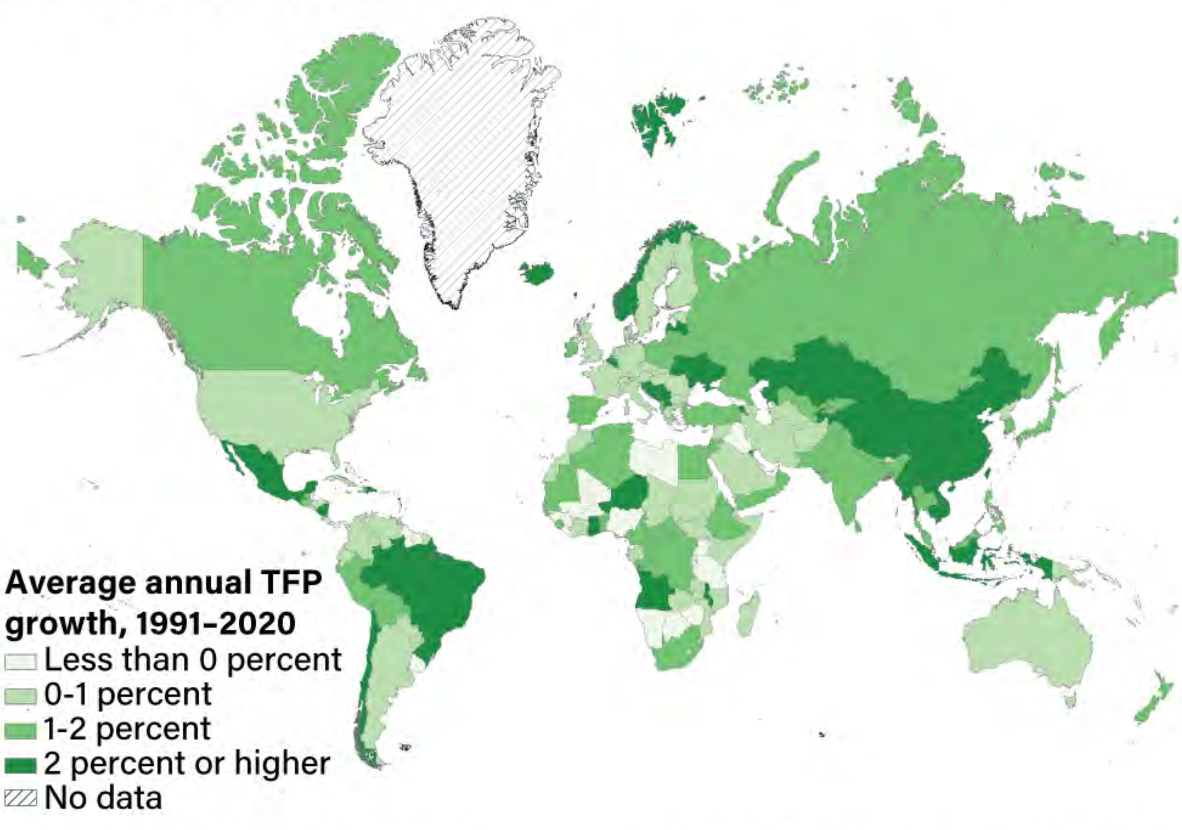
Source: USDA, Economic Research Service (ERS) using data from the ERS International Agricultural Productivity data product.

Long-term agricultural productivity growth has varied across countries. For example, from 1991 to 2020, TFP grew at an annual rate of more than 2 percent in the large agricultural-producing countries of Brazil, China, Mexico, and Ukraine (see map below). In the same period, annual TFP growth was between 1 and 2 percent a year in Canada, India, and Russia and between 0 and 1 percent a year in the United States and Australia. Several countries have experienced negative TFP growth in the past 30 years in Africa and South America. While TFP fluctuates from year-to-year due to weather and other factors, over the long term, growth in TFP can be negative if farmers are expanding into less productive agricultural land, natural resources are being degraded, or from climate change.

The slowdown in agricultural productivity growth may be linked to several factors. First, recent studies have shown that climate change and associated weather shocks such as drought have slowed the growth in or decreased agricultural yields. If weather shocks become more extreme or frequent over time, the negative effects on agricultural productivity are likely to become even larger. Second, the emergence of new pests and diseases like disease-resistant weeds have in some cases reduced crop yields or required additional inputs or management practices to control. Third, the rate of development of new productivity-enhancing technologies may be slowing.

Previous ERS research has highlighted a decrease in public agricultural R&D spending among high-income countries that could be associated with long-term declines in TFP growth. At the same time, farmers across different regions of the world may be slow to adopt improved technologies. For example, producers in developing countries often lack access to robust agricultural extension systems, agricultural finance

Average annual growth in total factor productivity varied by country and region from 1991 to 2020



Note: **TFP** = Total factor productivity, a measure of the overall efficiency with which farmers turn agricultural inputs (land, labor, capital, and material resources such as fertilizer and feed) into crop and animal commodities.

Source: USDA, Economic Research Service (ERS) using data from the ERS International Agricultural Productivity data product.

and insurance, or reliable information technology infrastructure that makes it easier to adopt new technologies. Finally, ERS research has shown that barriers to international trade may limit the transfer of productivity-enhancing technologies between countries and make the import of agricultural inputs more expensive.

What Role Does Total Factor Productivity (TFP) Play in Agricultural Output Growth?

Total factor productivity (TFP) measures the overall efficiency with which farmers transform agricultural market inputs (land, labor, capital, and material inputs such as fertilizer and feed) into crop and animal commodities. Other commonly used measures of productivity include crop yield and the value added per worker, but they focus more narrowly on just one input used in production.

Farmers can increase output by expanding their agricultural acreage or by increasing yield per acre. They can increase yields by adding irrigation or through more intensive use of agricultural inputs (such as by using more labor, capital, or fertilizer per acre).

They can also achieve higher yields by applying technological improvements to existing inputs—in other words, by increasing TFP. The figure below illustrates the role TFP plays in agricultural output growth. With growth in TFP, fewer inputs are required for each unit of output, so unit production costs fall. Growth in TFP is driven by the adoption of improved technologies and is influenced by policies that encourage innovation and technology adoption, such as investments in agricultural research and extension.

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R&D Capital, R&D Spillovers, and Productivity Growth in World Agriculture, by Fuglie, K., Applied Economic Perspectives & Policy, 2017

Resources, Policies, and Agricultural Productivity in Sub-Saharan Africa, by Keith Fuglie and Nicholas Rada, ERS, February 2013

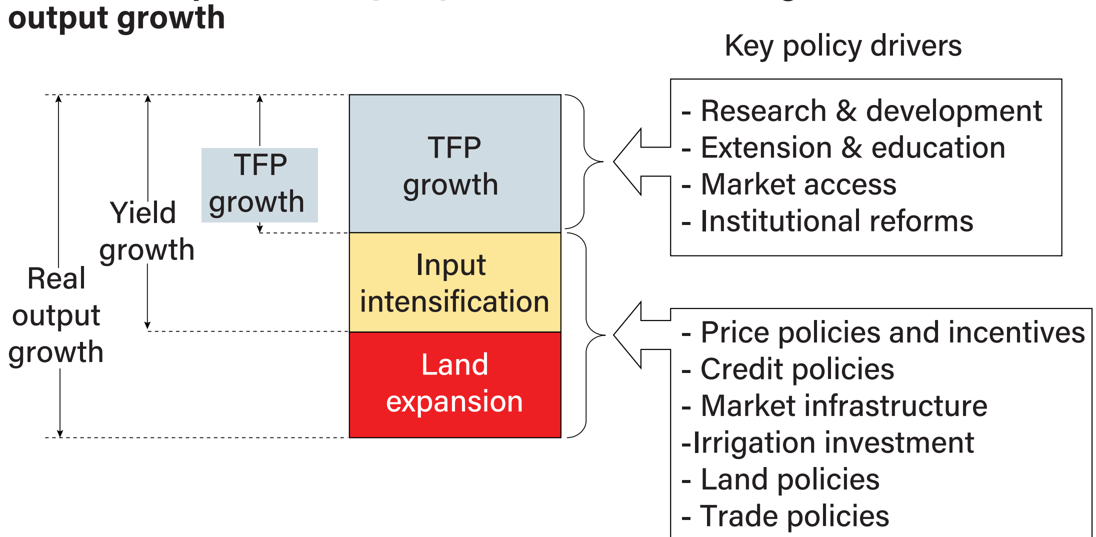
Harvesting Prosperity: Technology and Productivity Growth in Agriculture, by Fuglie, K., M. Gautum, A. Goyal, and W.F. Maloney, World Bank Group, 2020

