USDA Economic Research Service
U.S. DEPARTMENT OF AGRICULTURE

**Economic Research Service**

Economic Research Report Number 315

March 2023

# U.S. Organic Production, Markets, Consumers, and Policy, 2000–21

Andrea Carlson, Catherine Greene, Sharon Raszap Skorbiansky, Claudia Hitaj, Kim Ha, Michel Cavigelli, Peyton Ferrier, and William McBride

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## Abstract

Organic agriculture can support global and domestic food needs, expand consumer food choices, enhance farm profitability, and increase agricultural sustainability. Public policy has played a key role in the development of the organic industry in the United States, beginning with the passage of the Organic Foods Production Act of 1990 and the U.S. Department of Agriculture's (USDA) subsequent publication of national organic rules in 2000. While U.S. organic acreage was still only 1 percent of U.S. farmland in 2019, organic farm sales accounted for about 3 percent of U.S. farm receipts. Consumer demand for organically produced products has driven an expansion in U.S. organic production since 2000. The premiums paid by consumers give farmers the opportunity to recover the cost of production and improve their financial well-being. This report describes U.S. organic policy initiatives since 2000 and examines the importance of investment in research on organic practices. The report also investigates key components of organic supply chains—including production, certification, farm-level costs and returns, wholesale markets, and industry structure—along with the evolving characteristics of organic food consumers and retail markets.

**Keywords:** U.S. organic agriculture, USDA organic standards, organic farming systems, organic wholesale markets, organic price premiums, organic research, organic production costs and returns, organic food marketing channels, organic retail sales, organic retail market share, organic consumer characteristics, USDA organic certifier surveys, USDA Organic INTEGRITY Database, USDA Agricultural Resource Management Survey, USDA Census U.S. Organic Trade Data, retail food scanner data.

## Acknowledgments

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## About the Authors

Andrea Carlson and Sharon Raszap Skorbiansky are economists with USDA, Economic Research Service (ERS). Catherine Greene and William McBride are retired and Claudia Hitaj and Kim Ha are former USDA, ERS economists. Michel Cavigelli is a soil scientist at the USDA, Agricultural Research Service. Peyton Ferrier is an economist at USDA, Agricultural Marketing Service.

## Disclaimer

# Contents



**Errata**
On March 15, 2023, the text corresponding to the yellow bars in figure 2.6 was corrected. No other text or figures were affected.

# Key Acronyms Used in This Report

**AMS**–USDA, Agricultural Marketing Service

**AAP**–American Academy of Pediatricians

**ARMS**–Agricultural Resource Management Survey

**ARS**–USDA, Agricultural Research Service

**CV**–Coefficient of Variation

**CDC**–U.S. Department of Health and Human Services, Centers for Disease Control and Prevention

**CPI-U**–Consumer Price Index for All Urban Consumers

**CSP**–Conservation Stewardship Program

**EQIP**–Environmental Quality Incentives Program

**ERS**–USDA, Economic Research Service

**FDA**–U.S. Department of Health and Human Services, Food and Drug Administration

**FCIC**–Federal Crop Insurance Corporation

**FSA**–USDA, Farm Service Agency

**GATS**–Global Agricultural Trade System

**GE**–Genetically Engineered

**GHG**–Greenhouse Gas

**IRI**–Information Resources, Inc.

**LLP**–Low Level Presence

**NAP**–Noninsured Crop Disaster Assistance Program

**NASS**–USDA, National Agricultural Statistics Service

**NIFA**–USDA, National Institute of Food and Agriculture

**NOP**–USDA, Agricultural Marketing Service, National Organic Program

**NOSB**–National Organic Standards Board

**NRCS**–USDA, Natural Resources Conservation Service

**NBJ**–Nutrition Business Journal

**OFPA**–Organic Foods Production Act of 1990

**OREI**–Organic Agriculture Research and Extension Initiative

**OFRF**–Organic Farming Research Foundation

**RMA**–USDA, Risk Management Agency

**WFRP**–Whole-Farm Revenue Protection Program

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*A report summary from the Economic Research Service* March 2023

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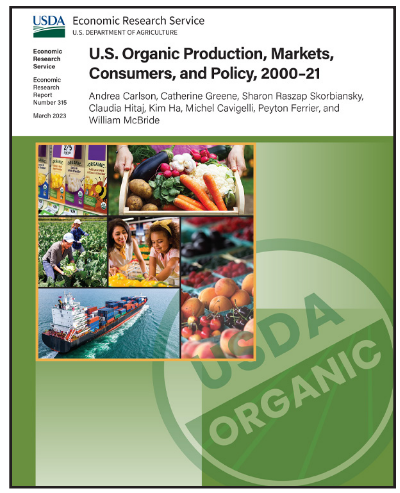



## What Is the Issue?

The U.S. Department of Agriculture (USDA) envisions a key role for organic farming in meeting global and domestic food needs, enhancing farm profitability, and increasing agricultural sustainability. Organic food and agriculture became a federally regulated industry in the United States in 2000 when USDA published the final rule to implement the Organic Foods Production Act of 1990 (OFPA). Under the final rule (7 CFR § 205), USDA began implementing national organic standards for production and certification and established the National Organic Program (NOP) to provide ongoing regulatory oversight. In the two decades since USDA published national organic rules, a broad organic consumer base has emerged in the United States. Increasing U.S. consumer demand, along with price premiums for organic food, has driven an increase in U.S. organic production since 2000, and an extensive organic industry sector has also emerged.

## What Did the Study Find?

Trends in U.S. organic policy initiatives and research investments since 2000:

- Over the past two decades, USDA's Agricultural Marketing Service (AMS) has published rules creating pasture standards for dairy cows (2010), proposed expanded regulatory oversight to importers, brokers, and traders of certified organic products (2020), and proposed additional rulemaking for livestock and poultry operations (2021).
- The 2002 Farm Act funded the National Organic Certification Cost Share Program to help producers pay for USDA organic certification, with current funding at $24 million over the 5-year period from 2019 to 2023. Funding levels varied between $7 million and $60 million per funding period, although certification costs have trended up since 2014, and cost share per certification has dropped.
- Policy changes since 2000 have widened producers' access to and use of USDA farm assistance programs.

- Organic products were first introduced into the international trade data in 2011. The number of organic import and export codes is small compared with overall tracked codes but continue to expand. The focus of private agricultural research has largely been on products not used in organic systems. The 2002 Farm Act introduced the Organic Agriculture Research and Extension Initiative (OREI) and gradually increased funding to $20 million annually in fiscal year 2020—with a sharp annual increase to $50 million set for fiscal year 2023. OREI seeks to solve critical organic agriculture issues, priorities, and problems through the integration of research, education, and extension activities.
- U.S. organic grain and oilseed producers indicate crop yields are among their top concerns. While research efforts to address yield and other organic production challenges were limited in 2000, recent research findings from long-term cropping system trials suggest greater organic yields are possible.

Trends in U.S. organic production and commodity markets since 2000:

- U.S. organic farm sales have increased from an estimated (inflation adjusted to 2021 dollars) $609 million in 2002 to nearly $11 billion in 2021. While organic acreage was still only 1 percent of U.S. farmland in 2019, organic farm sales accounted for almost 3 percent of U.S. farm receipts, reflecting the high-value sector focus and the price premiums for commodities. U.S. organic farms continue to have higher production costs than the average of all U.S. farms but also higher average total sales and net cash income.
- As in 2000, fruits, vegetables, dairy, eggs, and other high-value commodities make a larger share of organic production when compared with conventional systems. While the Pacific and northeast crop regions have consistently led as the top organic producers in terms of sales since 2000, organic farming expanded in almost every State between 2012 and 2019.

Consumer characteristics and trends in U.S. organic market share and sales since 2000:

- After adjusting for inflation to 2021 dollars, U.S. retail sales of organic food rose more than five times between 2000 and 2020—to nearly $56 billion—and continues to grow at a faster pace than overall food market sales.
- Since 2000, when natural food stores—stores that only sell certified organic products or a mixture of organic and products marketed as "natural"—dominated organic food sales, the food industry has broadened organic food access across food marketing channels, expanded the use of lower cost private label brands, and developed new product lines based on ethnic and international food preferences. By 2020, traditional stores—including the expanded organic offerings of club and warehouse stores—accounted for over half of organic sales. Internet sales are an emerging market for organic food.
- Fruits and vegetables have led the U.S. organic food market for over two decades. USDA's Economic Research Service (ERS) estimates show a rapid increase in the organic retail share of popular produce items between 2008 and 2018. Snack foods, meat, poultry, and fish are among the smallest grocery retail categories in organic sales but are also the fastest growing.
- Recent studies show that organic shoppers cut across all types of consumer demographics.
- Research suggests organic consumers are primarily motivated by a desire to avoid pesticide residue and antibiotics in their food and to support more environmentally friendly agriculture, along with a belief that organic food is more nutritious.

## How Was the Study Conducted?

The report relies heavily on data from USDA, including USDA, National Agricultural Statistics Service's Agricultural Resource Management Survey (ARMS), Organic Certifier Surveys, National Organic Certifier and Producer surveys, Census of Agriculture surveys, organic market news reports from USDA, Agricultural Marketing Service, international trade data, and administrative data. Private data sources are also used, including retail food scanner data purchased from the market research company Information Resources, Inc. (IRI), and organic sales data from the Nutrition Business Journal. Many of USDA's organic data sources are fragmentary and do not use a consistent methodology, which has limited trend analysis.

# U.S. Organic Production, Markets, Consumers, and Policy, 2000–21

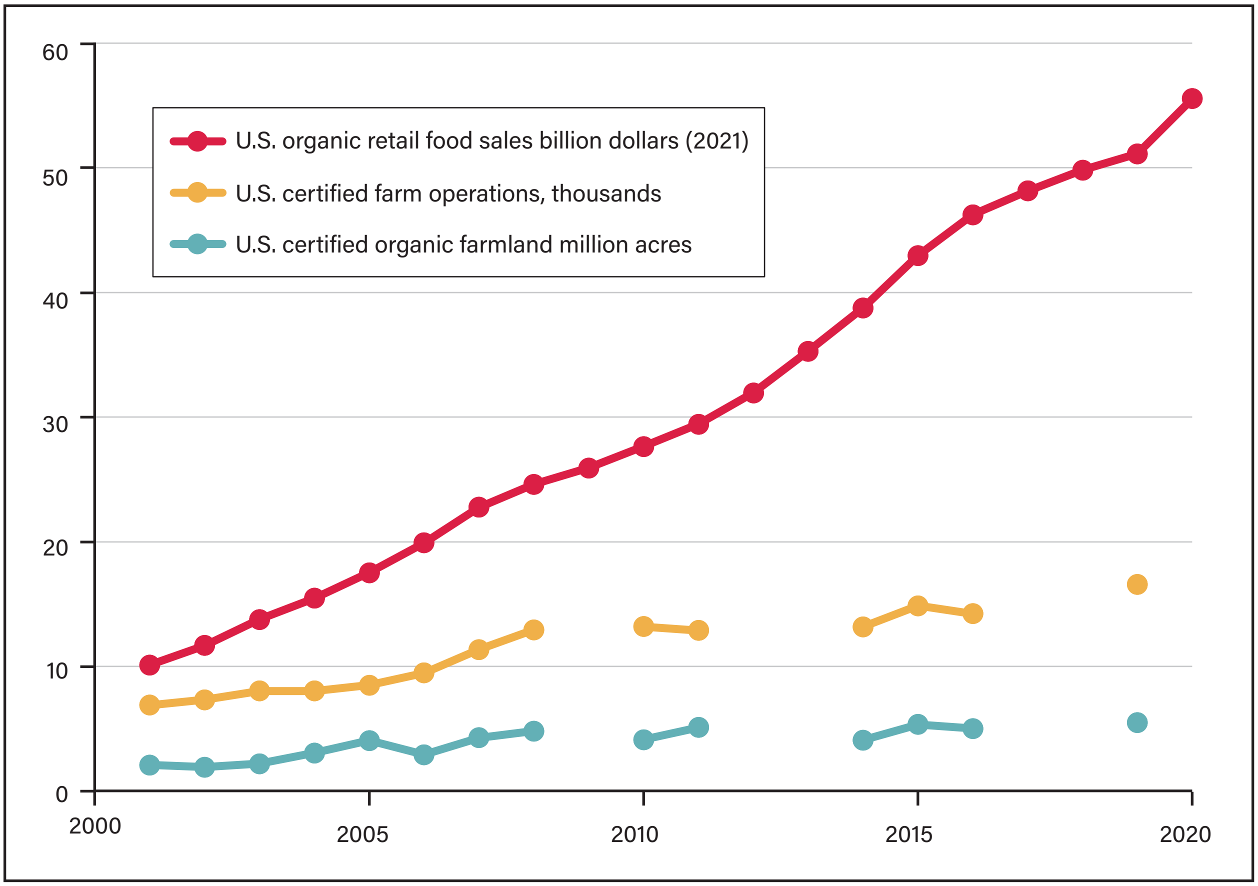
## Chapter 1: Background

A market for organic food started to develop after consumer demand for food produced without synthetic chemicals began in the 1970s. Since organic food cannot be identified visually and is typically priced higher than conventional products, food labeling or other verification methods were needed to prevent suppliers from selling fraudulent products. While some States initiated organic regulation as early as the 1970s, their standards varied, and enforcement was limited. In 1990, the Organic Foods Production Act (OFPA) required the U.S. Department of Agriculture (USDA) to implement national organic standards to assure consumers organic products meet a consistent standard and to facilitate interstate commerce in organically produced food (Organic Foods Production Act, 1990).

In 2000, USDA first published uniform, national standards for organic food production and handling. The standards addressed the substances and practices permitted for use in organic production systems in order to protect natural resources, support onfarm cycling of resources, promote ecological balance, and conserve biodiversity (see box 1.1, "USDA Organic: Key Production and Processing Standards"). The fundamental goals of organic agriculture include maintaining or increasing soil organic matter to improve system resilience, fostering resistance to perturbation and nutrient cycling, and providing healthy and productive crops (Balfour, 1943; National Research Council, 1989; Reganold and Wachter, 2016; The Organic Center, 2022).

Since USDA set national organic standards two decades ago—and created the National Organic Program (NOP) for enforcement and oversight—a broader consumer base has emerged in the United States, and organic food sales have climbed steadily. U.S. organic food sales have increased faster than certified organic acreage (figure. 1.1), and an extensive organic trade sector has also emerged to meet consumer demand. After adjusting for inflation, organic retail food sales increased nearly 450 percent between 2001 and 2020 while certified organic farms operations increased 191 percent between 2000 and 2020, and acres of certified organic farmland increased 347 percent between 2000 and 2019.

Figure 1.1
**Growth in U.S. organic food sales has outpaced organic farmland growth since 2000**




Note: Sales adjusted for inflation using Consumer Price Index for all Urban Consumers (CPI-U). Certified farm operations and certified organic farmland acres estimates for 2001–2015 are based on data from an organic certifier survey that was discontinued temporarily in 2016. Estimates for 2016 and 2019 are based on organic producer surveys. Producer survey estimates are typically lower than certifier-based estimates due to methodological differences. USDA, National Agricultural Statistics Service (NASS) did not conduct certified organic surveys for years 2017, 2018, and 2020.

Source: USDA, Economic Research Service using Nutrition Business Journal; and USDA, National Agricultural Statistics Service.

The USDA National Organic Program (NOP) accredits State and private (including nonprofit) groups to provide certification services to producers and handlers. Other key components of NOP include:

- *Certifier Role in Regulatory Enforcement:* Certification by a USDA-accredited certifier is mandatory for all producers and handlers who label or advertise products as organic and earn more than $5,000 in annual organic sales (those earning $5,000 or less are exempt). Certifiers review annual organic system plans and conduct annual on-site inspections of every certified operation. Certifiers have authority to conduct investigations, initiate suspension or revocation actions, and conduct residue testing for prohibited pesticides, antibiotics, and genetically engineered (GE) ingredients.

- *Civil Penalties for Fraudulent Labeling:* Organic operations falsely selling or labeling products as organic are subject to civil penalties. In 2021, the civil penalty was $18,951 per violation, though the monetary penalty is adjusted for inflation annually. USDA has levied millions of dollars in civil penalties for false labeling and sales. Additionally, USDA has used criminal prosecution as an enforcement tool in cases involving large-scale organic fraud (USDA, AMS, 2021).

- *National List of Approved and Prohibited Substances:* USDA organic standards generally allow the use of nonsynthetic substances in organic production and prohibit the use of synthetic substances. The National List outlines the exceptions to these general rules. Changes to the National List can be initiated through a petition to add or remove a substance or made through the sunset review process (see National Organic Standards Board below). Exceptions to prohibited substances must be evaluated for toxicity, environmental persistence, and effects on human health, the agroecosystem, soil organisms, crops, and livestock before being included on the National List.