Policy, Technology, and Efficiency of Brazilian Agriculture, by Nicholas Rada and Constanza Valdes, ERS, July 2012

Propellers of Agricultural Productivity in India, by Nicholas Rada and David Schimmelpfennig, ERS, December 2015

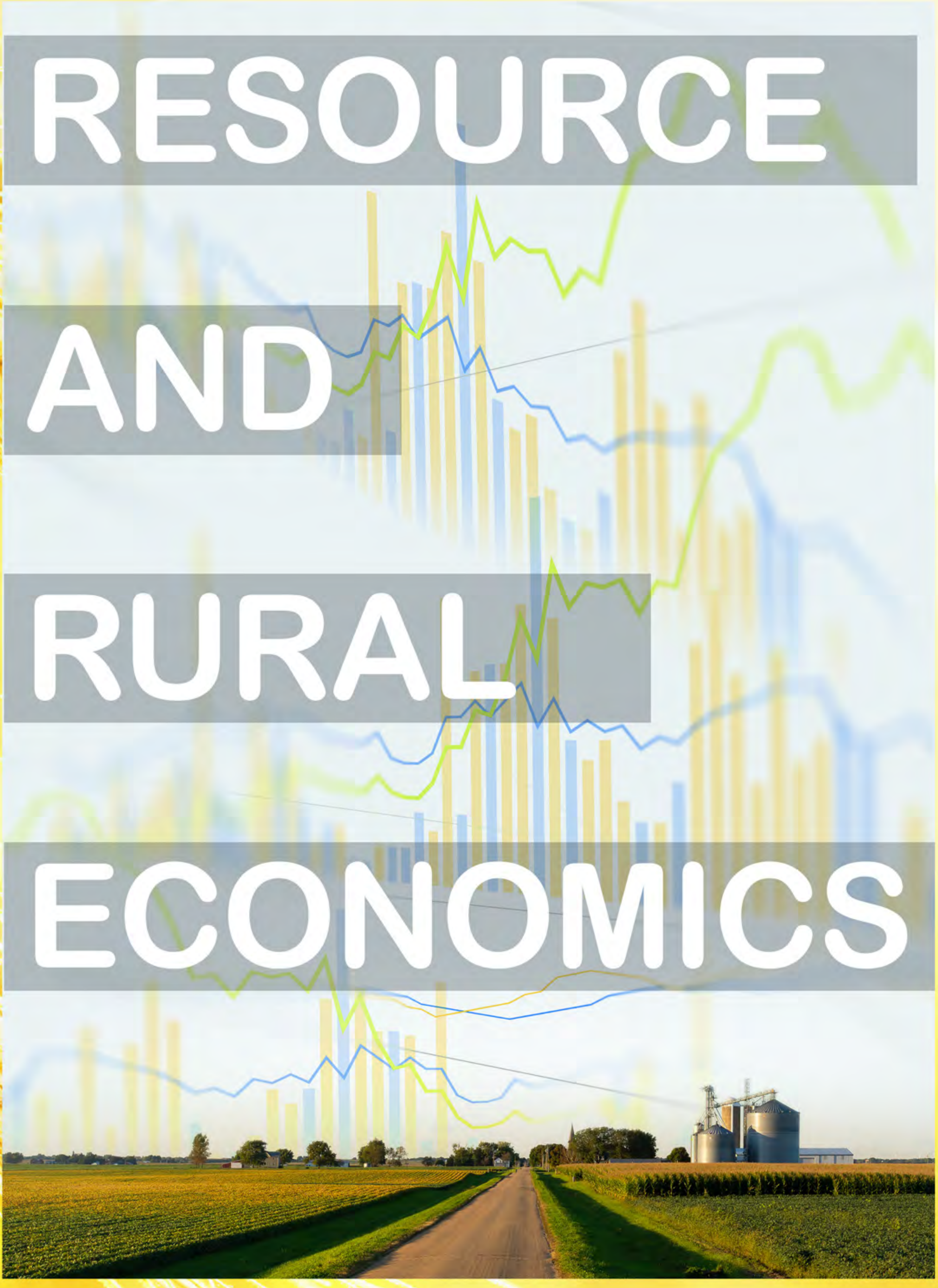
Productivity Growth and the Revival of Russian Agriculture, by Nicholas Rada, William M. Liefert, and Olga Liefert, ERS, April 2017

Total factor production (TFP) contributes to total agricultural output growth



Source: USDA, Economic Research Service

RESOURCE AND RURAL ECONOMICS



June **2022**

Investment in U.S. Public Agricultural Research and Development Has Fallen by a Third Over Past Two Decades, Lags Behind Major Trade Competitors

by **Kelly P. Nelson and Keith Fuglie**

Highlights:

- U.S. public agricultural R&D expenditures, when adjusted for the rising cost of conducting research, have declined by about one-third since peaking in 2002.
- The Federal Government funds about two-thirds of public agricultural research in the United States, with State governments and non-Government sources funding the rest.
- Land-grant universities and other non-Federal institutions perform about 70 percent of U.S. public agricultural research. USDA agencies perform the remainder.
- The United States is falling behind other major countries in investment in agricultural R&D.

In the United States, public agricultural research and development (R&D), which includes any agricultural R&D conducted at universities or Government laboratories regardless of funding source, is supported through Federal-State partnerships. This partnership provides an important complement to business R&D, providing scientific and technological innovations that raise U.S. agri-food system productivity.

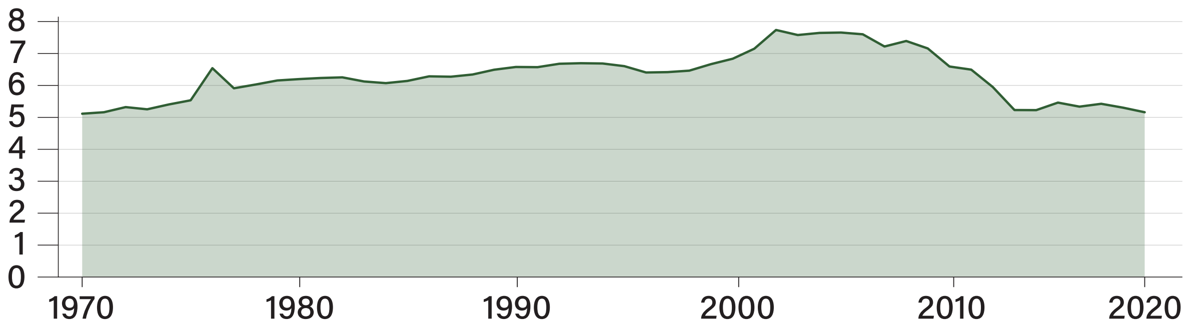
This public R&D investment is the primary driver of long-term productivity growth in U.S. agriculture. In addition to increasing farm productivity, public agricultural R&D investment also supports improvements in natural resources and forestry management, helps advance rural development, enhances food safety and quality, and informs markets and policy. Research supported by the USDA, Economic Research Service (ERS) has found spending on public agricultural R&D from 1900 to 2011 generated, on average, $20 in benefits to the U.S. economy for every $1 of spending. However, this spending has been trending downwards. In 2019 (the last year for which complete statistics are available), public agricultural R&D spending in the United States totaled $5.16 billion, about a third lower than the peak in 2002 when spending was $7.64 billion (in constant 2019 dollars). At the same time, other countries have maintained or increased their spending on agricultural R&D.

Accounting for Inflation When Measuring Public Agricultural R&D Spending

ERS researchers estimated the amount of R&D investment in constant dollars by adjusting nominal spending by an R&D price index. This R&D price index, the Biomedical Research and Development Price Index, was developed by the National Institutes of Health (NIH), is maintained by the Bureau of Economic Analysis, and spotlights the changing costs of resources devoted to R&D in life sciences fields, including agriculture. This measure indicates the rate of change in the cost of research inputs, including salaries and benefits of research personnel, prices paid for laboratory materials and equipment, and capital depreciation of research facilities. By adjusting nominal spending on agricultural R&D by this price index, it shows in real terms the amount of R&D conducted over time. Using this measure, ERS researchers found that U.S. public agricultural R&D spending peaked in 2002, and by 2019 spending had declined to roughly where it was in 1970.

Public spending on agricultural research and development (R&D) fell over the 2000s in the United States

Inflation-adjusted 2019 U.S. dollars, billions



Notes: Spending on public agriculture R&D includes Federal, State, and non-Government funds used for food, agriculture, and forestry research by USDA, land-grant universities, and other cooperating institutions. Spending is in constant 2019 dollars adjusted for inflation using the National Institutes of Health Biomedical Research and Development Price Index. The spike in R&D spending in 1976 is due to an adjustment in the Federal fiscal year in which 1979 included five quarters of spending.

Source: USDA, Economic Research Service (ERS) using data from the ERS data product Agricultural Research Funding in the Public and Private Sectors.

The Federal Government Funds Most Public Agricultural R&D

Through different programs, Federal and State Government agencies and non-Government sources fund agricultural R&D. In 2019, the Federal Government funded $3.24 billion, or 64 percent of the total amount spent on public agricultural R&D. State governments funded an additional $1.06 billion, and non-Government sources funded $741 million. Most of the Federal funds for agricultural R&D were channeled through the USDA, where the funding was used for research performed by USDA agencies (referred to as intramural research) and research grants to universities and other cooperating institutions (extramural research). Other Federal agencies, including the National Science Foundation and the National Institutes of Health, also funded agricultural research primarily through grants to university colleges and schools of agriculture, forestry, and veterinary medicine. Non-Government sources of funds, primarily for research at universities, include industry grants, self-generated funds (such as patent licensing fees and product sales), and sources such as private nonprofit foundations and farm or producer organizations.

Of all U.S. funds allocated for public agricultural R&D in 2019, USDA administered more than half (55 percent), which was equally divided between intramural and extramural research. The USDA, Agricultural Research Service (ARS) and the R&D arm of the Forest Service received the largest share of USDA agency intramural research funds. USDA's National Institute of Food and Agriculture (NIFA) administers most of the funds for extramural research funded by USDA. NIFA allocates one part of its research funds through "capacity grants" to State and territorial institutions on a formula basis and requires States to match the Federal grant. Capacity grants include:

- Hatch funds for State agricultural experiment stations of land-grant universities established under the Morrill Act of 1862;
- Evans-Allen funds for colleges of agriculture at historically Black colleges and universities established through the Morrill Act of 1890;
- McIntire-Stennis funds for forestry schools; and

- Animal Health and Disease Research Capacity Program funds (Section 1433 of the 1977 Farm Bill) for veterinary schools.

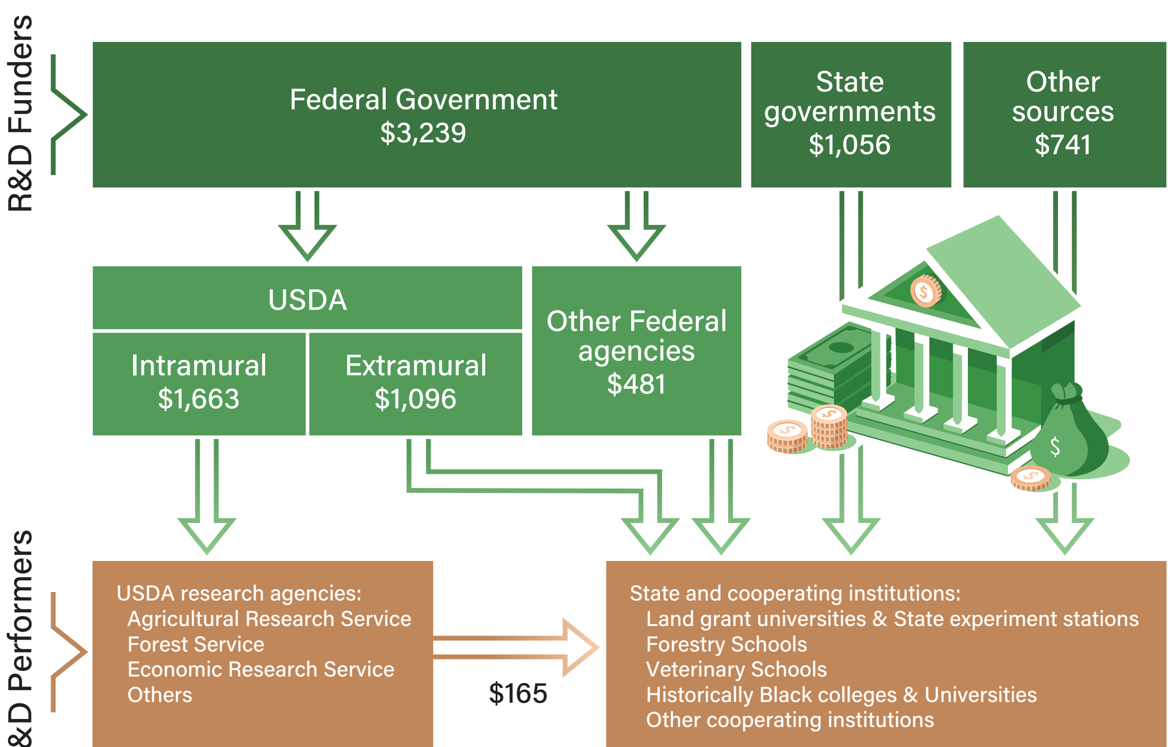
NIFA allocates another group of funds competitively, especially through the Agriculture and Food Research Initiative (AFRI). AFRI grants can be awarded to universities or other organizations and attract researchers from outside the traditional land-grant colleges of agriculture and forestry to conduct agriculture research.

A third set of NIFA funds is allocated through noncompetitive research grants directed by Congress to support designated institutions or specific programs. The Tribal Colleges Research Grants Program and the Sustainable Agriculture Research and Education program are examples of congressionally directed special grants. In 2019, NIFA allocated nearly $1.1 billion for research. Of this, 38 percent was allocated through competitive grants, 26 percent through capacity grants, and the remaining 36 percent through directed special grant programs.

While the Federal Government funds nearly two-thirds of all public agricultural R&D in the United States, non-Federal institutions (land-grant universities and other cooperating institutions) perform about 70 percent of the agricultural research. USDA agencies such as ARS, ERS, and the Forest Service perform the other 30 percent of public agricultural R&D. Universities and State agricultural experiment stations usually focus research on the commodities and resource problems of greatest interest to their States. However, the scientific knowledge and technologies their research generates often have broader uses. University research also plays a

Funders and performers of U.S. public agricultural research in 2019

U.S. dollars, millions



Notes: Total funds allocated to agricultural research and development (R&D) in 2019 were $5.04 billion, while total reported expenditures by R&D performing institutions that year was $5.16 billion because of differences in budget procedures and timing of expenditures.

Source: USDA, Economic Research Service based on data from USDA, National Institute of Food and Agriculture and National Science Foundation.

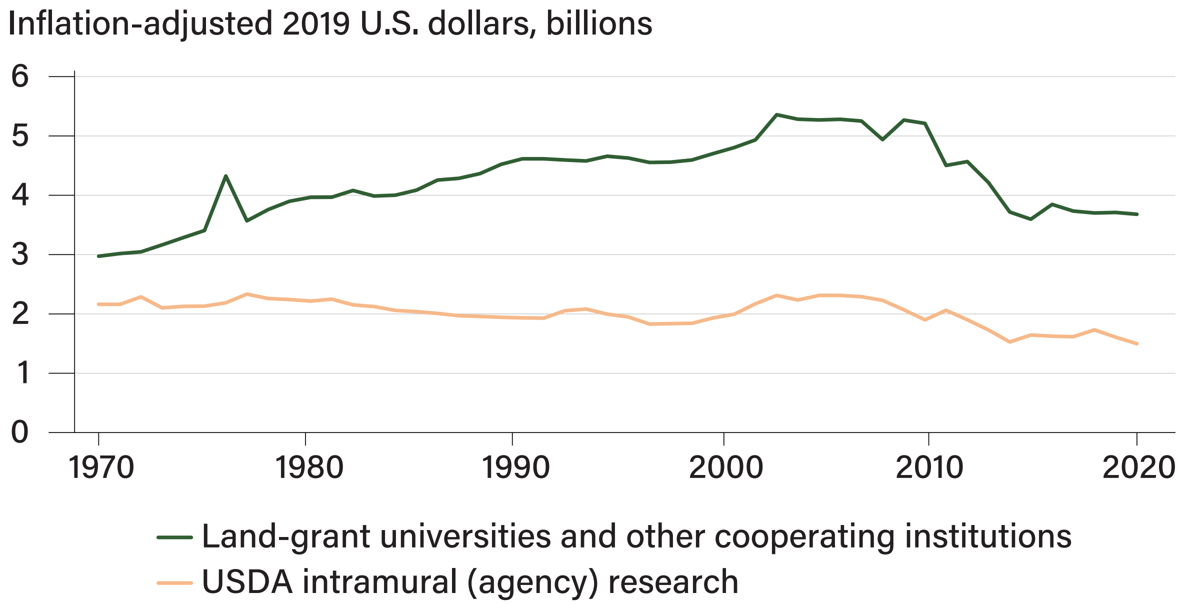
vital role in training the next generation of agricultural scientists. USDA agency research, on the other hand, focuses on issues of national or regional importance, provides critical research infrastructure such as plant genetic resource conservation, and supports the regulatory and program functions of USDA agencies.