- *Authorization for Organic Trade:* To be sold in the United States, imported organic products must be certified to the USDA organic standard or to an authorized international standard. NOP has authorized certifying agents in many countries to certify operations to the USDA organic standard and established organic trade partnerships to authorize U.S. organic imports from and exports to countries with an equivalent organic standard. These countries include Canada, the European Union, Taiwan, Japan, South Korea, Switzerland, and the United Kingdom. USDA has also facilitated trade partnerships through recognition agreements with Israel and New Zealand. Countries with an organic recognition agreement do not have their own organic standards. The United States allows their governments to authorize certifying agents in the country to certify operations in that country to the USDA organic standards. In 2020, the United States ended its recognition agreement with India.

- *National Organic Standards Board (NOSB):* The Organic Foods Production Act (OFPA) established a Federal Advisory Board of volunteers from across the organic community to make ongoing recommendations to USDA. Under the sunset review process, NOSB must review every substance on the National List of Allowed and Prohibited Substances every 5 years to confirm that it continues to meet all required criteria. NOSB has made almost 700 recommendations regarding organic practice standards and materials allowed in organic production.

- *Rulemaking to clarify and strengthen national standards:* NOP develops the rules and regulations for the production, handling, labeling, and enforcement of USDA organic products. The rulemaking process seeks to clarify and strengthen national organic standards with recommendations from NOSB and an opportunity for public comment.

- Every major periodic Farm Act has included organic initiatives since 2000 to broaden support for organic production and the 3-year transition period to organic production—during which farmers must employ organic production practices but are not yet certified and do not receive organic price premiums (see appendix A). For example, the 2002 Farm Act launched two national programs. One of the programs assists producers with the costs of organic certification, and the other funds public research on organic farming systems (see box 1.2, "Milestones in U.S. Organic Legislation and Policy, 2000–21".

In this report, we examined the impact of these organic policy changes on organic producers' access to U.S. farm assistance programs, public funding for organic research, and other issues affecting the adoption of organic farming systems. In addition, this report examined the uneven adoption of organic systems across commodity sectors and regions, as well as other trends in U.S. organic production since 2000, including changes in organic retail markets and the momentum of consumer demand going into the next decade. A large body of scientific literature has also emerged since 2000 comparing the agronomic, environmental, and other characteristics of organic and conventional production systems, as well as new studies on organic consumer demographics and consumer motivations to purchase organic products. The report has synthesized findings from new studies on these topics.

**Box 1.1**

## USDA National Organic Program: Production and Processing Standards

In 2000, USDA published the National Organic Rule implementing the U.S. organic standards set by law in the Organic Foods Production Act of 1990. The regulatory definition of organic production is: "A production system that is managed in accordance with the Act and regulations in this part to respond to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity."

*Key regulatory standards for organic production and marketing*

- Prohibit use of almost all synthetic pesticides and fertilizers.
- Prohibit use of genetic engineering—including recombinant DNA and other technologies.
- Prohibit use of ionizing radiation and sewage sludge, which may contain heavy metals.
- Require practices to build soil quality such as adding animal or green manures and compost.
- Require practices to conserve soil such as cover cropping, mulching, and conservation tillage.
- Require crop rotation to help manage pests and disease, build soil organic matter, prevent soil erosion, and increase farm biodiversity.

*Key organic livestock systems*

- Prohibit use of antibiotics and growth hormones.
- Require that natural nutritional and behavioral animal requirements be met, including access to pasture for ruminants during the grazing season.
- Require use of organic feed, including all feed, pasture, forage, and plant-based bedding.
- Livestock must be raised organically for the last third of gestation, and birds for poultry and egg production must be raised organically by the second day of life.
- Require livestock vaccination and other disease-preventive techniques.

*Organic handlers*

- Prohibit mixing of organic and conventional products along the supply chain.
- Require organic pest management in facilities.

*Organic labels*

- USDA Organic Seal authorized on "100-percent Organic" and "Organic" labels.
- "100-percent organic"—only organic ingredients (excluding water and salt).
- "Organic"—at least 95-percent organic ingredients.
- "Made with organic ingredients"—at least 70-percent organic.
- Listing in ingredients panel only—less than 70-percent organic.
- For more information, consult the USDA, National Organic Program website.

Source: USDA, Economic Research Service using USDA, National Organic Program.

Box 1.2

## Milestones in U.S. Organic Legislation and Policy, 2000–21

| Year | Milestone |
|---|---|
| 2000 | USDA publishes National Organic Rule, setting Federal standards for organic farming and processing and creating the National Organic Program (NOP) for oversight. |
| 2000 | The Agricultural Risk Protection Act of 2000 passes, expanding the definition of good farming practices to include scientifically sound, sustainable, and organic farming practices eligible for Federal Crop Insurance Corporation (FCIC) insured crops. Crop insurance does not cover losses if farmers do not follow appropriate and good farming practices. |
| 2002 | USDA National Organic Rule takes effect, requiring producers and handlers who label products as organic to be certified to national standards by a USDA-accredited certifier. |
| May 2002 | Organic Agriculture Research and Extension Initiative (OREI) and the National Organic Certification Cost-Share Program included in the 2002 Farm Act. |
| 2005 | USDA's National Organic Standards Board (NOSB) submits a pasture standard for ruminants to NOP to fill one of the gaps in national organic standards. |
| May 2008 | The 2008 Farm Act includes first-time organic provisions in the Conservation Title, as well as new provisions on credit, trade, and crop insurance for organic agriculture. |
| 2009 | The United States signs the world's first bilateral organic equivalency agreement with Canada to streamline organic trade between the two countries. |
| 2010 | USDA finalized a new rule establishing a pasture standard for ruminants, setting June 17, 2011, as the deadline for producers to meet the new standard. |
| 2010 | USDA sets first goal to expand organic agriculture and the number of certified organic operations in the United States by 25 percent over a 5-year period. |
| Feb 2014 | The 2014 Farm Act boosted funding for most organic programs and authorizes a potential Organic Commodity Promotion Order funded by industry. |
| 2017 | USDA publishes the Organic Livestock and Poultry Practices final rule amending requirements for avian living conditions. |
| Dec 2018 | The 2018 Farm Act creates permanent funding status for OREI and expands funding for NOP to strengthen tracking and verification of organic imports. |
| 2019 | USDA withdraws the Organic Livestock and Poultry Practices rule. |
| 2020 | USDA publishes the Strengthening Organic Enforcement proposed rule to strengthen NOP oversight and enforcement of organic production, handling, and sales. |
| June 2021 | USDA announces it would begin rulemaking on the Organic Livestock and Poultry Practices rule again. |

Source: USDA, Economic Research Service using USDA, National Organic Program.

# Chapter 2: U.S. Organic Research and Policy Developments

A decade in the making, the debut of the USDA Organic Seal on products in the early 2000s was met with considerable consumer interest. Consumers' demand for organic food increased quickly during the period after the national organic regulations were established, at least in part due to implementation of the USDA's organic regulatory program and label (Kiesel and Villas-Boas, 2007; Molyneaux, 2007; Batte et al., 2007).

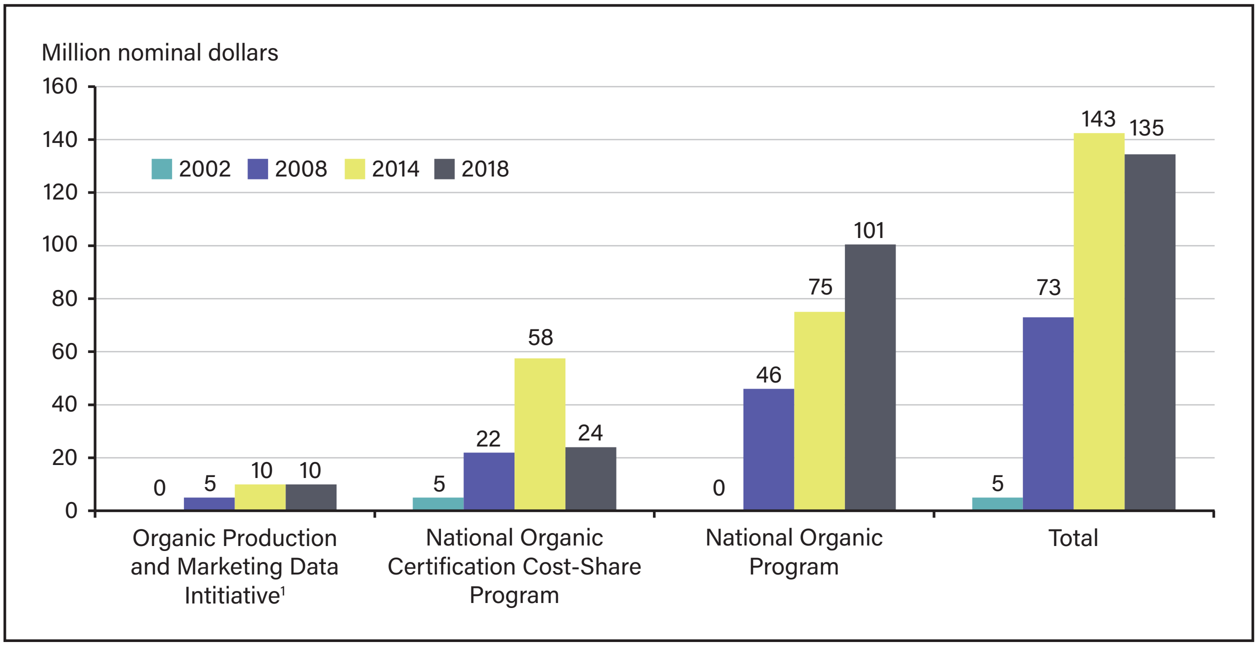
U.S. producer response was more muted. Growth in organic food sales have outpaced growth in domestic production since the USDA program started in 2000. In response, all four of the major updates to U.S. farm policy since 2000 have included programs to broaden support for organic agriculture (see appendix A, "Organic Provisions, 2002–18 Farm Acts" for a comprehensive list of these organic initiatives and provisions). Steady funding increases for public research on organic agriculture is one of the major policy developments since 2000. Public research for organic agriculture is especially important because organic systems rely on biological pest management, cover crops, and other ecological practices rather than the chemical products on which most agricultural-input companies focus their research. Other organic measures that have become law since 2000 include a national program initiative to help producers pay for USDA organic certification, expansion of industry oversight, and USDA farm program changes to lower barriers for organic production.

## Organic Regulatory Program Provisions

### *USDA National Organic Program*

USDA's National Organic Program (NOP) regulates an industry that has grown from $10 billion (inflation adjusted to 2021 dollars) in U.S. organic retail sales in 2001 to over $56 billion in 2020 (figure 1.1). The 2008 Farm Act was the first one to authorize funding for NOP, and funding has steadily increased since then with $100.5 million authorized for the current period of fiscal years 2019–23 (figure 2.1). The Agriculture Act of 2014 and the Agricultural Improvement Act of 2018 (2014 and 2018 Farm Acts) require NOP to strengthen industry oversight and enforcement. NOP subsequently expanded its public database of certified organic operations to include operations with surrendered, revoked, or suspended organic certification. In 2020, NOP published a major proposed rule—Strengthening Organic Enforcement—that would expand the types of food handling businesses required to be certified organic. The proposed rule would expand oversight of organic supply chains by also requiring organic certification for importers, brokers, and traders. The proposal would also require all organic products entering the United States to have NOP Import Certificates and all organic certifiers to conduct unannounced inspections on 5 percent of their certified operations every year.

Figure 2.1
**Mandatory spending on USDA organic regulatory program, certification assistance, and data authorized by the 2002–18 Farm Acts**




[1]Includes an additional $5 million in 2014 and 2018 for the National Organic Program for technology upgrades to improve regulatory enforcement and fraud prevention.

Source: USDA, Economic Research Service using data from the 2002, 2008, 2014, and 2018 Farm Acts.

## *National Cost-Share Assistance for Organic Certification Fees*

The 2002 Farm Act launched the National Organic Certification Cost-Share Program in every State to assist organic producers and handlers with the cost of organic certification. Initial funding was a total of $5 million for the 5-year period covered by the 2002 Farm Act (fiscal years 2002–2007), which expanded to $58 million in 2014 before dropping to $24 million in the 2018 Act covering the fiscal year (FY) 2019–23 period (figure 2.1).

However, the certification cost-share program covered a smaller share of certification expenses in 2019 compared with 2014. In 2019, annual organic certification costs averaged about $2,800 per farm compared with about $1,500 in 2014 (USDA, NASS, 2015; USDA, NASS, 2020). Although the costs of certification have increased, the maximum Federal cost share through 2019 was 75 percent—with a cap of $750 per scope or area of certification (e.g., livestock, crops)—and has not increased since 2008. However, in 2020, USDA dropped both caps below the 2008 Farm Act caps—50 percent for the Federal cost share, and $500 per certification scope. For more information on the Organic Certification Cost Share Program, please see the "Organic Certification Cost Share Program (OCCSP)" on the U.S. Department of Agriculture's Farm Service Agency website.

## *Organic Production and Marketing Data Initiative*

The 2008 Farm Act authorized segregated organic data collection and funded the Organic Production and Marketing Initiative at $5 million for the 5-year period of the 2008 Farm Act (FY 2008–13). Funding for this initiative has remained flat since 2008, except for an additional $5 million in the 2014 and 2018 Farm Acts for technology upgrades to improve enforcement and fraud prevention through NOP (figure 2.1).

To expand organic data collection and reporting on U.S. organic production, prices, marketing, distribution, and consumer purchasing, this initiative has provided funding to the three USDA agencies focusing on agricultural marketing, statistics, and economics. The USDA, Agricultural Marketing Service (AMS) has used the increased funding to expand price reporting on wholesale markets—from a handful of produce items to well over 100 organic fruits and vegetables—and started wholesale price reports for organic poultry, eggs, grains, dairy, and cotton. USDA, National Agricultural Statistics Service (NASS) used the funding to initiate a national survey of all organic producers in 2007, which is updated every 5 years, to examine trends in organic production and marketing. USDA, Economic Research Service (ERS) expanded USDA's major annual economic survey of U.S. farmers and ranchers—the Agricultural Resources and Management Survey (ARMS)—to include a representative sample of organic producers. Since 2005, USDA, ERS has conducted ARMS surveys for organic dairy, apples, soybeans, wheat, and corn. USDA, ERS has published studies comparing organic and conventional production costs, revenues, yields, structure, marketing, and practices (see appendix B, "U.S. Data Sources on U.S. Organic Production, Marketing, and Trade," for a comprehensive description).

## Changes in USDA Farm Assistance Programs

Two of USDA's largest farm assistance efforts—crop insurance and a set of conservation programs—have historically been underused by organic farmers. Crop insurance policies did not match well with organic production because organic producers could only be compensated for a crop loss at the conventional price, which is lower than the organic price. Furthermore, both crop insurance and conservation programs have had rules that did not accept some of the conservation activities and agronomic practices used in organic production systems. Since 2008, the Farm Acts have included provisions intended to reduce the obstacles faced by organic farmers in accessing USDA farm assistance programs.

### *Risk Management for Organic Agriculture*

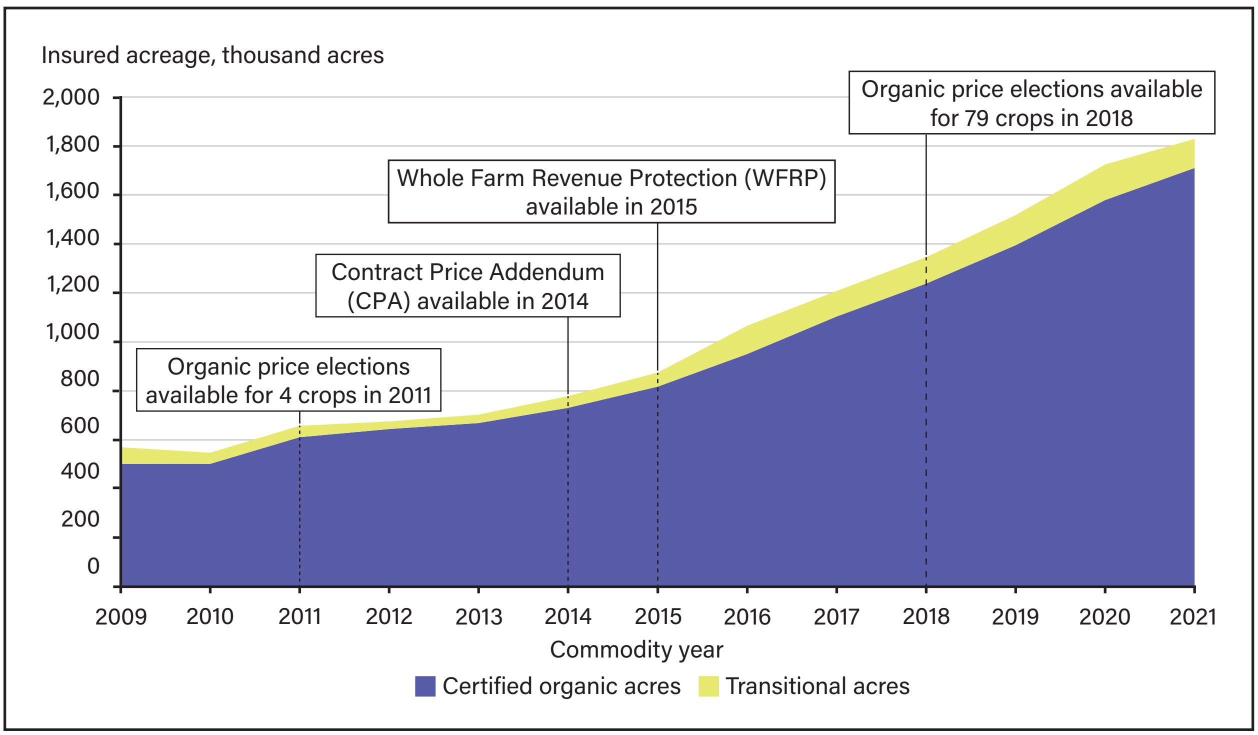
The Federal Crop Insurance Corporation (FCIC), managed by USDA's Risk Management Agency (RMA), is the corporation devising and establishing crop insurance products. The Agricultural Risk Protection Act of 2000 recognized organic farming as a "good farming practice" covered by Federal crop insurance. In response, USDA's crop insurance program began covering transitional and certified organic acreage in crop year 2001, although coverage did not reflect organic price premiums and included a 5-percent surcharge. The 2008 Farm Act required USDA to study how to improve organic coverage and—beginning in August 2010—USDA, RMA eliminated the 5-percent surcharge imposed on several crops and developed price elections for cotton, corn, soybeans, and processing tomatoes.

The 2014 Farm Act required USDA, RMA to report annualy to the Committee on Agriculture of the House of Representatives and the Committee on Agriculture, Nutrition, and Forestry of the Senate on progress made in developing and improving the Federal Crop Insurance Program (FCIP) for organic crops. USDA, RMA was charged with expanding organic price elections by 2015—to enable organic farmers to purchase crop insurance that would reflect the value of their crops based on the price premiums received for those organic crops. In the 2015 crop year, organic price elections became widely available for organic crops, making crop insurance more attractive to organic producers. A contract price option—or Contract Price Addendum—also became available for the 2014 crop year for organic crops grown under contract to be insured at the contract price.

In 2015, USDA, RMA also introduced the Whole-Farm Revenue Protection (WFRP) program, a USDA, RMA pilot risk management tool. This option was designed to be attractive to diversified farms, including fruit and vegetable, and other specialty crop operations producing a wide range of products, as well as to operations with resource-conserving crop rotations. WFRP was first offered across a subset of States in 2015 and is now available in all 50 States. Because WFRP is a pilot program, organic producers can combine coverage with other USDA crop insurance programs. The 2018 Farm Act established continuing education requirements for crop insurance agents and loss adjusters to ensure their familiarity with conservation activities and agronomic practices used in organic production systems. Additionally, the 2018 Farm Act incorporated cover crops as "good farming practices," such that cover crops are treated just as other management practices like fertilizer or tillage practices (USDA, RMA, 2019b).

Wider availability of organic crop insurance options and strong growth in the U.S. organic industry led to increases in the use of FCIP. Insured organic and transitional acreage more than tripled between crop years 2009 and 2020, passing one million insured acres in 2016 (figure 2.2). In the 2021 crop year, there were over 80 organic crops that could be insured with an organic price election. Only 19 crops did not have organic price elections in 2021 due to no known organic production in insured areas, limited organic production leading to lack of data to price the insurance product, or available data suggesting the organic crop does not receive a premium. If organic pricing is not available, growers receive the same price as published by USDA, RMA for nonorganic practices. Organic corn, soybeans, and other field crops are more extensively covered by insurance than specialty crops. The top 10 insured organic crops accounted for over 70 percent of the total value insured by organic producers between crop years 2012 and 2021. In addition, field crops continued to have the highest share of coverage during this period (figure 2.3). Higher coverage in field crops versus specialty crops is consistent with crop insurance adoption in conventional crops.

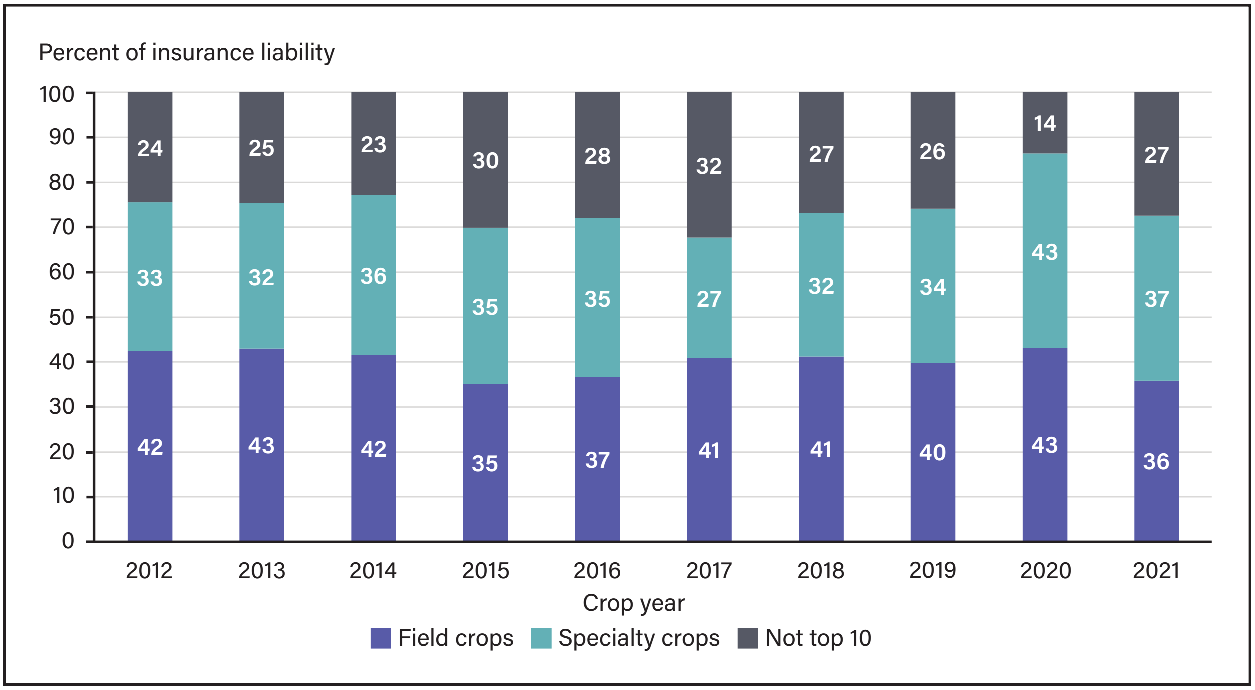
Figure 2.2
**Certified organic and transition acreage insured under Federal crop insurance**




Source: USDA, Economic Research Service using data from USDA, Risk Management Agency, Federal Crop Insurance Corporation Summary of Business for Organic Production, multiple years 2010–21.

Figure 2.3

**Share of Federal crop insurance liability for the top 10 organic crops covered by Federal crop insurance, crop years 2012–21**




Source: USDA, Economic Research Service based on data from USDA, Risk Management Agency, Federal Crop Insurance Corporation Summary of Business for Organic Production, multiple years 2010–21.

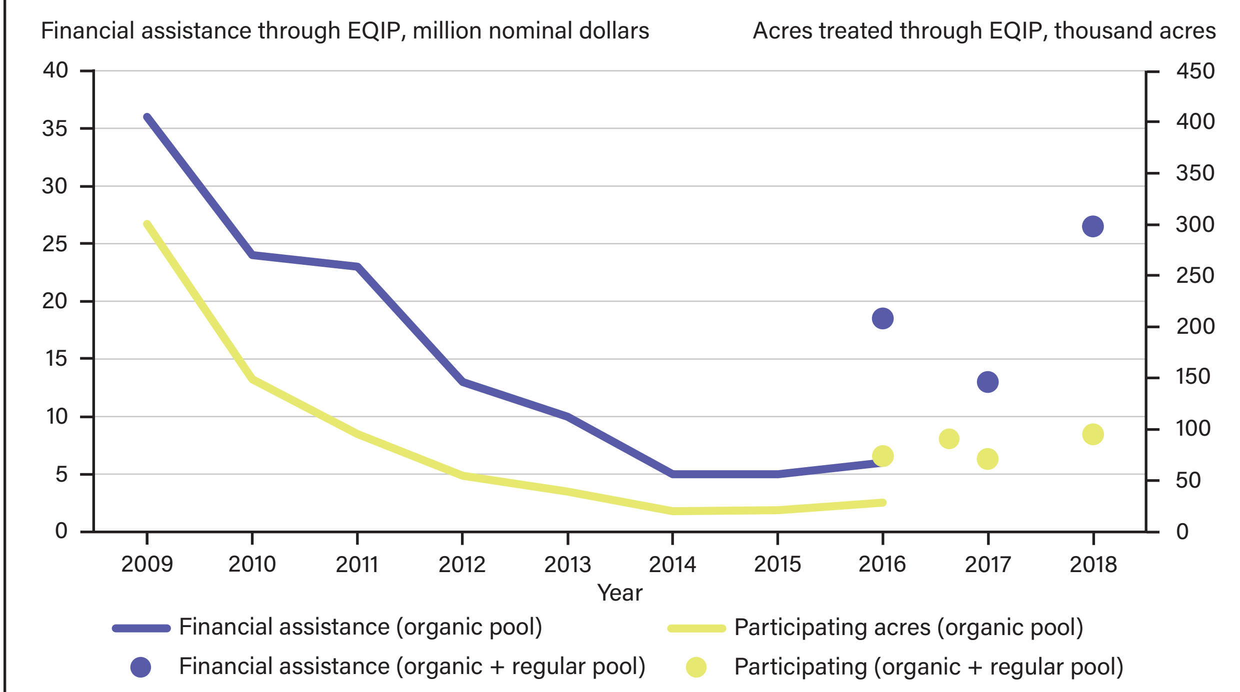
Producers growing crops not covered by a USDA, RMA Federal crop insurance individual policy can purchase coverage through USDA, Farm Service Agency's (FSA), Noninsured Crop Disaster Assistance Program (NAP). Growers transitioning to organic are considered conventionally grown under NAP until certification is complete. Like USDA, RMA, USDA's Farm Service Agency uses organic pricing for organic acres covered under NAP when available. Organic average market prices may be based on USDA, RMA organic price for the crop, 145 percent of the average market price, or a price based on acceptable organic price data from other sources. However, the producer may receive the conventional market price if sufficient data are not available.

Despite increases in the availability of FCIP and NAP for organic producers, organic producers have historically purchased fewer risk management products relative to conventional producers. In a collaborative USDA and University of Maryland study conducted in the early 2000s, organic farmers raised concerns about the type of coverage offered, the lack of organic price options, and the usefulness of traditional crop insurance for diversified fruit and vegetable farmers (Hanson et al., 2004). Organic farmers echoed those same concerns in a recent study based on a nationwide survey of organic farmers. Frequently reported concerns with the Federal crop-insurance options available to organic farmers included limited commercial availability of policies for many crops—especially fruits and vegetables—and restrictions and penalties for using USDA-approved organic farming practices. However, the same study also found specialty crop farmers were less aware of crop insurance than row-crop farmers (National Center for Appropriate Technology, 2019). Still, the number of organic specialty crop FCIP policies and NAP applications have both increased in recent years (Raszap Skorbiansky et al., 2022).

### *Conservation Programs*

The 2008 Farm Act expanded one of USDA's top conservation programs for working lands—the Environmental Quality Incentives Program (EQIP)—to include conservation practices tailored to both organic production and conventional production. Organic, transitioning-to-organic, and producers exempt from National Organic Program (NOP) certification requirements can receive financial and technical assistance for conservation activities consistent with an organic system plan. These producers compete in separate funding pools, with per farmer contract payments capped at $140,000 within the 2019–23 period. The contract payments for the 2019–23 period increased from $80,000 per 5 years, which was authorized in the 2008 Farm Act. Organic producers can also apply for the general EQIP program, which—depending on State-specific initiatives—may be more competitive. Under the EQIP organic program, USDA provided a total of $122 million between 2009 and 2016 to help over 6,800 organic and transitioning producers implement conservation practices on their farms, although program use declined for most of this period (figure 2.4). From 2016 to 2018, assistance to organic and transitioning producers through both the regular and organic EQIP organic programs totaled $58 million. Cover crops and conservation crop rotation have been among the most popular practices supported by this program for both organic and transitioning farmers. The southeast crop region, which has lagged other regions in adopting organic farming systems (Greene et al., 2010; Greene, 2003), had higher EQIP funding for transitioning operations than for certified operations. However, the northeast crop region—one of the longtime top organic crop regions—led in funding for both certified and transitioning operations (figure 2.5).

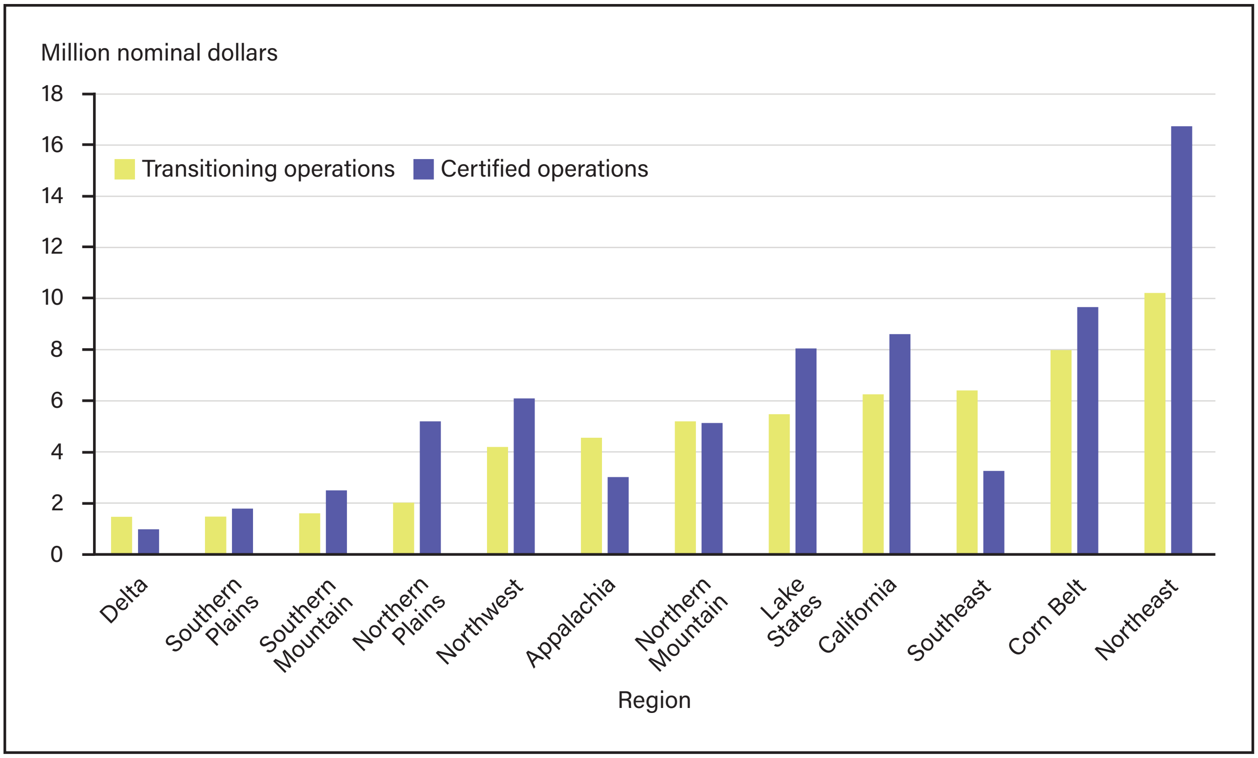
Figure 2.4
**Environmental Quality Incentives Program (EQIP) payments and acres to organic and transitioning operations, 2009–18***




*USDA began reporting combined assistance through both the regular and organic EQIP programs in 2016; Natural Resources Conservation Service discontinued funding breakouts through this initiative in 2017.

Source: USDA, Economic Research Service using data from USDA, Natural Resources Conservation Service, EQIP.

Figure 2.5
**Environmental Quality Incentives Program (EQIP) Organic Initiative funding, 2009–17**




Note: Northeast = CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, and VT; Appalachia = KY, NC, TN, VA, and WV; Southeast = AL, FL, GA, and SC; Lake States = MI, MN, and WI; Corn Belt = IL, IN, IA, MO, and OH; Delta = AR, LA, and MS; Northern Plains = KS, ND, NE, and SD; Southern Plains = OK and TX; Northern Mountain = ID, MT, and WY; Southern Mountain = AZ, CO, NV, NM, and UT; Northwest = OR and WA. Financial outlays are not adjusted for inflation. Between 2009 and 2017 cumulative inflation was about 14.3 percent, and about 4.2 percent between 2017 and 2019.

Source: USDA, Economic Research Service using USDA, Natural Resources Conservation Service, 2009–17 EQIP data.

The Conservation Reserve Program's Transition Incentive Program (CRP-TIP) provides 2 years of payments to landowners leaving CRP who rent or sell their land to beginning, veteran, or socially disadvantaged producers who commit to using sustainable grazing practices, resource-conserving cropping systems, or are transitioning to organic production. The new producer can count the last 2 years of the expiring CRP contract towards the 3 years required for organic certification.