Of the non-Federal institutions performing publicly funded agricultural R&D in the United States, the land-grant universities and their State agricultural experiment stations established under the Morrill Act of 1862 account for more than half of total public agricultural R&D expenditures. State forestry and veterinary schools together accounted for 5 percent of public agricultural R&D in 2019. The share of public agricultural R&D performed at historically Black colleges and universities established through the Morrill Act of 1890 is small but increasing, from about 1 percent in 2000 to about 2 percent in 2019. The fastest rising component of the public agricultural R&D system, however, is classified as "other cooperating institutions," whose share of public agricultural R&D expenditures increased from less than 1 percent in the 1990s to nearly 7 percent by 2019. These include universities outside the traditional land-grant system—reflecting the broad eligibility in the AFRI competitive grants program. The "other cooperating institutions" category also includes strengthened Federal support for Tribal colleges and universities.

China Has Become the World's Largest Funder of Agricultural R&D

ERS researchers compared spending for public agricultural R&D in the United States with other large countries and the European Union. China, the largest importer of U.S. agricultural goods, and Brazil, a major international competitor with the United States in agricultural exports, both increased their agricultural R&D

Land-grant universities and other cooperating institutions perform most public agricultural research and development (R&D) in the United States

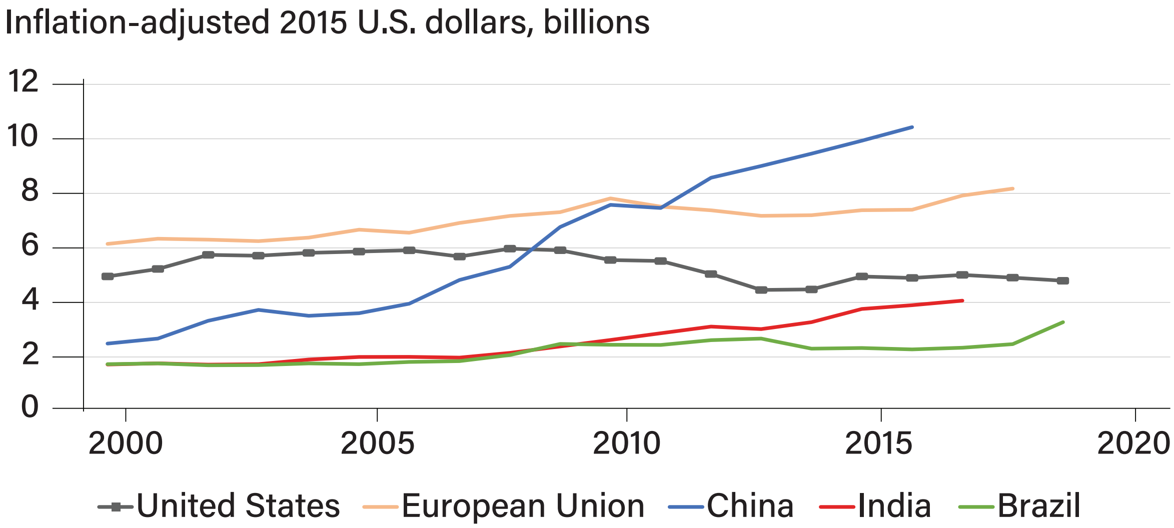


Note: R&D expenditures have been adjusted for inflation by the National Institutes of Health R&D Price Index.

Source: USDA, Economic Research Service (ERS) using data from the ERS data product Agricultural Research Funding in the Public and Private Sectors and from USDA, National Institute of Food and Agriculture's Research, Education, and Economics Information System.

funding during the past two decades. China has become the largest funder of agricultural R&D in the world, surpassing the United States and the European Union. India, another country with a large agricultural sector, also has increased its public R&D spending. Lower U.S. spending on agricultural R&D may be partially offset by private sector spending, but comprehensive information on private agricultural R&D investment by country is not available. Nonetheless, present trends may affect the U.S. role as a global leader in agricultural sciences and could lead to reduced U.S. agricultural trade competitiveness if U.S. agricultural productivity growth slows compared with other countries.

The United States has been losing ground to other countries in public agricultural research and development (R&D) investment



Notes: R&D spending is presented in constant 2015 purchasing-power-parity (PPP) dollars by first deflating by national Gross Domestic Product (GDP) price indexes and then converting into dollars using the 2015 PPP exchange rate, allowing for comparisons over time and across countries.

Source: USDA, Economic Research Service (ERS) using data from the ERS data product Agricultural Research Funding in the Public and Private Sectors (U.S. expenditures); ERS Economic Research Report 249, Agricultural Research Investment and Policy Reform in High Income Countries (European Union expenditures); International Food Policy Research Institute's Agricultural Science and Technology Indicators (expenditures for China, India, and Brazil); and the World Bank's World Development Indicators (GDP price indexes and PPP exchange rates).

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May **2022**

Coronavirus (COVID-19) Job Losses Hit Rural Areas Still Recovering From Great Recession

by **Austin Sanders**

By 2019, total employment in rural America had not yet recovered from jobs lost during and after the Great Recession (2007–2009), and according to a recently published USDA, Economic Research Service analysis, the Coronavirus (COVID-19) pandemic led to further job losses in 2020. Annual average employment levels in 2019 were only 97 percent of their pre-Great Recession levels in rural counties, while employment levels in urban counties had reached 111 percent of 2007 levels by 2019. The drop in rural employment from 2007 to 2019 partially coincided with an unprecedented period of rural population loss from 2010 to 2016 and an aging overall population.

Despite the loss in the total number of jobs in rural counties from 2007 to 2019, the prime-working-age unemployment rate was slightly lower in 2019 at 3.7 percent than in 2007, when it was 3.9 percent. Prime-working-age unemployment is the percentage of people ages 25 to 54 who are unemployed and actively seeking employment. By looking at unemployment rates for only people of prime working age, the effect that an aging population may have on unemployment rates over time is minimized, as is the effect of different age compositions across racial and ethnic groups.

Prime-age unemployment rates did not decrease for all races and ethnicities in rural areas, however. Compared with rural "White" residents, unemployment rates were 3.4 percentage points higher for the U.S. Census Bureau's category of rural "Black or African American" (3.5 percent vs. 6.9 percent) in 2007 and 0.6 percentage point higher for rural residents identified as "Hispanic or Latino" (3.5 percent vs. 4.1 percent). Those gaps widened from 2007 to 2019 to 4.2 percentage points for rural residents in the "Black or African American" category (3.2 percent compared with 7.4 percent) and 1.7 percentage points for rural residents identified as "Hispanic or Latino" (3.2 percent compared with 4.9 percent).

During the Coronavirus pandemic, restrictions on social and business activity, social distancing, and a decrease in consumer activity led to a decline in total employment and an increase in unemployment rates in urban and rural counties. In 2020, total rural

employment dropped to 92 percent of 2007 levels, lower than at any point in the Great Recession. Prime-age unemployment rates in rural counties increased 2.2 percentage points from 2019 to 2020. Among the largest racial/ethnic groups, these rates rose most for "Black or African American" (2.6 percentage points), followed by "White" (2.2 percentage points), and "Hispanic or Latino" (1.4 percentage points).

However, as the economy began to recover in 2021, total employment rose, and prime-working-age unemployment rates dropped faster in rural counties than in urban counties. By 2021, prime-working-age unemployment rates in rural counties returned to near, or in the case of "Black or African Americans", below their pre-pandemic levels of 2019. However, the 2021 rates were still higher for "Black or African Americans" than other groups.

This analysis was conducted using data from the U.S. Bureau of Labor Statistics' Current Population Survey and Local Area Unemployment Statistics.