The 2002 Farm Act authorized the Conservation Security Program (CSP), now called the Conservation Stewardship Program (CSP), to provide incentives for producers investing in enhanced conservation practices such as practices that conserve biodiversity and improve soil and water conditions. Programs supporting markets for ecosystem services offer a mechanism whereby farmers financially benefit from the ecosystem services they provide. There are overlaps between National Organic Program (NOP) required practices and rewarded practices of programs such as CSP, and therefore the likelihood of organic producers or those interested in transitioning of utilizing CSP conservation enhancements are high (USDA, NRCS, 2015).

## Expansion of Organic Research and Promotion

USDA research on food and agriculture is primarily funded and conducted by USDA, National Institute of Food and Agriculture (NIFA) and USDA, Agricultural Research Service (ARS). USDA, NIFA is an agency funding extramural research, education, and extension programs in land-grant universities and other State institutions through competitive grants and statutory capacity funds, whereas USDA, ARS has over 2,000 agronomists, soil scientists, entomologists, plant pathologists, weed scientists, nematologists, and other scientists conducting intramural scientific research.

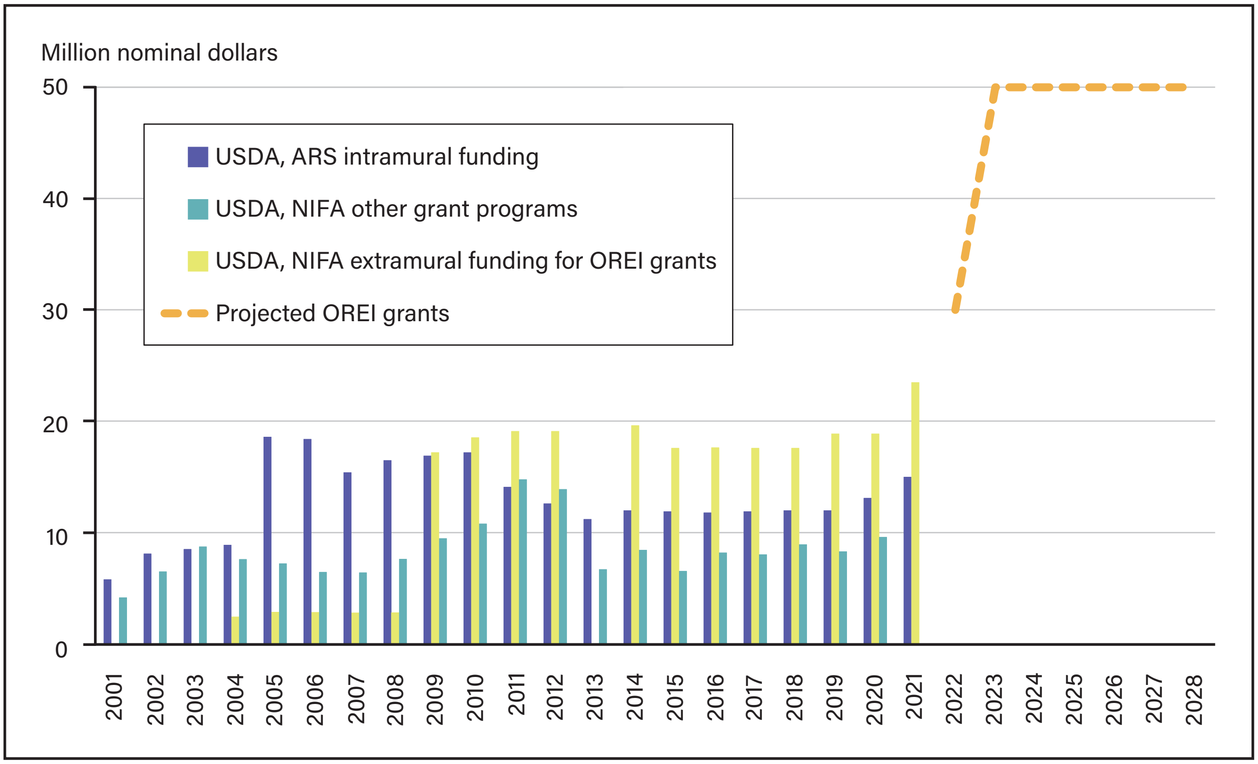
Before 2000, USDA funded few organic research projects. Research funding recommendations were made in its major 1980 organic report "to address the needs and problems of organic farmers and to enhance the success of conventional farmers who may want to shift toward organic farming" (USDA, Study Team on Organic Farming, 1980). During a 1982 congressional hearing, the USDA, ARS administrator reported that under 0.2 percent of the agency's research budget was devoted to organic research (Sinclair, 1982). A comprehensive analysis of USDA research funding in 1995 rated only 0.1 percent of all projects as strong organic projects (Lipson, 1997).

### *USDA Extramural Organic Research*

The 1998 Agricultural Research, Extension, and Education Reform Act of 1998 began closing this research gap by setting three research priorities: (1) Facilitate the development and improvement of organic agriculture production, breeding, and processing methods; (2) Evaluate the potential economic benefits of organic agricultural production and methods to producers, processors, and rural communities; and (3) Explore international trade opportunities for organically grown and processed agricultural commodities. The 2002 Farm Act launched the Organic Agriculture Research and Extension Initiative (OREI), an extramural competitive grants program directed by USDA, NIFA. Initial funding for OREI was set at $3 million per year (figure 2.6) and included three more specific priorities: (4) Determine desirable traits for organic commodities; (5) Identify marketing and policy constraints on the expansion of organic agriculture; and (6) Conduct advanced on-farm research and development that emphasizes observation of, experimentation with, and innovation for working organic farms, including research relating to production, marketing, food safety, socioeconomic conditions, and farm business management. The 2008 Farm Act increased OREI funding to $20 million annually, but it was not funded in 2013. Two additional priorities were added: (7) Examine optimal conservation and environmental outcomes relating to organically produced agricultural products; and (8) Develop new and improved seed varieties that are particularly suited for organic agriculture.

The 2018 Farm Act established permanent baseline funding for OREI—increasing annual funding from $20 million in 2019 to $50 million in 2023 and each subsequent year (figure 2.6). State funding for organic research at land-grant universities and other institutions is also expected to rise with increased OREI funding. OREI requires matching funds if the research project provides a particular benefit to a specific agricultural commodity.

Figure 2.6
**Federal organic research support through USDA intramural and extramural funding, 2001–28**




USDA, ARS = USDA, Agricultural Research Service; USDA, NIFA = USDA, National Institute of Food and Agriculture; OREI = Organic Agriculture Research and Extension Initiative.

Note: OREI is USDA's major extramural organic grant program awarded by USDA, NIFA. Other USDA, NIFA programs that fund organic research include Organic Transitions, Sustainable Agriculture Research and Education, and Beginning Farmer and Rancher Development. USDA, NIFA 2021 funding for other grant programs is not available.

Source: USDA, Economic Research Service using USDA, Agricultural Research Service program expenditure data; USDA, National Institute of Food and Agriculture; and Congressional Budget Office (December 2018) memo on the 2018 Farm Act.

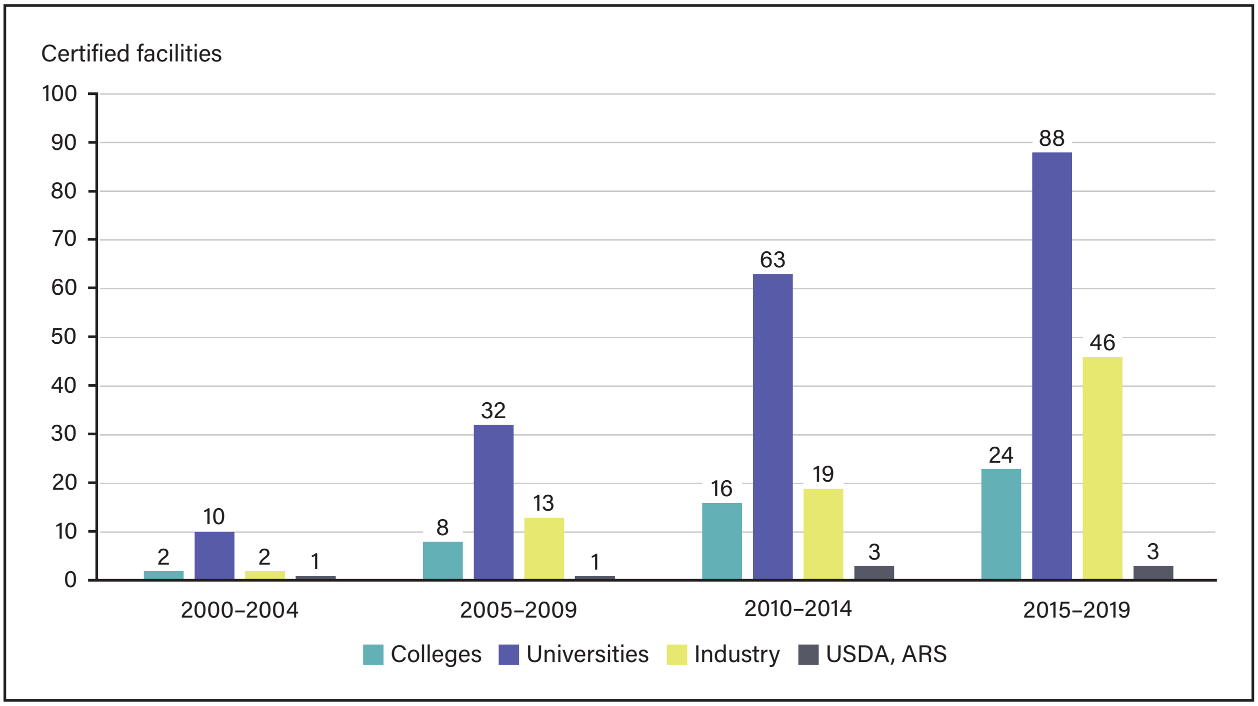
The number of public and private groups obtaining organic certification for research and education purposes expanded rapidly between 2000 and 2019. Universities had the biggest increase, mostly for certified agricultural research in the field, but also a few certified food processing facilities. By 2019, nearly 90 university locations[1] and several dozen colleges had certified organic facilities, triple the number during the 2005–2009 period (figure 2.7). The college facilities are mostly their own teaching gardens and farms, but a few universities also include certified processing facilities in addition to their research and teaching farms. The number of companies and industry groups obtaining organic certification, mostly for product development laboratories, also grew rapidly during this period. Research on organic agriculture at USDA, ARS also increased but the facilities generally do not produce food for sale; therefore, the facilities have never sought organic certification.

Certification requirements for projects funded by USDA, NIFA's OREI and Organic Transitions grant programs may have spurred the large increase in university certification for organic research fields and facilities. An Organic Farming Research Foundation study evaluated nearly 200 research projects funded by OREI and the Organic Transitions Program between 2002 and 2014. This study found land-grant universities received 90 percent of the funding (Schonbeck et al., 2016). The north central region received the most funding, followed by the northeastern and western regions, with the southern region receiving the least funding. These regional funding patterns closely match the location of universities that have obtained organic certification (figure 2.8).

[1] The 90 universities referenced include university branches in different locations.

The study also found USDA, NIFA's grant programs were meeting the high-priority needs of organic farmers, including research on soil health, nutrient management, weed management, and plant breeding (Schonbeck et al., 2016). Plant breeding is a particularly high-priority need for grain and oilseed farmers. The study determined the USDA, NIFA-funded projects developed several dozen new publicly held cultivars, hundreds of breeding lines with disease resistance, and other traits needed in organic systems during this period.

Figure 2.7
**U.S. certified organic research facilities and food innovation labs, 2000–19**

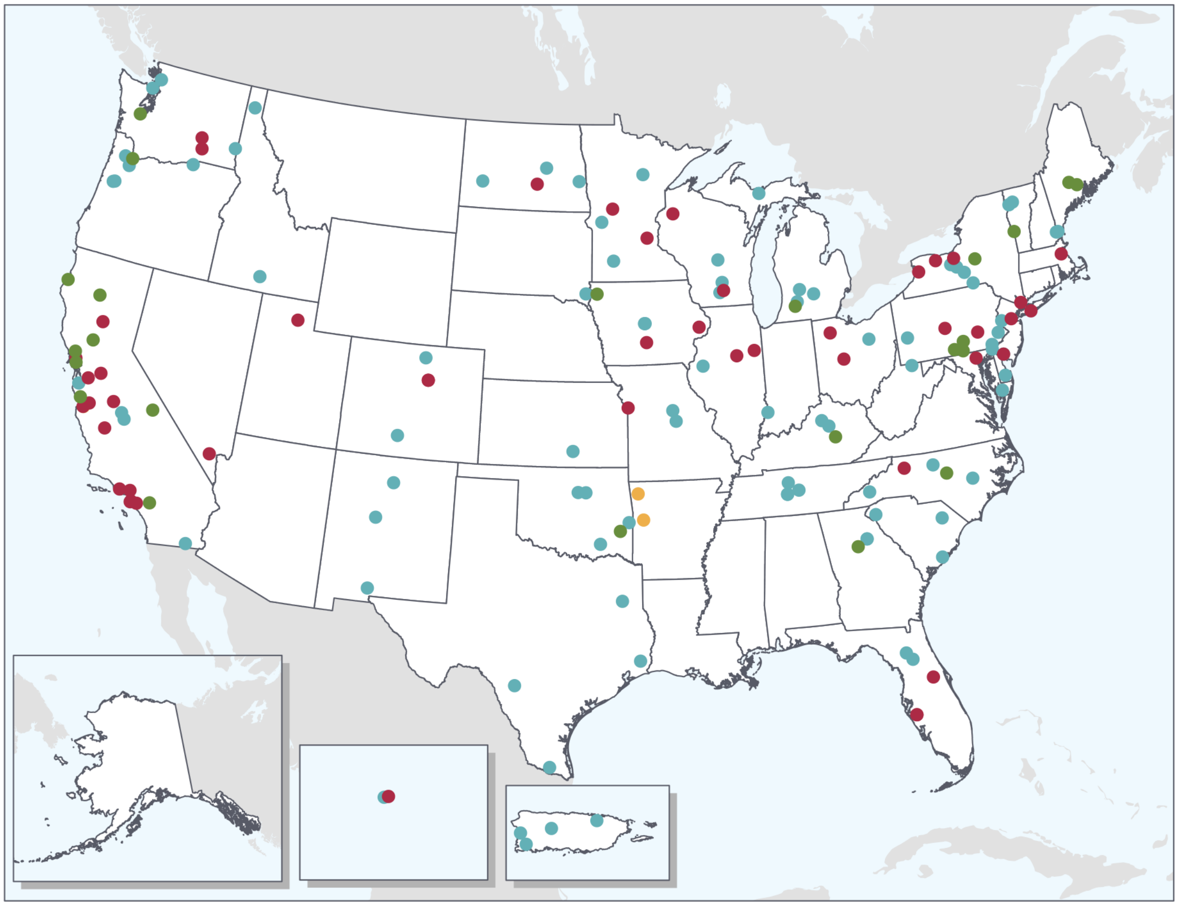



USDA, ARS = USDA, Agricultural Research Service.

Note: USDA organic standards require research fields and food lab facilities to be certified organic only if agricultural products will be labeled and sold as organic; however, grant funding from the USDA, National Institute of Food and Agriculture, Organic Agriculture Research and Extension Initiative (OREI) requires fields and laboratories to be certified organic. Most organic research done at USDA, Agricultural Research Service facilities does not produce food for sale; therefore, the facilities have never sought organic certification.

Source: USDA, Economic Research Service using data from USDA, Agricultural Marketing Service, Organic Program INTEGRITY Database.

Figure 2.8
**U.S. public and private research facilities certified organic in 2019**




Note: Most organic research done at USDA, Agricultural Research Service (ARS) facilities do not produce food for sale; therefore, these facilities have never sought organic certification.

Source: USDA, Economic Research Service using data from USDA, Agricultural Marketing Service, Organic Program INTEGRITY Database.

## *USDA Intramural Organic Research*

Soon after USDA set national organic standards and created a national organic regulatory program, USDA, Agricultural Research Service (ARS) conducted a survey of its scientists to determine the level of staff interest in conducting research on organic farming systems (Bull, 2006). About 8 percent of USDA, ARS scientists surveyed in 2001 indicated they were interested in organic research, and about 4 percent said they already had organic research projects underway. USDA, ARS organic research funding was approximately $6 million in 2001 (0.6 percent of total USDA, Agricultural Research Service's research funds) and $17 million in 2010 (1.5 percent of the total). Both organic and overall USDA, ARS research funding has declined since 2010, and USDA, ARS organic funding has plateaued at around $12 million (about 1.2 percent of the total).

USDA, ARS uses an interdisciplinary organic research approach to understanding fundamental biological and physical processes and uses this knowledge to develop pest and nutrient management solutions that do not rely on synthetic fertilizers and pesticides. USDA, ARS is conducting organic research at 16 facilities across 14

States, including those in the Northeast, Southeast, Midwest, Plains, and Pacific Coast States. As stated previously, few USDA, ARS facilities are certified organic because they do not produce food for sale. USDA, ARS also conducts a wide variety of research that supports organic production systems and considers these projects as providing indirect support for organic production. These projects are not included in figure 2.8.

The 2001 USDA, ARS survey identified obstacles that prevented or hindered the scientists' organic research (Bull, 2006). Some issues—especially a lack of resources—were not unique to organic research projects. The main obstacle to organic certification unique to organic research was the potential for chemical contamination from shared farm equipment and facilities at many research stations. However, a major advantage of USDA, ARS projects is that they are funded in 5-year cycles, making it easier for USDA, ARS than for universities—which generally rely on grant funding—to organize long-term organic projects (Bull, 2006). In 2005 and 2006, USDA, ARS hosted workshops attended by organic stakeholders to develop the first 5-year research action plan, and the second plan was based on a 2012 customer and stakeholder workshop. Research focus included transition from conventional production strategies to organic, soil health, disease, pest and weed management, livestock parasite management, whole farm systems, and developing market-driven production strategies to meet consumer demand for organic food and agriculture products.

### *Private Sector Investment in Organic Research*

In recent decades, the private sector investments in food and agriculture research and development (R&D) in the United States have increased. Food companies and agricultural input companies funded just over 75 percent of U.S. food and agriculture R&D in 2014, while Federal and State funding accounted for just under 25 percent of the total (Heisey and Fuglie, 2018). Private organic research facilities are not required to be certified unless they sell products advertised as organic or receive funding from a Federal grant that requires organic certification. However, the number of USDA organic-certified private research firms with food innovation laboratories experiment farms, and other research facilities increased from 2 firms between 2000 and 2004 to nearly 50 by 2019 (figure 2.7). These certified facilities are concentrated in California and States in the northeast and upper Midwest (figure 2.8).

Public and private agricultural research investments tend to be complementary. In 2013, the private sector was predominantly focused on food and feed manufacturing, crop protection inputs, and other areas with commercial applications. Conversely, the public sector largely focused on natural resources, human nutrition, and other areas with potential societal benefits (Clancy et al., 2016).

### *Agricultural Input Industry Research*

Although a major focus of agricultural input industries has been on developing synthetic crop inputs that Federal regulation prohibits in organic systems, the number of startups focused on biological crop inputs is growing (Manning, 2019). The global market for biological pest control products—including natural enemies, pheromones, botanical extracts, and microbial pesticides—was estimated at approximately $349 to $480 million annually—in 2021 dollars—between 1990 and 1992 (U.S. Congress, Office of Technology Assessment, 1995). The current worldwide market for biological pest control products is estimated at $3.3 billion (inflation adjusted to 2021 dollars) in 2018, and industry analysts project sales will double over the next 5 years (MarketsandMarkets Research Inc., 2019).

### *Food and Beverage Company Research*

In recent decades, many major food companies have added organic products to their product lines by acquiring the companies that pioneered organic brands. By 2019, 35 percent of the companies on the Institute of Food Technologist's annual list of top 100 food and beverage companies (by sales) had acquired organic brands (table 2.1). Some of these companies acquired their first organic brand before 2000, and most of the largest food and beverage companies had acquired at least one organic brand by 2018. CROPP Cooperative/Organic Valley stands out on the list of top 100 food and beverage companies that have acquired organic brands as a decades-old farmer cooperative that sells only organic products.

Although the portion for organic R&D is unknown, R&D spending is considerable in many of these firms, with a few allocating 1–2 percent of total sales to R&D. Research in most of these companies primarily focuses on new food uses, packaging, and other aspects of product development, although a few companies also do agricultural research. For example, The Kraft Heinz Company, Perdue Farms, and General Mills, Inc., have their own organic research farms, and Mars, Incorporated owns an organic seed and food company.

Table 2.1

**Top 100 food processing companies with organic brands, by U.S. sales**

| Top 100 food-processing companies with acquired organic brands[1] | Food sales (2019)[1] | Total sales (2019)[1] | First organic brand acquisition[2] | Research and development (R&D) spending/ total sales[3] |
|---|---|---|---|---|
| Ranked by food sales (2019) | Million dollars | Million dollars | Year | Percent |
| PepsiCo Inc. | 41,290 | 67,161 | 2005 | 1.1 |
| Tyson Foods Inc. | 41,116 | 42,405 | 2014 | 0.3 |
| Nestle (U.S. & Canada) | 34,141 | 95,322 | 2008 | 1.8 |
| The Kraft Heinz Company | 19,638 | 24,977 | 2018 | 0.4 |
| Anheuser-Busch InBev SA/NV | 15,488 | 52,329 | 2011 | 0.5 |
| General Mills Inc. | 14,262 | 16,865 | 1998 | 1.3 |
| The Coca-Cola Company | 11,925 | 37,266 | 2001 | -- |
| Mars, Inc. | 11,700 | 37,000 | 1997 | 1.0 |
| Conagra Brands Inc. | 11,054 | 11,054 | 2000 | 0.5 |
| Hormel Foods Corporation | 8,904 | 9,497 | 2015 | 0.3 |
| Cargill Inc. | 8,900 | 113,500 | 2010 | -- |
| Molson Coors Beverage Company | 8,549 | 10,579 | 2010 | -- |
| The Kellogg Company | 8,390 | 13,578 | 1999 | 1.0 |
| The J.M. Smucker Company | 7,801 | 7,801 | 1984 | 0.7 |
| Pilgrim's Pride Corporation | 7,637 | 11,409 | 2016 | -- |
| Mondelez International Inc. | 7,108 | 25,868 | 2000 | 1.2 |
| The Hershey Company | 7,082 | 7,986 | 2006 | 0.5 |
| Campbell Soup Company | 7,061 | 8,107 | 2008 | 1.1 |
| Keurig Dr Pepper | 6,359 | 11,120 | 2018 | 0.6 |
| Bimbo Bakeries USA | 6,056 | 6,056 | 2002 | -- |
| Danone North America | 6,000 | 6,000 | 2000 | 1.4 |
| Post Holdings Inc. | 5,263 | 5,681 | 2010 | 0.5 |
| Perdue Farms | 4,891 | 7,300 | 2011 | -- |
| Lactalis American Group | 4,400 | 4,400 | 2017 | -- |
| TreeHouse Foods Inc. | 4,289 | 4,289 | 2009 | 0.4 |
| Flowers Foods | 4,124 | 4,124 | 2015 | 0.1 |
| Unilever United States | 3,000 | 51,980 | 2017 | 1.6 |
| Maple Leaf Foods Inc. | 2,893 | 2,893 | 2017 | -- |
| Foster Farms | 2,400 | 2,400 | 2009 | -- |
| J. R. Simplot Company | 1,800 | 6,000 | 2008 | -- |

continued on next page ►

◂ continued from previous page

| Top 100 food-processing companies with acquired organic brands[1] | Food sales (2019)[1] | Total sales (2019)[1] | First organic brand acquisition[2] | Research and development (R&D) spending/ total sales[3] |
|---|---|---|---|---|
| Ranked by food sales (2019) | Million dollars | Million dollars | Year | Percent |
| B&G Foods Inc. | 1,660 | 1,660 | 2013 | -- |
| Cal-Maine Foods Inc. | 1,352 | 1,352 | 2016 | -- |
| J&J Snack Foods Corporation | 1,186 | 1,186 | 2012 | 0.1 |
| CROPP Cooperative/ Organic Valley | 1,100 | 1,100 | 1988 | -- |
| The Hain Celestial Group Inc. | 1,009 | 2,303 | 1977 | 0.6 |

Note: Estimates are for the most recent fiscal year available (2020/2021). Shares marked "--" indicate the research and development (R&D) numbers were not available. Share of R&D numbers are total R&D since corporate R&D numbers are not broken out by organic in public reports.

[1]Institute of Food Technologists, Food Processing, Top 100 list 2020.

[2]Howard, 2020.

[3]Anheuser-Bush InBev, 2020; Campbell Soup Co, 2020; Conagra Brands, 2019; Danone North America, 2020; Hain Celestial Group, 2020; The Hershey Company, 2020; Hormel Foods Corp, 2020; J&J Snack Foods, 2020; J.M. Smucker Company, 2021; Kellogg Company, 2020; Keurig Dr. Pepper, 2020; Mars Inc., 2020; Mondelez International, 2020; Nestle, 2020; Statistica, Inc, 2021; Treehouse Foods, 2020; Tyson Foods, Inc, 2020; Unilever, 2020.

Source: USDA, Economic Research Service using data from Institute of Food Technologists; Howard, 2020; food processing companies' annual reports and announcements; and Statistica, Inc.

Some food companies that are not on the top 100 list—especially those that sell mostly organic food products—have been leaders in private-sector initiatives to support organic farming research and education efforts. The top private funder of organic research in the United States is Clif Bar & Company, a major U.S. energy bar manufacturer that mostly uses organic ingredients (Wilcox, 2020). Clif Bar & Company funded three university endowments between 2015 and 2020—the University of Wisconsin, Washington State University, and the University of California—to develop organic varieties and accelerate use of organic farming practices (Kan-Rice and Forbes, 2020; Washington State University, 2018; University of Wisconsin, Madison, 2015). Some food companies have also started providing technical assistance to farmers who are transitioning to organic production (Dimitri and Baron, 2019).

### Organic Promotion

The 2002 Farm Act exempted organic producers from paying industry assessments (i.e., fees) for generic commodity research and promotion programs. In the past, organic farmers had often been required to pay commodity assessment fees, although these programs did not target organic research and promotion. The 2014 Farm Act authorized a potential organic commodity research and promotion order, although USDA has not yet approved one. Federal research and promotion programs are administered by the USDA and designed by commodity sectors wanting to fund their own generic research and marketing programs; since organic agriculture cuts across many commodities, organizing a diverse set of organic producers creates significant obstacles.

The 2018 Farm Act made organic products eligible for USDA, Foreign Agricultural Service's (FAS) Market Access Program, which provides cost-share funding to U.S. agricultural trade associations, cooperatives, State regional trade groups, and small businesses to expand export markets for U.S. products. The program funds promotion activities including consumer advertising, public relations, point-of-sale demonstrations, trade fairs and exhibition participation, market research, and technical assistance. In FY 2019, over $800 thousand was allocated to the Organic Trade Association, though it amounted to about 0.5 percent of that year's total allocation budget for the Market Access Program.

# Chapter 3: U.S. Organic Production, Characteristics, and Markets

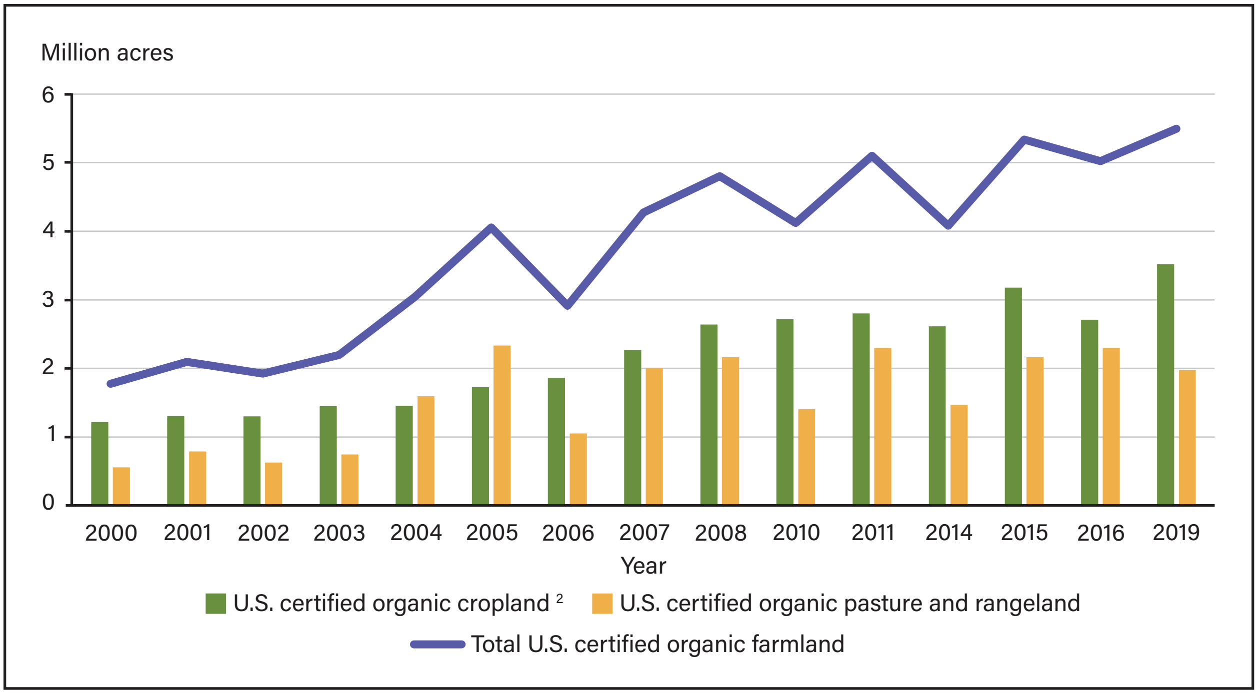
Consumer demand for organic food has been the primary driver of growth in the organic production sector over the last 20 years. Producers typically receive significant price premiums for their organic crop and livestock products, and these premiums have been key to the profitability of organic production (McBride et al., 2009; McBride et. al., 2015). Producers are motivated by the potential to increase farm income, as well as to protect family and community health, and to be more environmentally friendly (Slattery et. al, 2011; McBride et al., 2015).

Using the limited data available from USDA producer surveys and other sources, this chapter examines trends in U.S. organic production since 2000. USDA began broadening the types of organic data collected after the 2002 Farm Act funded the Organic Production and Marketing Data Initiative discussed in chapter 2. Unfortunately, most USDA data on organic production are fragmentary, data from different surveys are not comparable, and data availability is limited. USDA currently produces findings from its national Organic Survey once every 5 years (see appendix B, "USDA Data Sources on U.S. Organic Production, Marketing, and Trade," for a detailed description).

## Expansion and Characteristics of the U.S. Organic Farm Sector

U.S. organic farm sales have increased from an estimated (inflation adjusted to 2021 dollars) $609 million in 2002 to nearly $11 billion in 2019. U.S. producers more than tripled the amount of certified organic farmland operated between 2000 and 2019 (figure 3.1). U.S. pasture and rangeland are diverse types of land, mostly producing herbaceous plants and shrubs that provide forage for dairy cattle and other domestic livestock, as well as cover and food for wild game, songbirds, and other wildlife. U.S.-certified organic range and pastureland increased 254 percent during the 2000–19 period to 1.97 million acres while organic cropland increased 189 percent to 3.5 million acres (figure 3.1). The smaller increase in cropland than pasture and rangeland acreage partly reflected the greater challenges of converting field crop production to organic farming systems.

Figure 3.1
**U.S. certified organic acreage since the National Organic Program began in 2000[1]**




[1] Estimates for 2000–15 are based on data from an organic certifier survey while estimates for 2016. Estimates for 2016 and 2019 are based on organic producer surveys. Producer survey estimates are typically lower than certifier-based estimates due to methodological differences. USDA, National Agricultural Statistics Service (NASS) did not conduct certified organic surveys for 2017, 2018, and 2020.

[2] Certified-organic wild crop acreage is not included.

Source: USDA, Economic Research Service (ERS) using data from USDA, ERS, organic certifier surveys (2000–11); USDA, National Agricultural Statistics Service (NASS) organic certifier surveys (2014–2015); and USDA, NASS, national organic producer surveys (2016–2019).

The structure of the U.S. organic sector has differed substantially from the conventional agriculture sector since the 1990s. The adoption of organic farming systems continues to be higher in high-value commodity sectors, such as fruits and vegetables, dairy, and poultry, than in the grain and oilseed sector, which is a top segment in the U.S. farm economy overall (Greene, 2013; Greene et al., 2017). In terms of sales, the most recent USDA, National Agricultural Statistics Service's (NASS) Census of Agriculture shows fruits/vegetables and dairy lead in the organic sector, whereas grains/oilseeds and beef cattle/feedlots still lead in the top sectors in agriculture overall (figure 3.2).[2] Even though fruit and vegetable sales represented about 40 percent of organic farm sales in 2019, fruit and vegetables harvested acreage were only 11 percent of total organic crop acres in 2019 (see appendix D).[3] This is due to the higher per-acre value of crops for fruits and vegetables, compared with field crops for both organic and conventional agriculture.