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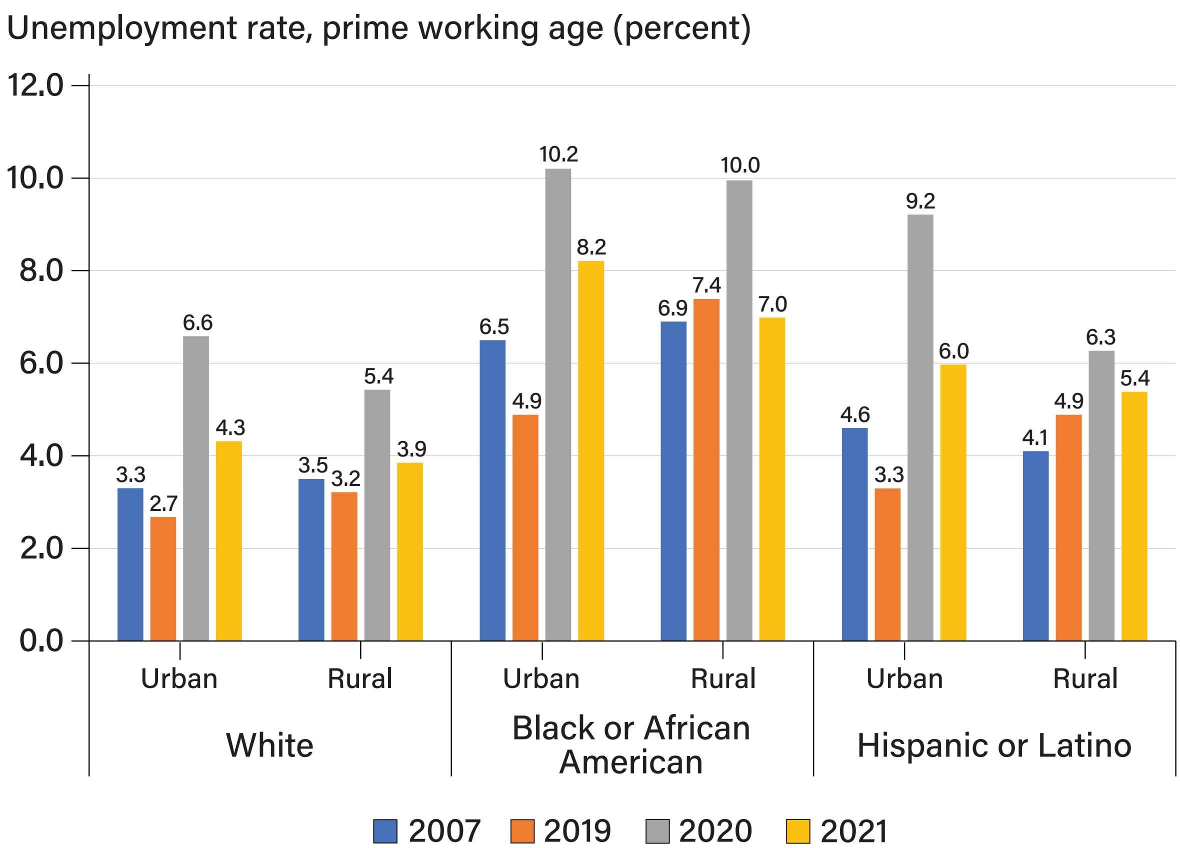
Rural Employment and Unemployment, by Austin Sanders, USDA, Economic Research Service, topic page, updated March 29, 2022

Rural unemployment rates recovered faster from 2020 to 2021, remained highest for "Black or African American" residents



Note: Prime-working-age unemployment is defined as the percentage of people ages 25 to 54 who are unemployed and actively seeking employment. "Urban" and "Rural" designations for 2007 data are based on the 2003 definition of metropolitan and nonmetropolitan counties, and designations for 2019, 2020, and 2021 are based on the 2013 definition as determined by the U.S. Office of Management and Budget. Race and ethnicity categories are based on the Current Population Survey, conducted by the U.S. Bureau of Labor Statistics and the U.S. Census Bureau.

Source: USDA, Economic Research Service using data from the U.S. Bureau of Labor Statistics' Current Population Survey.

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Atlas of Rural and Small-Town America, by John Cromartie, ERS, December 2022

August **2022**

The Most Rural Counties Have the Fewest Health Care Services Available

by **Elizabeth A. Dobis and Jessica E. Todd**

Access to health care depends on the three pillars of affordability, availability, and willingness to seek care. USDA, Economic Research Service (ERS) researchers compared the availability of health care based on a county's degree of urbanization. They found that during 2017–19 residents of the most rural counties may have had more difficulty finding and using health care services than residents living in metropolitan areas or rural counties with population hubs. The most rural counties had fewer health care facilities and were more likely to have health professional shortage areas, the research showed.

Counties that are part of, or economically linked to, large urban areas are "metropolitan." "Nonmetropolitan" counties are subdivided into "micropolitan" and "noncore" counties. Micropolitan refers to counties with smaller urban areas and outlying counties that are economically linked to them. Noncore counties are all other counties and are the most rural. ERS researchers examined health care resource availability by looking at three factors: the number of medical providers for every 10,000 residents, the number of beds in medical facilities for every 10,000 residents, and the share of counties with health care facilities.

ERS researchers found that in 2017, metropolitan counties had the greatest availability of medical professionals, with an average of 6.1 primary care physicians and 4.1 dentists for every 10,000 residents. In noncore counties, the average was 4.4 primary care physicians and 2.5 dentists for every 10,000 residents. However, metropolitan counties had the fewest beds per 10,000 residents, while sparsely populated noncore counties had the most (see table below).

Researchers found evidence that medical resources to treat residents in nonmetropolitan areas were concentrated in a few, probably more populated, locations. Residents in micropolitan counties—which contain rural population hubs—had the greatest availability of hospitals. The share of micropolitan counties with a short-term general hospital was the largest of the county types in 2017 at 89 percent. In addition, micropolitan counties had higher bed-to-population ratios than metropolitan counties.

Although noncore counties had the highest bed-to-population ratios (owing in part to their sparse populations), they were also less likely to have medical facilities available. In 2017, the share of noncore counties with hospitals was 72 percent, compared with 89 percent for micropolitan and 82 percent for metropolitan. The share with skilled nursing facilities was 83 percent, compared with 95 percent for micropolitan and 96 percent for metropolitan. This suggests people living in more remote locations needed to travel farther to access health care.

ERS researchers also examined health professional shortage areas (HPSA). As identified by the U.S. Department of Health and Human Services, a health professional shortage area is where there are too few practitioners to provide adequate care for area residents. These areas do not necessarily follow county boundaries. They can be as small as a single site in a county (such as a prison), cover an entire county, or be composed of multiple counties. HPSAs also take into account location characteristics such as distance to the nearest provider and whether residents have unusually high health care needs, so some shortage areas may exceed the minimum provider-to-population threshold.

In 2019, more counties in the United States were completely covered by mental health HPSAs (meaning the entire county lacked sufficient mental health care services) than any other type of health professional shortage, while the fewest counties were completely covered by a dentist shortage area. Noncore areas—the least densely populated rural areas—had the most counties completely covered by HPSAs of any type. Forty percent of noncore counties were completely covered by primary care shortage areas, compared with 16 percent for metropolitan counties. Moreover, 24 percent of noncore counties experienced entire-county shortages of dentists, compared with 8 percent for metropolitan counties. More than four-fifths (81 percent) of noncore counties were completely covered by mental health professional shortages, compared with 36 percent for metropolitan areas.

Health care was less available in the most rural U.S. counties in 2017 and 2019

	Metropolitan counties	Nonmetropolitan counties	
		Micropolitan	Noncore
Share of counties with facilities (percent, 2017)			
Hospital	82.1	88.9	72.2
Short-term general hospital	80.5	88.8	71.2
Skilled nursing facility	96.1	94.8	83.1
Mean bed-to-population ratio (per 10,000 residents, 2017)			
Hospital	25.0	27.8	35.2
Short-term general hospital	20.2	24.5	32.7
Skilled nursing facility	58.2	75.8	96.1
Mean provider-to-population ratio (per 10,000 residents, 2017)			
Total physicians	21.2	13.8	7.1
Primary care physicians	6.1	5.4	4.4
Dentists	4.1	3.6	2.5
Share of counties completely covered by HPSAs (percent, 2019)			
Primary care shortage	16.3	16.8	40.4
Dentist shortage	7.5	10.8	24.0
Mental health shortage	36.0	70.0	80.6

Notes: **Metropolitan counties** are part of an urban area of at least 50,000 residents or are tied to one through commuting. **Nonmetropolitan counties** are not part of a metropolitan area and are subdivided into micropolitan counties and noncore counties. **Micropolitan counties** are part of an urban area of between 10,000 and 49,999 residents or are tied to one through commuting. **Noncore** counties are all remaining nonmetropolitan counties. **Short-term general hospitals** provide general medical and surgical care to patients who usually stay less than 30 days. **Skilled nursing facilities** provide inpatient medical, nursing, or rehabilitative care at a level below that of a hospital. Only Medicare-certified skilled nursing facility beds are included in the table. **Physicians** include doctors of medicine and doctors of osteopathy. **Primary care physicians** include general/family medicine, general pediatrics, and general internal medicine. **HPSAs** are health professional shortage areas. Their population-to-provider ratio is below a threshold needed to adequately care for residents, as identified by the U.S. Department of Health and Human Services. HPSA shares indicate the percentage of counties whose entire area was part of HPSAs. Obstetricians and gynecologists are included in the definition of primary care physicians for HPSAs.

Sources: USDA, Economic Research Service using U.S. Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Workforce, 2018–19 Area Health Resources File.

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January **2022**

Trends in Irrigated Agriculture Reveal Sector's Ability To Adapt to Evolving Climatic, Resource, and Market Conditions

by **R. Aaron Hrozencik and Marcel Aillery**

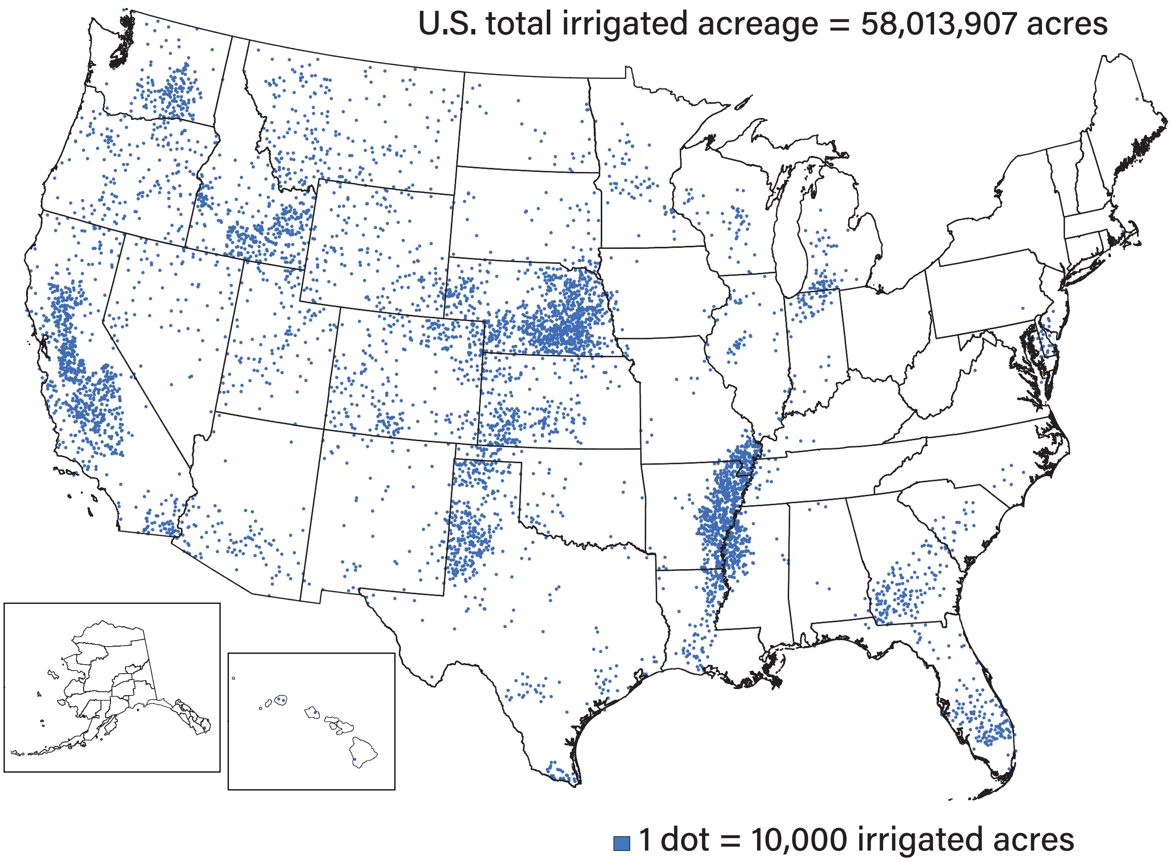
Highlights:

- Irrigated acreage has expanded rapidly since the passage of the Federal Reclamation Act of 1902. Nationwide, irrigated acreage grew from less than 3 million acres in 1890 to more than 58 million acres in 2017.
- Between 1949 and 2017, the share of U.S. irrigated cropland within the Mountain and Pacific regions decreased from 77 percent to 44 percent, while the share of irrigated cropland in the Mississippi Delta and Northern Plains regions increased from 8 percent to 34 percent.
- In the Pacific, Mountain, and Northern and Southern Plains regions, the share of irrigated acres using pressurized systems rose from 37 percent in 1984 to 72 percent in 2018, with innovations focused on improved precision of applied water, reduced pressurization requirements, and system automation.

Irrigation is a vital part of the U.S. agricultural economy. In 2017, irrigated farms produced more than 54 percent of the total value of crop sales. Irrigation allows for agricultural production in arid regions where precipitation is insufficient to meet plant water requirements. In more humid regions with variable growing-season rainfall, applied irrigation water supplements available soil moisture and provides a critical buffer against periodic drought.

However, increasing competition for water supplies, declining groundwater reserves, and shifts in climatic conditions and hydrologic flows are taxing the ability of regional water systems to meet irrigation needs. Projected increases in the frequency and severity of droughts have important implications for future agricultural water demand and supply. The resiliency of irrigated agriculture will depend on how farmers, and the institutions that influence water supply and use, adapt to increasing water scarcity.

Irrigated acreage is concentrated in the Western and Southeastern U.S.

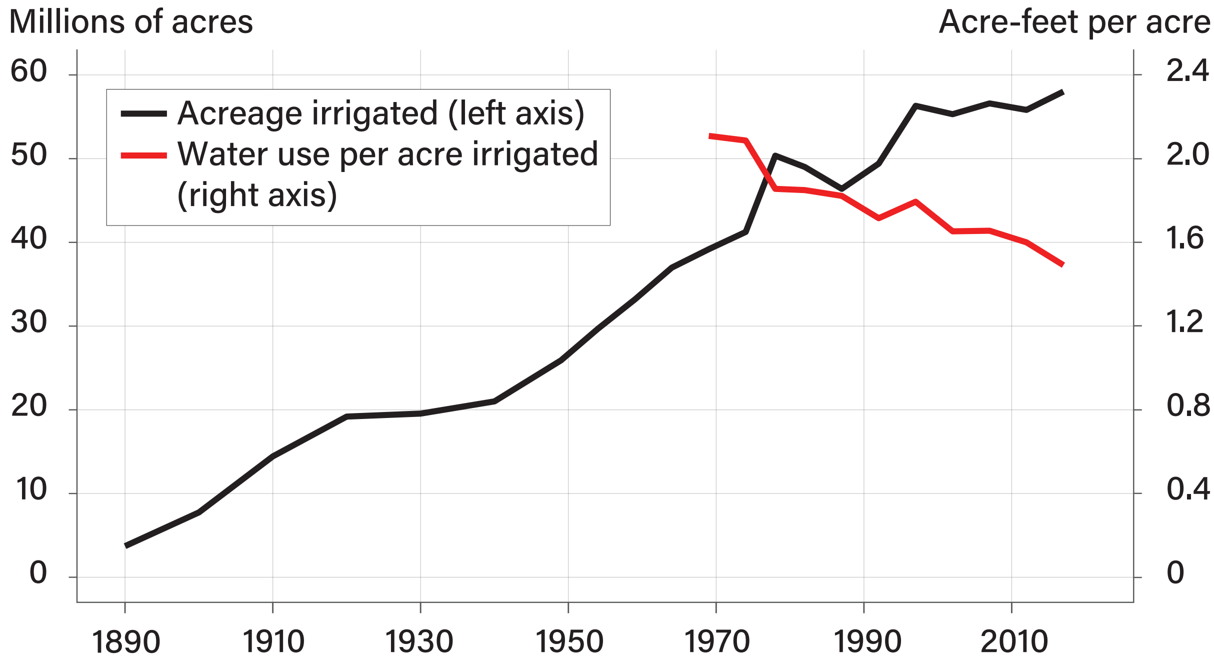


Note: Map is based on 2017 county-level estimates of irrigated acreage.