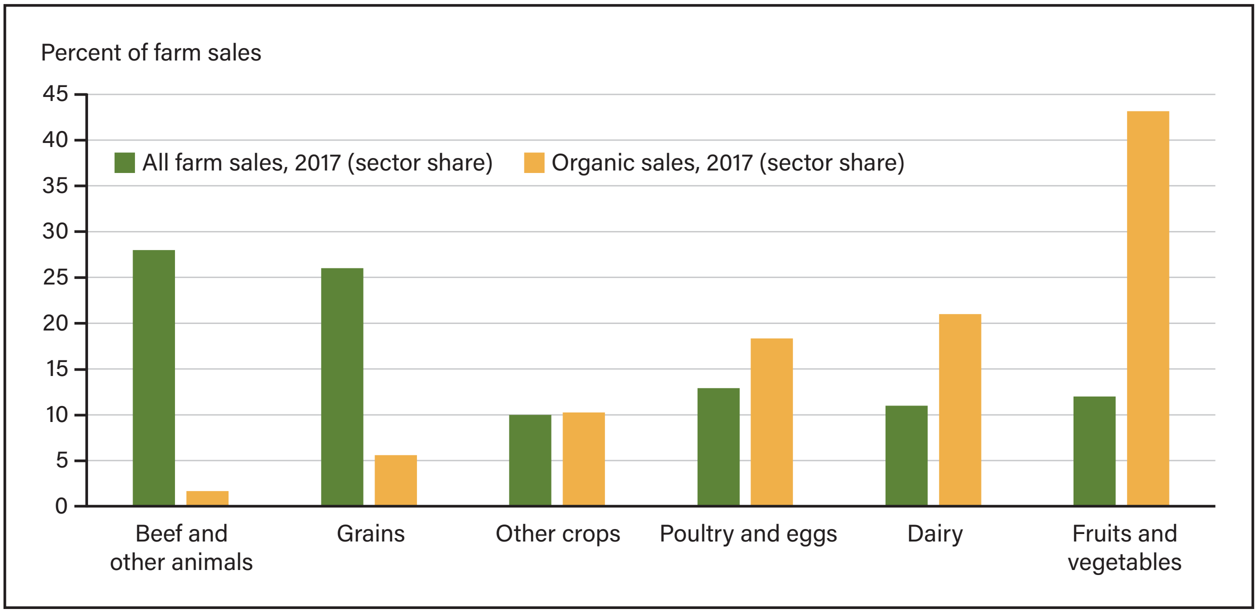
Adoption of organic systems for U.S. grain and oilseed production has lagged for multiple reasons. Organic grain markets in the early- and mid-1990s were mostly for food, and organic farmers may have been reluctant to switch to the organic feed grain markets that emerged later because of their lower prices (Revoredo, 2004). In USDA's national surveys of organic grain farmers between 2006 and 2010, farmers indicated that

[2] For more information on the overall agriculture production and prices, please see USDA, ERS web page "Agricultural Production and Prices."

[3] Organic acers for crops are reported in harvested acers, which do not include floriculture crops, nursery crops, mushrooms, cultivated Christmas trees, maple syrup, vegetables, and herbs under protection. Total organic cropland in 2019 totaled 3,517,051 acres.

achieving effective weed control and the processes involved with organic certification were their two top challenges. Organic grain producers may also have additional challenges such as access to storage facilities, transportation to processors, and sluggish markets for their rotation crops (McBride and Greene, 2015).

Figure 3.2
**Organic and all farm sales by sector**




Note: Other animals include hogs, sheep, goats, and other livestock.

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

Although organic price premiums typically make organic grain production more profitable[4] than conventional grain production, the 3-year transition period is marked by lower yields and higher costs while organic prices cannot be claimed.[5] The Agricultural Resource Management Survey (ARMS), USDA's major annual economic survey of producers, included national organic oversamples between 2006 and 2010 as part of the U.S. soybean, wheat, and corn commodity surveys (see appendix B for more information on ARMS). The surveys found, on average, the yields for organic corn, wheat, and soybeans were 27 percent, 32 percent, and 34 percent lower, respectively, than for their conventional counterparts during the 2006–10 study period (McBride et al., 2015). Findings from long-term organic cropping-system trials suggest organic yield performance may improve overall with increased managerial experience and timely weed management (Delate et al., 2015).

A large portion of grains and oilseed production is for animal feed and industrial uses, which usually receive lower prices than food crops, making it more difficult for grain and oilseed producers to navigate the 3-year transition period. Delbridge et al. (2017) identified several additional factors that may complicate organic transition for grain and oilseed farmers. These include scarce technical assistance for organic production methods; limited organic grain elevators and other critical pieces of physical infrastructure; limited data on organic crop prices, along with market uncertainty; cultural pressure from neighbors to not go organic; and

[4] Profit is defined as the total returns minus the economic costs.

[5] Between 2006 and 2010, USDA included national organic oversamples in the Agricultural Resource Management Survey (ARMS), USDA's major annual economic survey of producers, as part of the U.S. soybean, wheat, and corn commodity surveys. USDA's Economic Research Service used ARMS data to calculate estimates of production costs and returns for both organic and conventional production systems (see appendix B for more information on ARMS).

policy obstacles in USDA farm support programs that are tailored to conventional production (Delbridge et al., 2017). Different groups of farmers vary in their perspective on resource and funding obstacles, depending on whether they have successfully transitioned, are in the midst of transitioning, have both organic and nonorganic operations, or have changed their mind about having an organic operation (Stephenson et al., 2017).

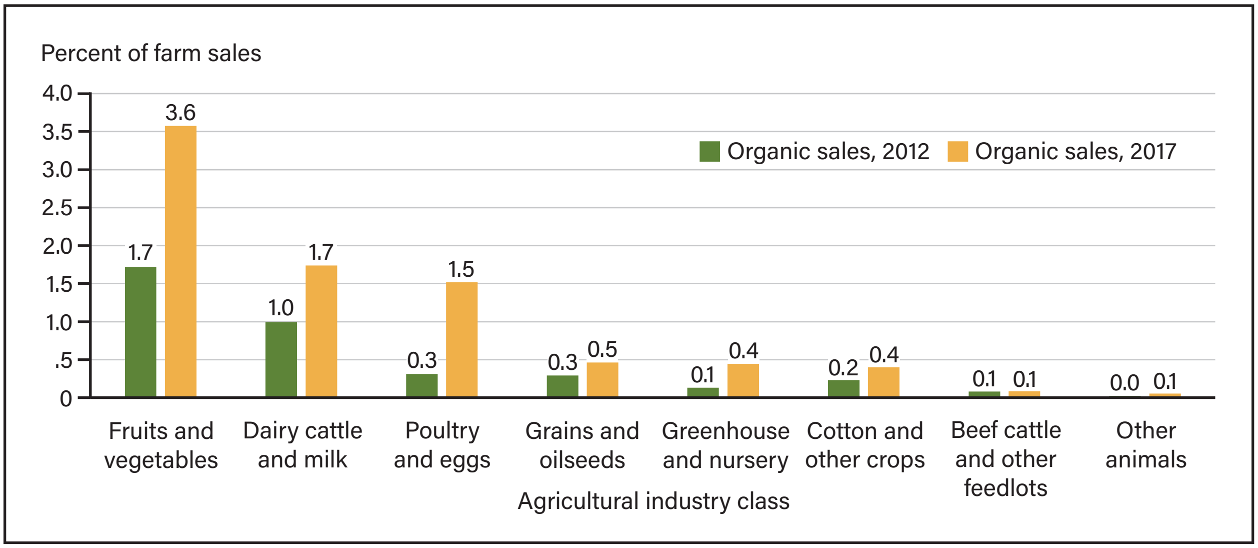
To support farmers through the transition period, USDA has increased funding on extension education and research through the USDA, National Institute of Food and Agriculture (NIFA) grants programs[6] and expanded USDA, National Resources Conservation Service (NRCS) technical expertise and conservation planning programs for organic farmers, ranchers, and forest landowners. Some food companies are setting up programs to aid farmers during the transition in order to increase domestic organic production. The most common types of support focus on reducing technical barriers to organic farming and providing advice to transitioning farmers on the organic standards and organic farming practices (Dimitri and Baron, 2019). For example, Clif Bar & Company organized a fund to offer technical assistance, onfarm instruction, assessment and mapping of organic storage and processing capacity, and cost-share or transition price premiums with long-term purchasing contracts (Dillon, 2019). Kashi partnered with an organic certifier to create a Certified Transitional label to support farmers with crop premiums during their 3-year transition period to organic certification (Kashi, 2019; Quality Assurance International, 2019). Additionally, Annie's Homegrown, Inc. and Costco Wholesale Corporation offer farmers purchase contracts before they start the transition to organic production (Cernansky, 2018).

### *Organic Growth in Farm Sectors and Regions*

Although organic farming systems were used on less than 1 percent of U.S. cropland in 2017, organic commodity sales accounted for 2.6 percent of all U.S. farm sales (USDA, NASS, 2019; USDA NASS, 2020). This discrepancy reflects the prevalence of high-value crop and livestock production specialties in the organic sector and the price premiums paid for organic commodities. U.S. organic commodity sales gained momentum between 2007 and 2017, with overall organic sales increasing by 65 percent after adjusting for inflation during the first 5-year period (2007–12) and overall organic sales increasing more than 118 percent after adjusting for inflation during the second period (2012–2017). After adjusting for inflation, organic poultry and egg sales more than quadrupled between 2012 and 2017, substantially outpacing growth for grains and oilseeds (figure 3.3). The top three sectors—fruit and vegetables, dairy, and poultry and eggs—accounted for 83 percent of total organic sales in 2017. Organic grain and oilseed sales doubled during this period but still only accounted for 6 percent of total organic commodity sales. Sales in the high-value greenhouse and nursery sector tripled, whereas growth in beef/feedlots and other animals was negligible (figure 3.3).

[6] USDA supports research on organic transition through the Organic Transitions and other grant programs (see the Chapter 2 section titled "USDA Extramural Organic Research" under "Expansion of Organic Research and Promotion") and published a report on strategies for dealing with production and marketing challenges during transition (DiGiacomo, 2015).

Figure 3.3
**U.S. organic sales, 2012 and 2017**




Note: Inflation adjusted using the Consumer Price Index for all Urban Consumers (CPI-U). "Other animals" include hogs, sheep, goats, and other livestock.

Source: USDA, Economic Research Service using USDA, National Agricultural Statistics Service, 2012 and 2017 Census of Agriculture data.

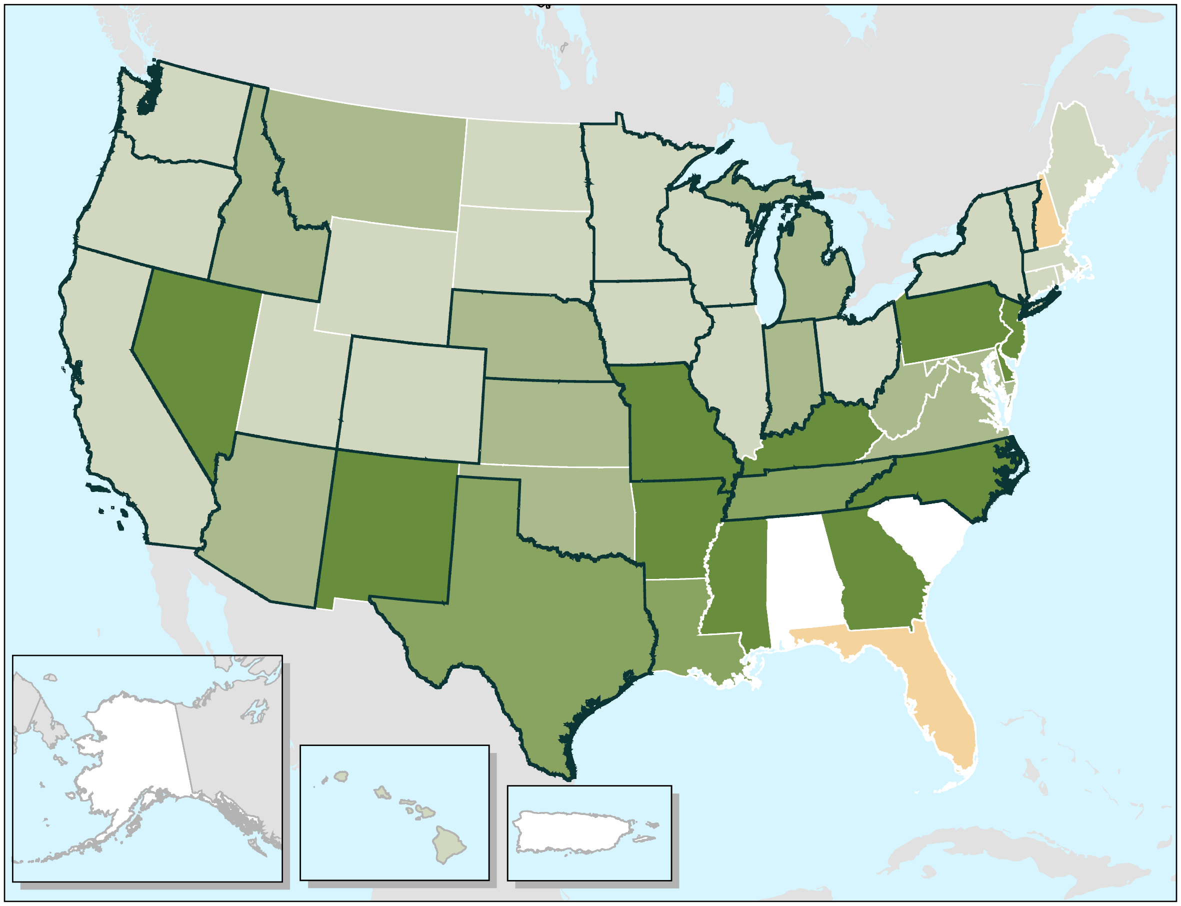
Figure 3.4 shows the changes in organic commodity sales by State between 2012 and 2019,[7] after adjusting for inflation, organic sales for the States with more than 100 million dollars in organic agriculture sales, and the organic share of total agricultural sales in those States. After adjusting for inflation, organic sales increased in most States during the 2012–2019 period, with sales more than doubling in 39 States. States with the highest percent increase tended to be States with lower sales in 2012, particularly states in the South where weeds and pests thrive in the hot humid climate.

[7] The 2012 data are derived from the USDA, NASS, 2012 Census of Agriculture, while the 2019 numbers are from the 2019 Organic Survey which only includes certified and transitioning operations. To make the comparison, we subtracted the exempt sales from the 2012 reported organic sales in the USDA, NASS, 2012 Census of Agriculture. Exempt sales were obtained through a special tabulation from the USDA, NASS, 2012 Census of Agriculture. We compare these numbers with the 2019 certified organic sales.

Figure 3.4

**Inflation-adjusted percent growth in organic sales, 2012–2019; 19 States (outlined) reached at least $100 million (inflation adjusted to 2021 dollars) in organic sales in 2019**

Percent change in organic sales, 2012–2019




| State | Total value of organic sales (billion 2021 dollars) | Organic share of total agricultural sales (2017) |
|---|---|---|
| United States | 10.8 | 1.9 |
| California | 3.9 | 6.3 |
| Washington | 9.7 | 7.9 |
| Pennsylvania | 8.1 | 9.1 |
| Oregon | 5.0 | 5.5 |
| Texas | 4.6 | 1.2 |
| North Carolina | 4.0 | 1.0 |
| New York | 3.3 | 3.8 |
| Wisconsin | 2.9 | 2.2 |
| Michigan | 2.5 | 2.1 |
| Idaho | 2.2 | 1.7 |
| Arizona | 2.2 | 2.5 |
| Nebraska | 2.0 | 0.3 |
| Colorado | 2.0 | 1.8 |
| Indiana | 2.0 | 0.7 |

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| State | Total value of organic sales (billion 2021 dollars) | Organic share of total agricultural sales (2017) |
|---|---|---|
| Vermont | 1.7 | 15.1 |
| Iowa | 1.6 | 0.3 |
| Ohio | 1.3 | 1.1 |
| Missouri | 1.2 | 0.6 |
| Minnesota | 1.2 | 0.6 |

Note: After adjusting for inflation to 2021 dollars, low values of sales in 2012 for these States (less than $950,000 for Arkansas, $250,000 for Delaware, and $83,000 for Mississippi) led to percent increases of about 6,000 percent for Arkansas and Delaware and nearly 40,000 percent for Mississippi. Organic share of total agriculture sales is based on organic and total agriculture sales in 2017, the most recent data available for total agriculture sales. All sales are adjusted to 2021 dollars using the Consumer Price Index for all Urban Consumers (CPI-U) before deriving percent increases and share of sales.

Source: USDA, Economic Research Service using USDA, National Agricultural Statistics Service (NASS), 2012 and 2017 Census of Agriculture data; USDA, NASS, 2019 Organic Survey; USDA, NASS, 2017 Census of Agriculture Special Study; and USDA, NASS, 2012 Organic sales used to calculate the percent difference only include the certified sales. Exempt sales for 2012 were optioned through a special tabulation from the 2012 Census of Agriculture.

California, the United States' largest farm State in terms of sales—and the largest producer of fruits, vegetables, and dairy products—is also the largest organic producer by sales and acreage. After adjusting for inflation, organic sales in California increased by nearly 140 percent between 2012 and 2019 to $3.9 billion and accounted for 36 percent of organic commodity sales nationwide (figure 3.4). Washington was the United States' second largest organic producer in 2019. Washington's organic sales increased 173 percent during the 2012–2019 period to $966 million (inflation adjusted to 2021 dollars). Pennsylvania—which has a diverse farm sector located near major metropolitan areas—was the third largest organic production State in 2019. Between 2012–2019 organic sales increased more than eightfold in Pennsylvania to $909 million (inflation adjusted to 2021 dollars) in 2019, and the State expanded the organic development programs with the goal of expanding organic agriculture (Pennsylvania Department of Agriculture, 2019). Among the top organic States in 2017, the highest organic shares of total State agricultural sales were in Vermont (15 percent), Pennsylvania (9 percent), Washington (8 percent), and California and Oregon (6 percent) (figure 3.4).