Source: USDA, Economic Research Service using data from USDA, National Agricultural Statistics Service, 2017 Census of Agriculture.

Water availability, climate, and growing-season weather conditions largely determine where cropland is irrigated. Irrigation is most common in the arid Western United States, where major water infrastructure projects store and transport the region's surface water resources. Publicly financed reclamation investments in reservoirs and canal networks allow high-value agricultural production in regions such as the Central Valley of California, south-central Washington, and the Snake River Valley of Idaho. In the Ogallala Aquifer region of the Northern and Southern Plains, concentrations of irrigated acreage reflect the availability of groundwater resources. Irrigation also occurs in the more humid Eastern United States, with the largest irrigated acreage concentrations in the Mississippi Delta, southern Georgia, and central Florida. In these regions, irrigation is primarily used to supplement rainfall to minimize production risks associated with variable weather conditions.

Irrigated acreage expanded from 1890 to 2017, while average water use per acre irrigated decreased from 1969 to 2018



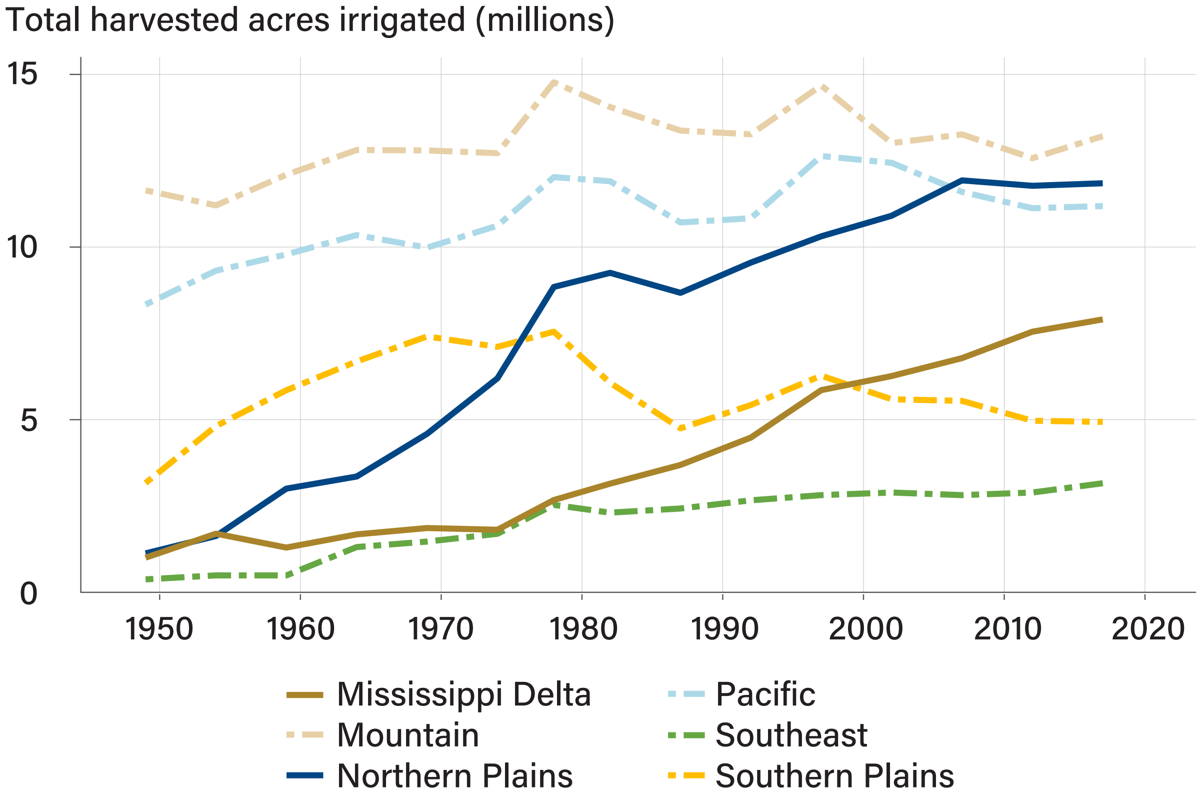
Notes: **Acre-feet** is the amount of water needed to cover one acre of land under a foot of water. Water use per acre irrigated in 1969 and 1974 was calculated using data reported in the Census of Agriculture—Irrigation and Drainage on Farms, which reported irrigated acreage for only the 17 Western States as well as Louisiana and Arkansas.

Source: USDA, Economic Research Service using data from the Census of Agriculture (1890–2017) collected by USDA's National Agricultural Statistics Service (1997–2017) and the U.S. Bureau of the Census (1890–1992); Farm and Ranch Irrigation Survey (1979–2013) and the Irrigation and Water Management Survey (2018) collected by USDA's National Agricultural Statistics Service (1998–2018) and the U.S. Bureau of the Census (1979–1994); Census of Irrigation (1890–1940) collected by the U.S. Bureau of the Census.

Irrigated acreage in the United States has grown from fewer than 3 million acres in 1890 to more than 58 million acres in 2017, accounting for approximately 15 percent of the 396 million acres of total U.S. cropland. This expansion has contributed significantly to cropland productivity. While the total irrigated land area steadily increased, the average amount of water applied per irrigated acre fell from more than 2 acre-feet per acre irrigated in 1969 to less than 1.5 acre-feet per acre irrigated in 2018. The diminishing intensity of water use per acre reflects changes in on-farm irrigation conveyance and application technologies, as well as shifts in regional irrigated area and evolving crop patterns.

Aggregate trends in U.S. irrigated land mask important variations across regions, with implications for the resilience of the agricultural sector. After the mid-20th century, irrigation gradually shifted eastward, as the amount of irrigated land decreased across the West and expanded in the East. Between 1949 and 2017, the share of total U.S. irrigated cropland in the Mountain and Pacific regions decreased from 77 percent to 44 percent, while the share of irrigated cropland in the Mississippi Delta and Northern Plains regions increased from 8 percent to 34 percent. Acreage declines in traditionally irrigated areas of the Western United States reflect increasing regional competition for available water supplies, changes in surface flow regimes largely reliant on mountain snowpack melt, and diminishing groundwater availability. Meanwhile, irrigation has continued to expand in the Eastern United States, reflecting access to relatively shallow groundwater aquifers and incentives to minimize soil-moisture deficits during critical crop growth stages, particularly during periods of drought.

Much of the expansion in irrigated acreage between 1949 and 2017 occurred in the Mississippi Delta and Northern Plains regions



Note: Regions refer to USDA Farm Production Regions: **Mississippi Delta** (Louisiana, Arkansas, and Mississippi); **Mountain** (Colorado, Utah, Arizona, New Mexico, Nevada, Idaho, Wyoming, and Montana); **Northern Plains** (Kansas, Nebraska, South Dakota, and North Dakota); **Pacific** (Oregon, Washington, and California); **Southeast** (Florida, Alabama, Georgia, and South Carolina); and **Southern Plains** (Texas and Oklahoma). The chart does not include the Appalachia, Corn Belt, Lake, and Northeast regions because irrigation is relatively rare in those regions.

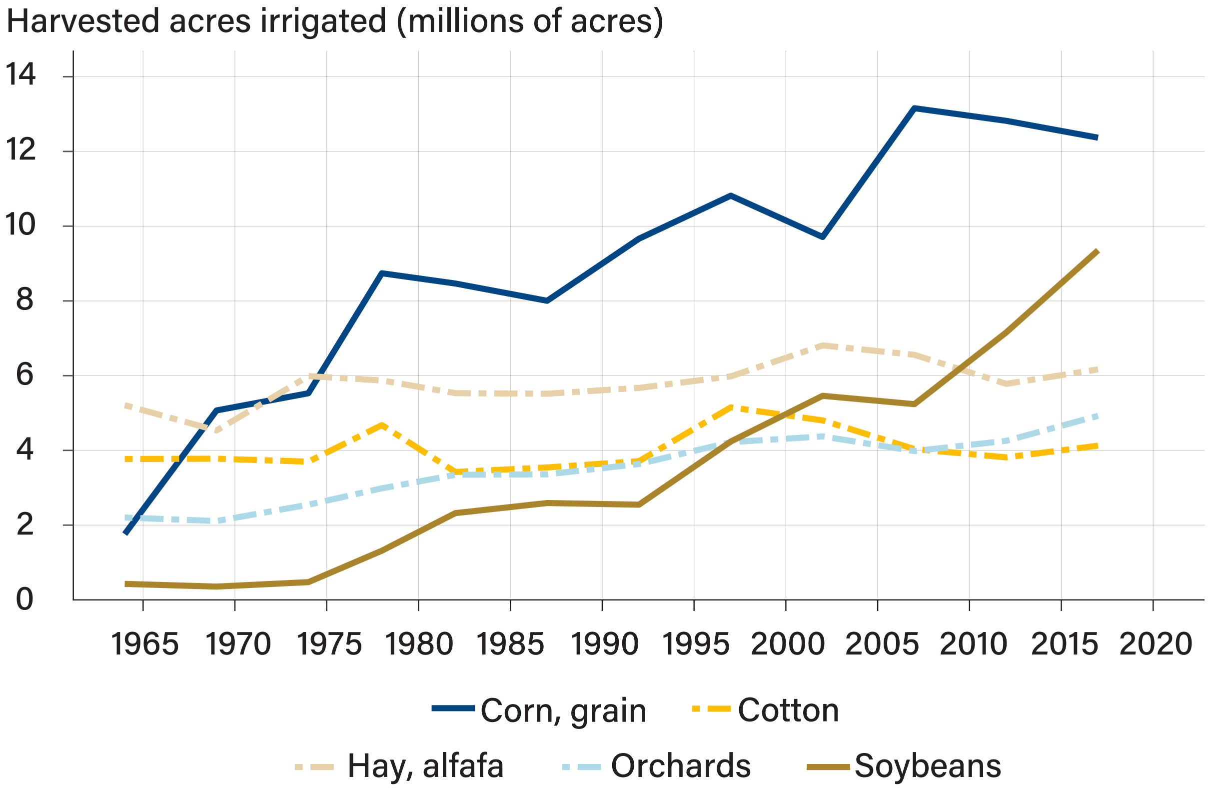
Source: USDA Economic Research Service using data from the Census of Agriculture (1949–2017) collected by USDA's National Agricultural Statistics Service (1997–2017), and the U.S. Bureau of the Census (1949–1992).

Over the past half century, irrigated cropping patterns have shifted significantly as corn and soybeans replaced alfalfa and cotton as the most commonly irrigated crops. Corn and soybeans have become increasingly important as livestock feed. In addition, roughly a third of U.S. corn production is dedicated to ethanol production, and soybeans serve as an important biodiesel feedstock. The tend to use less water per acre irrigated on average than some previously dominant crops, such as alfalfa. Site-specific impacts on water withdrawals depend on local shifts in irrigated cropping patterns, as well as changes in total land irrigated. transition to irrigated corn and soybeans has potential water use implications at a national scale.

These crops tend to use less water per acre irrigated on average than some previously dominant crops, such as alfalfa. Site-specific impacts on water withdrawals depend on local shifts in irrigated cropping patterns, as well as changes in total land irrigated.

In recent decades, the irrigation sector has experienced a significant change in the technologies used to irrigate crops. Irrigation application technologies can be broadly categorized as either gravity or pressurizedsy stems.

Between 1964 and 2017, corn and soybeans replaced alfalfa and cotton as the most commonly irrigated crops



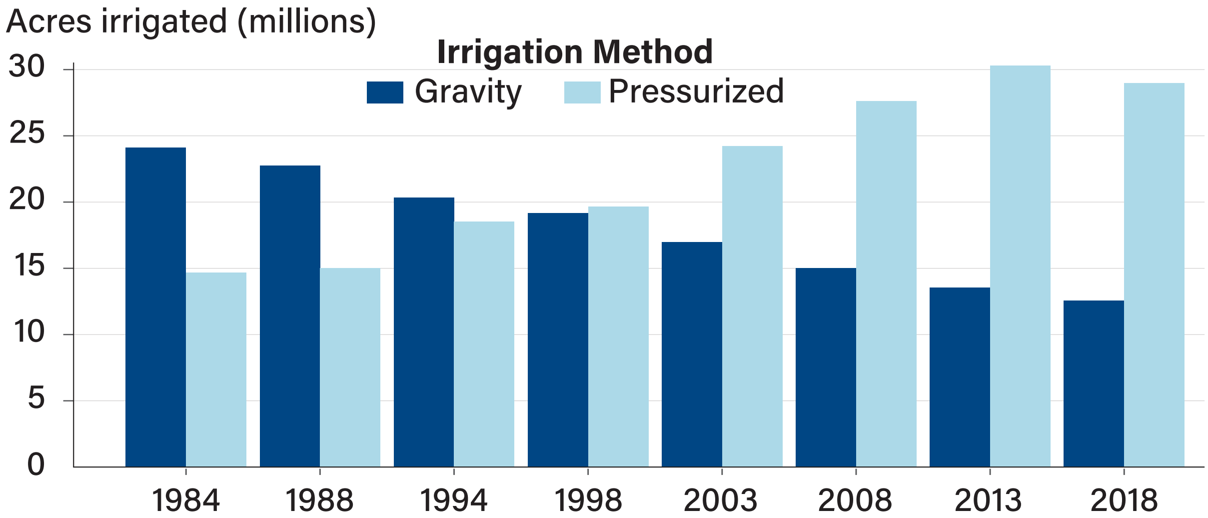
Note: For "hay, alfalfa," the chart represents only acreage harvested for alfalfa hay. The Census of Agriculture did not differentiate alfalfa and non-alfalfa haylage before 2002, and irrigated haylage acres were not reported before 1997.

Source: USDA, Economic Research Service using data from the Census of Agriculture (1964–2017) collected by USDA's National Agricultural Statistics Service (1997–2017), and the U.S. Bureau of the Census (1964–1992).

Gravity irrigation systems use on-field furrows or basins to advance water across the field surface through gravity only, while pressurized systems (such as center pivot sprinklers) apply water under pressure through pipes or other tubing directly to crops. The use of pressurized irrigation application systems, which are generally more water-use efficient than gravity-flow systems in most field settings, has increased significantly. This shift was especially pronounced in the Western United States, where the share of irrigated acres using pressurized systems rose from 37 percent (15 million acres) in 1984 to 72 percent in 2018 (29 million acres). Federal programs such as the Environmental Quality Incentives Program (EQIP), administered by USDA's Natural Resources Conservation Service (NRCS), have supported irrigation efforts during this transition. EQIP provides financial and technical assistance to encourage the adoption of more efficient irrigation technologies and water management practices (such as soil-moisture monitoring) that enhance the agricultural sector's resilience to drought and long-term water scarcity.

In addition to improvements in water-use efficiency, USDA supports the resiliency of the irrigated agricultural sector through measures that enhance water-supply security in areas facing shortfalls because of drought and long-term water scarcity. For example, the Conservation Reserve Enhancement Program administered by the USDA, Farm Service Agency works with States to offer financial incentives to producers that voluntarily retire irrigated land and associated water rights in water-stressed basins. Additionally, the NRCS' Regional Conservation Partnership Program provides funding to coordinate drought resiliency initiatives at the regional or basin level with State and local stakeholders.

Since 1984, the use of pressurized irrigation systems has increased significantly in the 17 Western States



Notes: Data include only acres irrigated in the open (not in greenhouses and other enclosed structures). **Gravity** irrigation systems use on-field furrows or basins to advance water across the field surface through gravity-means only. **Pressurized** systems apply water under pressure through pipes or other tubing directly to crops. Pressurized irrigation includes acres irrigated by sprinkler and micro/drip irrigation systems. The 17 Western States are Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming.

Source: USDA, Economic Research Service using data from the Irrigation and Water Management Survey (2018) and the Farm and Ranch Irrigation Survey (1984–2013) collected by USDA's National Agricultural Statistics Service (1998–2018) and the U.S. Bureau of the Census (1984–1994).

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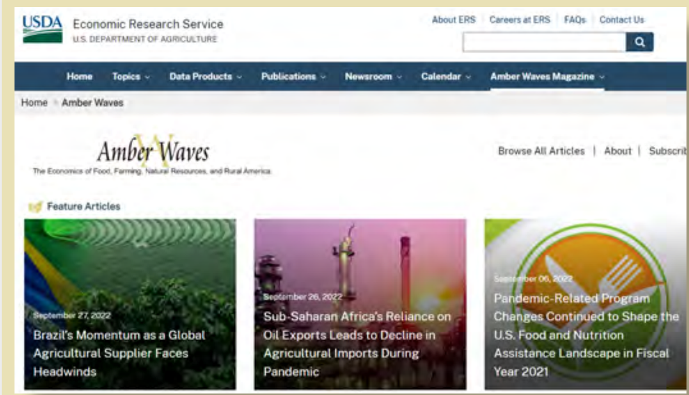

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