Table 3.1 illustrates U.S. organic sales increased 118 percent between 2012 and 2017 after controlling for inflation, while overall U.S. agricultural sales declined by 8 percent after controlling for inflation. Every crop region in the United States had positive growth in organic sales during this period, and after adjusting for inflation, organic sales more than doubled in every region except in the southeast and the northern plains regions.

The Pacific, northwest, and the northeast regions had the highest organic sales in 2017 and the highest shares of total agricultural sales at 6.2 percent, 7.1 percent, and 5.7 percent, respectively. These three regions have the longest history of third-party organic certification (Greene, 2001). In addition, these regions illustrate the substantial differences in farm size and organization in the U.S. organic sector. The northeast has a large share of smaller scale, more diversified farms, whereas the Pacific and northwest regions have a large share of large and very-large family and nonfamily farms. These three regions stood out in a recent study that identified spatial clusters with high levels of organic production or "hotspots." This recent study found that counties in organic hotspots had higher median household income and lower poverty rates (Marasteanu and Jaenicke, 2016).

Table 3.1
**Regional trends in U.S. total and organic agricultural sales, 2012–2017**

| United States and region | U.S. agricultural sales, 2017 | Organic sales, 2017 | U.S. agriculture sales, change 2012–2017 | Organic sales, change 2012–2017 | Organic sales/ total sales (2012) | Organic sales/total sales (2017) |
|---|---|---|---|---|---|---|
| | Thousand 2021 dollars | Thousand 2021 dollars | Percent | Percent | Percent | Percent |
| United States | 441,909,695 | 8,277,332 | (8) | 118 | 0.8 | 1.9 |
| Appalachia | 27,152,308 | 187,588 | 5 | 423 | 0.1 | 0.7 |
| Corn Belt | 76,940,925 | 396,383 | (2) | 123 | 0.2 | 0.5 |
| Delta | 19,020,106 | 42,888 | (5) | 1,199 | 0.0 | 0.2 |
| Lake States | 38,043,748 | 526,005 | (9) | 117 | 0.6 | 1.4 |
| Mountain | 28,990,596 | 486,443 | (5) | 112 | 0.8 | 1.7 |
| Northeast | 23,787,620 | 1,352,702 | (3) | 255 | 1.7 | 5.7 |
| Northwest | 14,641,283 | 1,036,991 | 5 | 113 | 3.5 | 7.1 |
| Northern Plains | 58,721,780 | 130,001 | (6) | 57 | 0.1 | 0.2 |
| Pacific | 45,788,621 | 2,848,003 | 6 | 109 | 3.1 | 6.2 |
| Southeast | 25,919,929 | 124,006 | 1 | 39 | 0.3 | 0.5 |
| Southern Plains | 32,389,553 | 304,664 | (0) | 311 | 0.2 | 0.9 |

Note: Parentheses "( )" indicate a negative percent change. Northeast = CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, and VT; Appalachia = KY, NC, TN, VA, and WV; Southeast = AL, FL, GA, and SC; Lake States = MI, MN, and WI; Corn Belt = IL, IN, IA, MO, and OH; Delta = AR, LA, and MS; Northern Plains = KS, ND, NE, and SD; Southern Plains = OK and TX; Mountain = AZ, CO, ID, MT, NM, NV, UT, and WY; Northwest = OR and WA; Pacific = AL, CA, HI. Inflation adjusted using the Consumer Price Index for all Urban Consumers (CPI-U).

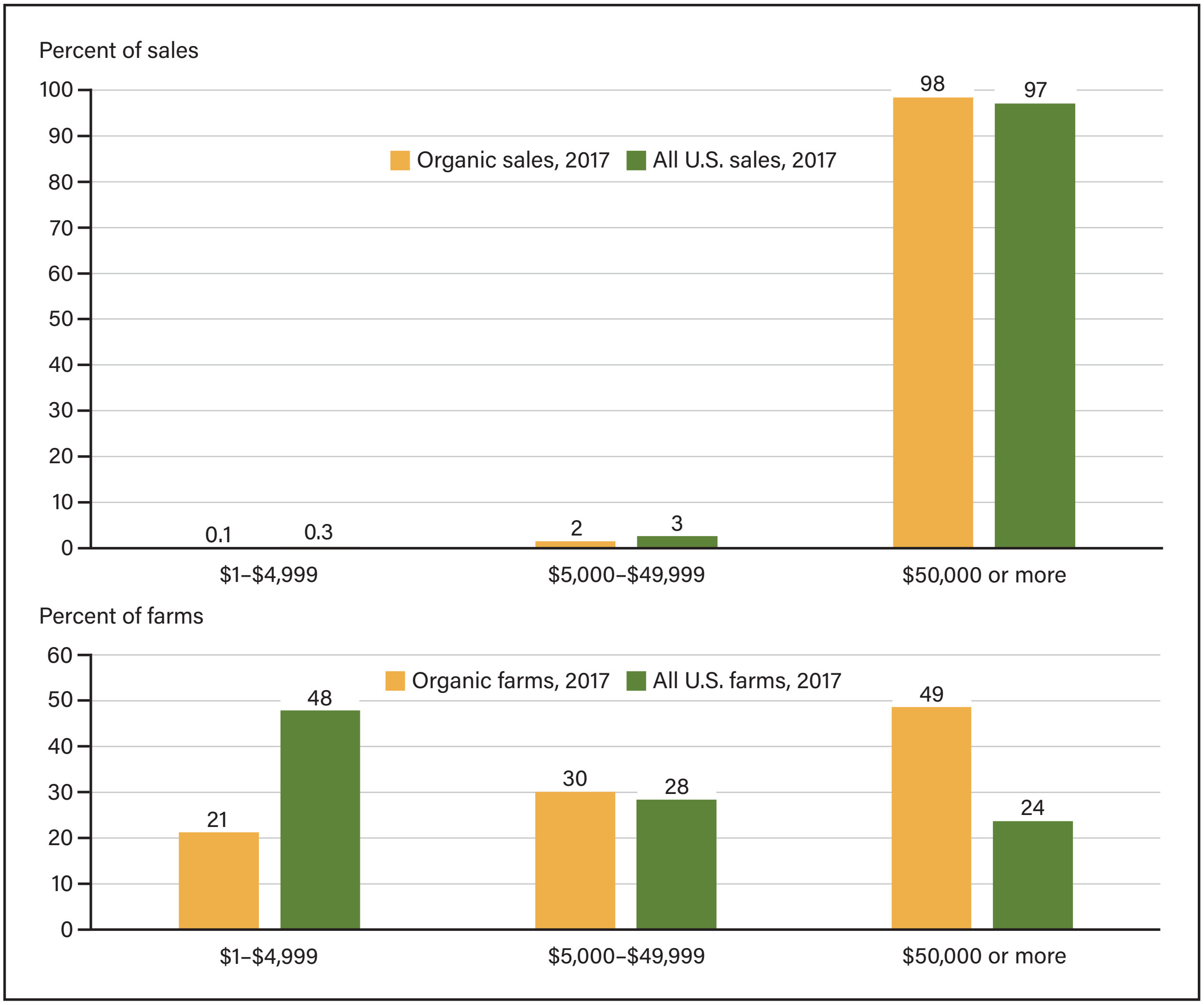
Source: USDA, Economic Research Service using USDA, National Agricultural Statistics Service, 2012 and 2017 Census of Agriculture data.

## *Organic Farms: Sales, Income, and Years of Operation*

The United States had over 18,000 organic farms in 2017, and nearly half had $50,000 or more in organic sales that year. These farms accounted for more than 98 percent of total organic sales in 2017 (figure 3.5). About 20 percent of U.S. organic farms had under $5,000 in organic sales in 2017—the cutoff to qualify for an exemption from the organic certification requirement. In contrast, nearly half of all farms in the United States had less than $5,000 in agricultural sales in 2017, and only about a quarter of all U.S. farms had at least $50,000 in agricultural sales (figure 3.5).[8]

[8] USDA, ERS classifies almost half of farms in the United States as "retirement" or off-farm occupation (Whitt et al., 2020). The proportion of organic farms in these classes is not readily measured from currently available data.

Figure 3.5
**Share of total U.S. and organic farm sales and number of farms by size**




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

According to the 2017 Census of Agriculture, about 3.9 percent of all U.S. farms had at least $1 million in the market value of agricultural products sold in 2017, and those farms accounted for 69.3 percent of the total value of agricultural products sold. The organic sector is too small for USDA to report the number of organic farms with at least a million dollars in organic sales, but the organic sector may follow a similar pattern to the sales concentration in larger farms. Very large farms in the United States, measured by sales, are more likely to specialize in fruit and vegetable crops, dairy, and egg production, rather than—for instance—corn and soybeans (MacDonald et al., 2018).[9] These high-value specialty crops also account for a higher proportion of sales in the organic sector than in the conventional sector.

In 2017, average organic farm sales were higher than average farm sales. According to the 2017 Census of Agriculture, the average organic farm sales for farms with over $50,000 in sales was $811,000 per farm, whereas overall average farm sales for farms with sales over $50,000 was $761,000. However, in 2007, the

[9] Numbers in the report by MacDonald et al. (2018) do not directly align with the Census of Agriculture because USDA, ERS estimates farm sales as gross cash farm income (GCFI), which includes Government farm program payments and only the amount the farm receives for contract production. In contrast, the Census of Agriculture reports the value of agriculture products sold, which does not include the Government farm program payments and includes the total value of the product, not just the contract income to the farm.

reverse was true: Organic farms with over $50,000 in sales averaged $383,000 compared with $591,000 for all farms of this size. In most crop and livestock sectors, organic production grew more than the number of producers between 2007 and 2017 as farmers with larger operations entered the organic market and certified producers transitioned additional fields into organic production. Farmers often stagger the timing of transitioning fields to organic production because some fields may be eligible for organic certification sooner than others, as well as to gain expertise in organic farming.

USDA's most recent report on organic farm income indicates that U.S. farms with organic sales had higher production costs, higher total sales, and higher net cash income than all farms in 2017 (USDA, NASS, 2019). Organic sales accounted for 50 percent or more of total sales on over half of farms (73 percent) with certified organic operations in 2017. Average net cash farm income was $142,865 on these farms, compared with $43,053 on all farms (USDA, NASS, 2019).

On average, organic farmers are younger and more likely to be primarily employed in farming (table 3.2), partly because organic farming requires more labor than conventional farming (McBride et al., 2015; McBride et al., 2009). In 2017, data on up-to-four principal operators were collected for the first time—data were only collected for a single principal operator before 2017. This data collection indicated a higher proportion of organic operations had a female principal operator. Organic farmers are also much more likely to reside on their farm operation.

Table 3.2

**Characteristics of farm operators in 2007 and 2017, by organic status**

| | Organic farms | | All farms | |
|---|---|---|---|---|
| | 2007 | 2017 | 2007 | 2017 |
| | (percent) | (percent) | (percent) | (percent) |
| Primary occupation is farming | 60 | 64 | 45 | 42 |
| Farm is primary residence | 84 | 75 | 23 | 28 |
| Principal producers who are female[1] | 22 | 37 | 13 | 30 |
| Under 10 years on present farm | 36 | 39 | 27 | 26 |
| Average age | 53 | 51 | 57 | 57 |

[1]Data collected for up-to-four principal producers in 2017, but data were collected for only one in 2007 and 2012.

Source: USDA, Economic Research Service using USDA, National Agricultural Statistics Service, 2007 and 2017 Agricultural Resource Management Survey data.

### *Soil Health Practices Widely Used, but Specialized Equipment Has Limited Availability*

USDA organic regulations require a mix of cultural, biological, and mechanical practices to be used in organic production, distinguishing organic production systems from those in conventional agriculture, which have additional tools such as synthetic fertilizers, pesticides, and genetically engineered seeds. Approved organic practices include cover crops (crops planted for covering the soil rather than for harvesting), complex crop rotations, biological pest management, and rotational grazing—practices that are widely used in organic farming. In some regions and crops—especially specialty crops—practices such as crop rotation and biological pest management are also used by conventional farmers.

Organic crop and livestock producers are five times more likely than conventional producers to plant a cover crop, which helps reduce soil erosion and nutrient runoff, increases soil nutrients, and provides an opportunity for implementing rotational grazing, which can help forage plants to renew energy reserves, rebuild vigor, and deepen their root systems when livestock are grazing in another pasture (Hellerstein et al., 2019; McBride and Greene, 2009). A recent meta-analysis comparing organic and conventional cropping systems in Europe and North America found organic crop rotations are 15 percent longer, resulting in higher crop diversity and more even crop-species distribution (Barbieri, 2019).

The mix of equipment and facilities used in organic farming also differs from that used in the overall agricultural sector. Organic farmers may have different equipment for weed control or spreading manure, as well as a different farm layout and facilities to provide livestock access to the outdoors and pastures. Some of the specialized equipment used in organic farming—such as roller-crimper tractor attachments for terminating cover crops in no-till organic cropping systems—still has limited commercial availability.

## Agronomic and Environmental Characteristics of Organic Production

Since 2000, considerable scientific literature has emerged comparing the agronomic and environmental characteristics of organic and conventional production systems. Studies have examined changes in soil organic matter, soil carbon, and crop yields over time, and other key characteristics of these systems. Many of the key findings are based on research conducted in long-term farming experiments comparing organic and conventional field crop production (see appendix C, "Research Findings: Agronomic and Environmental Characteristics of Organic Production," for an extensive synthesis of the literature and specific citations).

Long-term farming experiments are critical for evaluating the sustainability of all agricultural systems because soil organic carbon (SOC)—the amount of carbon in soil organic matter—and other sustainability indicators change slowly over time. Furthermore, other indicators—such as crop yields and soil erosion—have high interannual variability. In addition to USDA-led projects in Maryland and the Rodale Institute's project in Pennsylvania, U.S. public universities are conducting long-term farming experiments that include both conventional and organic trials in California, Iowa, Michigan, Minnesota, New York, North Carolina, Ohio, and Wisconsin (see appendix C and table C.1).

Some agricultural production inputs, particularly synthetic pesticides, have been implicated in negative environmental effects. Since synthetic pesticides, fertilizers, and other inputs are largely restricted in organic farming, organic agriculture is commonly viewed as a means of improving agricultural sustainability. The perception that organic farming is better for the environment than conventional farming is an important reason why some consumers purchase organic products. However, assessing organic farming's potential to contribute to global agricultural and environmental sustainability is complex. One key piece of this complexity is that crop yields in organic systems are, on average, lower than in conventional systems. The environmental impacts of organic farming are often lower per unit of land, although not necessarily per unit of production. Assessments based on land area are helpful to assess overall impacts of agriculture while assessments on a production unit basis integrate tradeoffs, if any, between agricultural production and environmental harms.

USDA has defined organic production as systems that integrate farming practices to foster resource recycling, promote ecological balance, and conserve biodiversity. Some studies have found organic farming increases biodiversity compared with conventional farming, although the extent of those increases varies for different plant and animal groups. Some of the reasons diversity may be greater include the wider use of plant residues and/or manure in organic compared with conventional farming, as well as the use of fewer and often less toxic (to humans) pesticides in organic systems.

Although natural substances are generally allowed, USDA regulations prohibit the use of nearly all synthetic pesticides in organic production. Comprehensive USDA surveys of U.S. field crop production show almost all organic producers do not use pesticides—natural or synthetic—in organic production of corn, soybeans, and wheat, the top three U.S. crops (Greene et al., 2016).[10] Although it is difficult to generalize about the effects of specific pesticides because of their diversity and use in complex combinations, the environmental impacts of some pesticides used in conventional farming have been well-studied and impacts include groundwater and surface water contamination by some pesticides. Another commonly addressed environmental impact of agriculture is the maintenance or increase of soil organic matter (SOM), particularly as a means of carbon sequestration. Again, many factors are involved such as the amount of organic matter added to the soil and the amount of tillage and results differ across regions and crops but—as discussed in appendix C—several studies have shown organic farming results in greater soil organic carbon and soil quality than conventional farming.

## Organic Commodity Markets and Trade

Trade plays an important role in meeting U.S. consumer demands for various organic products and in providing markets for U.S.-produced organic products.[11] Although the total value of U.S. organic trade is unknown, the United States began tracking organic imports and exports in 2011. Currently, agricultural organic products that have a unique harmonized export trade code are mostly fresh fruits and vegetables, whereas the set of tracked U.S. organic imports is broader. The number of organic import and export codes is small compared with overall tracked codes but continues to expand. Tracked organic imports include horticultural products—tropical fruit and vegetables have the highest value—other tropical products such as coffee, olive oil, and cane sugar, and food and feed grains (figure 3.6). The top organic imports are tropical products such as bananas,[12] coffee, and olive oil, which are not widely produced in the United States because of their limited growing conditions and produce items such as blueberries and apples that are used to extend the fresh season. The tracked value of U.S. organic trade has increased since 2011, but much of the increase has reflected the value of new products added to the USDA's set of products being tracked since 2011. While some commodities had substantial growth in import amounts, like blueberries, others grew moderately since 2011. For example, imports of organic rice ranged from $22 to $42 million (inflation adjusted to 2021 dollars)[13] between 2011 and 2021, while imports of cultivated blueberries increased from $3.6 million in 2011 to $415 million in 2021 (inflation adjusted to 2021 dollars).

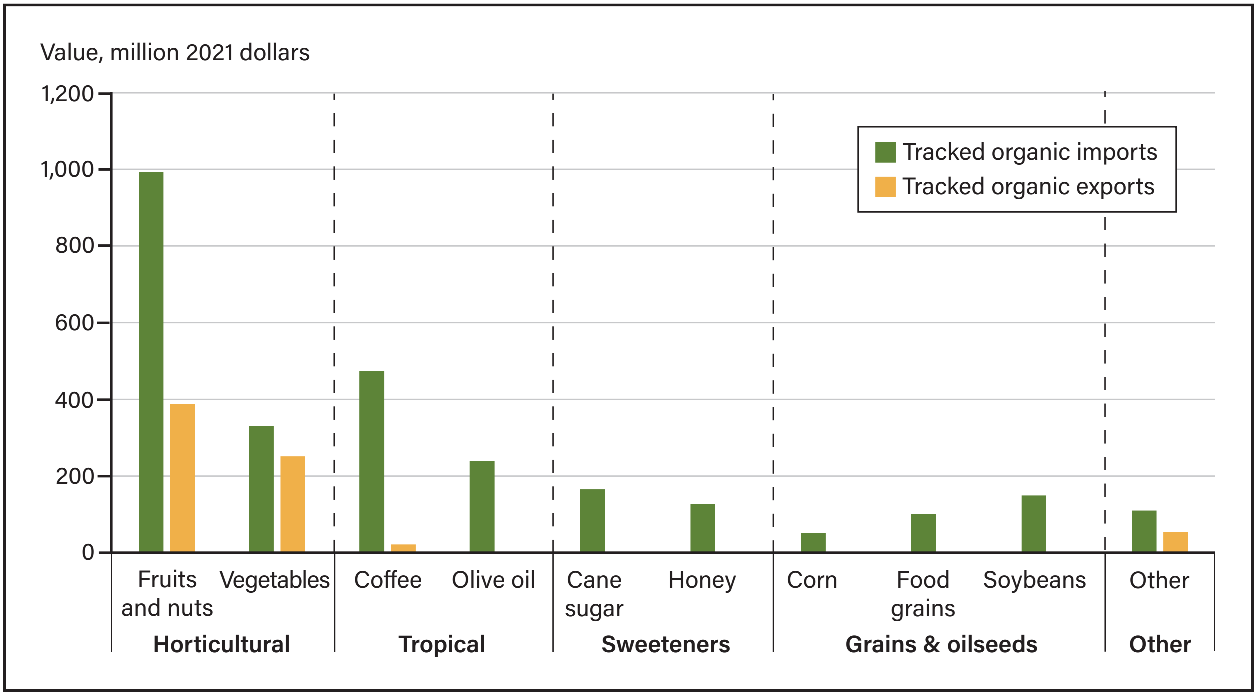
[10] Greene et al. (2016) summarized USDA, NASS, 2006 and 2010 ARMS data (most currently available organic corn, soybeans, and wheat) and there is reported use of Beauveria and Trichoderma Harzianumm in one State, but reported use is too small to report the rate or acres treated.

[11] Organic imports must be certified by USDA organic standards or by an authorized international standard to be sold as organic in the United States. USDA has worked with multiple foreign governments to establish international trade arrangements that allow U.S. organic products to be bought and sold as organic without additional certification, facilitating trade by lowering administrative and other costs.

[12] Tropical fruits such as bananas are included in the category "Horticultural" in figure 3.6.

[13] Inflation adjustment using the CPI-U.

Figure 3.6
**Tracked U.S. organic exports in 2021**




Note: Other imports include wine and tea whereas other exports include tomato sauce, milk, and vinegar.

Source: USDA, Economic Research Service based USDA, Foreign Agricultural Service data; and the U.S. Department of Commerce, Bureau of the Census data.

Although cattle raising is the largest animal sector in U.S. agriculture (USDA, NASS, 2017b), it continues to be a very small part of the organic animal products market. USDA prohibited the use of an organic label throughout the 1990s, leading to the popularity of beef being labeled as "natural" (Greene, 2001). Even though the natural label is neither precisely defined nor regulated, consumers may have retained loyalty to this label (Kuchler et al., 2020).

## *U.S. Organic Fruit and Vegetable Markets*

U.S. organic fruit and vegetable markets have experienced significant market expansion over the last two decades. Between 2008 and 2019, more than 1,000 new fruit and vegetable farms entered the organic sector. Harvested organic fruit acreage expanded by more than 60 percent (see appendix table D.2). The value of U.S. organic fruit[14] and vegetable sales increased more than the number of organic farms and acres during this period. After adjusting for inflation, organic fruit sales increased by 225 percent to $2.2 billion (inflation adjusted to 2021 dollars) and vegetable sales increased by 156 percent to $2.3 billion (inflation adjusted to 2021 dollars). Apples are the highest valued U.S. organic fruit crop. In 2019, U.S. growers had over $517 million (inflation adjusted to 2021 dollars) in organic apples sales, accounting for nearly 22 percent of total organic fruit and nut sales, 16 percent of total apple sales value, and almost 30 percent of total apple acreage.[15] Other top organic fruit and nuts crops (in value) were strawberries, grapes, blueberries, and almonds in 2019 (see appendix D and table D.2).

[14] In this chapter, total fruit figures include tree nuts and berries.

[15] USDA, NASS organic fruit and nut surveys measure harvested acreage and value of sales. In contrast, USDA, NASS's conventional surveys measure bearing acreage (which may not be harvested) and value of production (which may not be sold that year), making the conventional estimates an upper bound of possible harvested acreage and value of sales.

The adoption of organic systems for fruit and vegetable production has increased at a much higher rate than in other organic sectors. In 1997, approximately a third of U.S. herbs and mixed vegetable crops—or several horticultural crops grown on a small parcel—and over 2 percent of apples, grapes, and lettuce crops were grown organically, while U.S. certified[16] organic acres represented about 0.2 percent of all U.S cropland overall (Greene, 2001). As in the organic fruit sector, the value of organic vegetable sales grew faster than the number of organic vegetable operations and acres. Organic fruit, tree nut, and berry sales totaled over $2 billion in 2019, after adjusting for inflation 34 percent higher than in 2016, and a 225-percent increase between 2008 and 2019 (see appendix D, "U.S. Certified Organic Operations, Harvested Acreage and Value, 2008–19"). The top U.S. organic vegetables were lettuce, tomatoes, potatoes, spinach, and sweet potatoes. Lettuce—a fresh-market vegetable typically sold whole or cut for salad mixes—accounted for 19 percent of all organic vegetable farm sales in 2019. After adjusting for inflation, the growth rate for lettuce sales grew 43 percent between 2008 and 2011, declined between 2011 and 2014, but grew 35 percent between 2016 and 2019, from $322 million to $436 million (inflation adjusted to 2021 dollars).

Organic vegetable and fruit operations are still heavily concentrated in California, which had more than 633 certified organic vegetables operations and over 2,600 organic fruit and tree nut operations in 2019. The gap in the number of vegetable operations between California and the next largest State is wide. Wisconsin ranks behind California with 311 organic farms with vegetables sales, followed by Washington with 208 farms.

### *Organic Fruit and Vegetable Farm-Level Price Premiums*

USDA has expanded reporting from a handful of organic produce items to over 250 since 2000. Organic price premiums for some widely traded organic fruits and vegetables averaged between 56 and 86 percent in the San Francisco wholesale market between 2015 and 2021 (table 3.3).[17] The coefficients of variation (CV)[18] indicated the organic wholesale price volatility for most items was similar to what was observed in the conventional market (table 3.3). The conventional iceberg lettuce, grape tomato, and cherry tomato markets showed higher volatility when compared with the organic markets. Premiums are variable from commodity to commodity. Premiums vary by packaging, marketing, variety (e.g., fuji apples versus granny smith apples), season, and year. During the period of observation, USDA, AMS terminal prices for fuji, gala, and granny smith apples at the San Francisco terminal market and packed in carton tray packs trended downward. Meanwhile, cherry tomatoes at the San Francisco terminal market in 12, 1-pint baskets trended upward during the period of observation.

[16] Since the national organic standards were not in place in 1997, certification here means certified by a State-level certification process or an independent certifier.

[17] Historical monthly wholesale price averages of organic and conventional produce items are available on the USDA Specialty Crops Market News website.

[18] The coefficients of variation are a statistical measure of volatility, calculated by taking the ratio of the standard deviation to the mean. Lower coefficients of variation signify lower volatility in the data.

Table 3.3
**Selected fruit and vegetable weekly prices, San Francisco Terminal Market, 2015–21**

| | Count | Mean price | Median price | Maximum price | Minimum price | Standard deviation | CV | Average premium (dollars) | Average premium (percent) |
|---|---|---|---|---|---|---|---|---|---|
| **Strawberries** (flats of 8 1-pound containers, with lids) | | | | | | | | 11.47 | 56.34 |
| Conventional | 239 | 20.36 | 18.04 | 46.58 | 9.67 | 7.43 | 0.37 | | |
| Organic | 239 | 31.83 | 29.44 | 63.50 | 15.00 | 11.47 | 0.36 | | |
| **Iceberg lettuce** (cartons) | | | | | | | | 12.94 | 60.88 |
| Conventional | 239 | 21.25 | 17.29 | 61.75 | 9.92 | 10.12 | 0.48 | | |
| Organic | 112 | 34.20 | 31.25 | 68.50 | 19.00 | 9.37 | 0.27 | | |
| **Grape tomatoes** (flats of 12 1-pint containers, with lids) | | | | | | | | 11.99 | 77.79 |
| Conventional | 239 | 15.42 | 14.25 | 36.13 | 8.25 | 4.77 | 0.31 | | |
| Organic | 222 | 27.41 | 27.67 | 42.38 | 13.75 | 6.35 | 0.23 | | |
| **Cherry tomatoes** (flats of 12 1-pint baskets) | | | | | | | | 17.42 | 85.81 |
| Conventional | 239 | 20.31 | 19.13 | 39.00 | 10.63 | 5.82 | 0.29 | | |
| Organic | 174 | 37.73 | 38.00 | 54.50 | 7.50 | 7.31 | 0.19 | | |
| **Fuji apples** (cartons, tray pack) | | | | | | | | 20.23 | 66.26 |
| Conventional | 239 | 30.52 | 30.78 | 42.50 | 15.89 | 4.46 | 0.15 | | |
| Organic | 185 | 50.75 | 49.00 | 100.00 | 30.00 | 10.15 | 0.20 | | |
| **Gala apples** (cartons, tray pack) | | | | | | | | 18.73 | 55.54 |
| Conventional | 239 | 33.71 | 33.50 | 49.30 | 23.50 | 4.78 | 0.14 | | |
| Organic | 150 | 52.44 | 50.50 | 93.67 | 36.50 | 9.78 | 0.19 | | |
| **Granny smith apples** (cartons, tray pack) | | | | | | | | 22.46 | 65.10 |
| Conventional | 239 | 34.50 | 33.91 | 70.50 | 22.78 | 7.59 | 0.22 | | |
| Organic | 165 | 56.96 | 56.00 | 91.25 | 39.00 | 10.39 | 0.18 | | |

Note: The coefficient of variation (CV) is a statistical measure of volatility, calculated by taking the ratio of the standard deviation to the mean. Lower coefficients of variation signify lower volatility in the data. Apples are packed in tray packed cartons, which are containers with pressed trays made with molded cups between layers. Lettuce is typically packed in cardboard cartons.

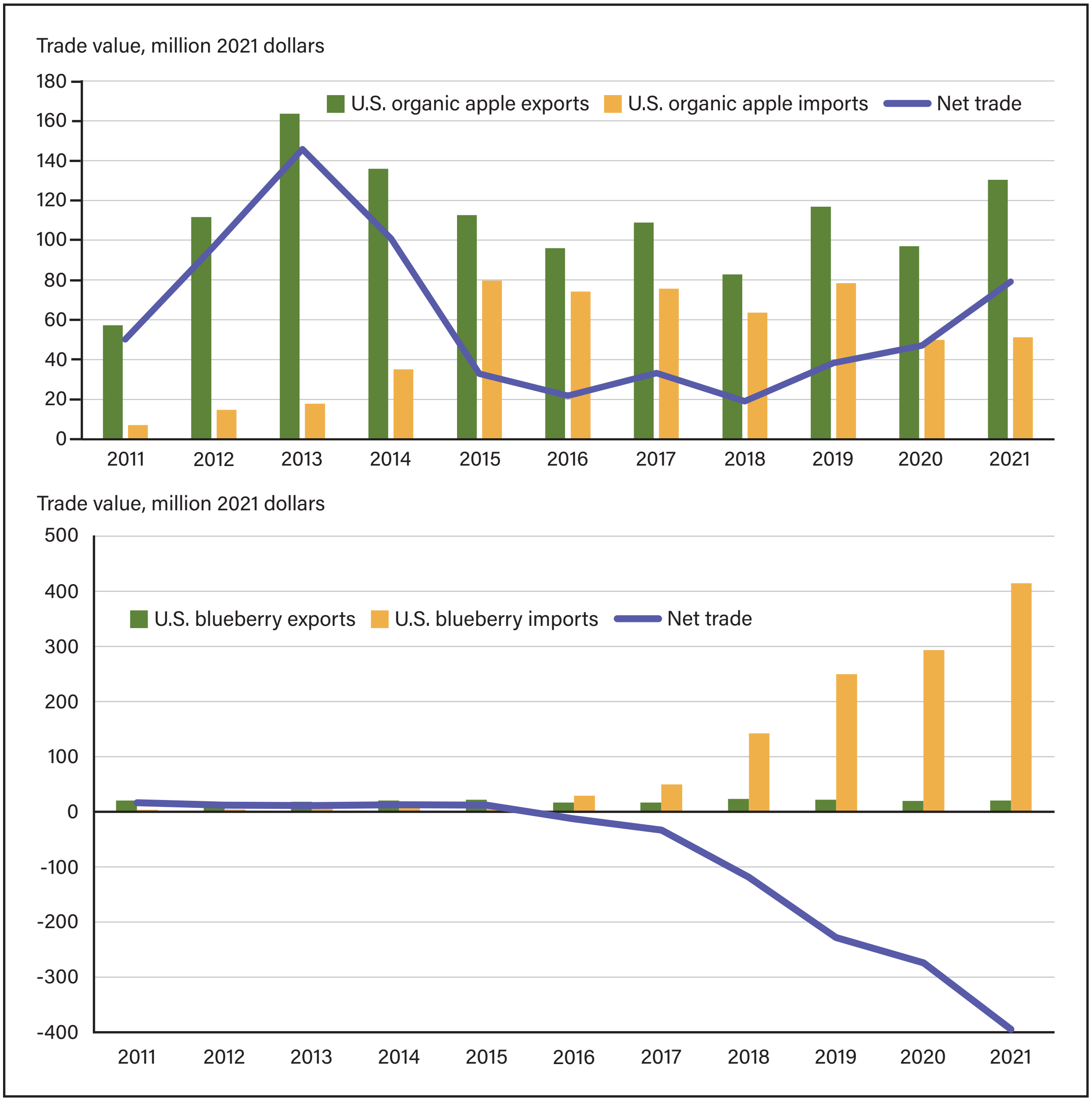
Source: USDA, Economic Research Service using data from USDA, Agricultural Marketing Service.

## *Produce in U.S. Organic Trade*

U.S. fruit and vegetable exports were valued at $567 million in 2020, accounting for more than 70 percent of tracked U.S. organic exports. The top three U.S. organic exports were apples, valued at $90 million in 2020, followed by grapes ($74 million), and nonhead lettuce ($68 million). U.S. organic produce imports were valued at nearly $1 billion (40 percent of tracked organic imports) in 2020—including bananas ($315 million), blueberries ($252 million), and avocados ($136 million). Mirroring the conventional sector, Canada and Mexico are the top destinations for U.S. organic produce exports, and Mexico is also the top organic produce supplier.

Apples, blueberries, and pears are the organic produce commodities for which the United States tracks both imports into the country and exports. Partly because of fast-growing domestic demand, most organic exports, including apples and blueberries, have been relatively flat since 2015. The U.S. apple sector has maintained a positive trade balance since 2011, while organic blueberry imports have substantially outpaced domestic blueberry production and exports (by value) since 2016 (figure 3.7). According to industry analysts, the recent increase in blueberry popularity is due to growing awareness of their health benefits and as a ready-to-eat snack (the broad changes in consumer demand for organic food are discussed in Chapter 4). Between 2011 and 2021 net trade in organic pears ranged from negative $3.3 million in 2015 to $20 million in 2012 (inflation adjusted to 2021 dollars). The net trade in 2021 was $6.9 million.

Figure 3.7
**Net trade for organic apples and blueberries**




Note: Adjusted for inflation using CPI-U 2021 (Consumer Price Index for all Urban Consumers, 2022) annual average.

Source: USDA, Economic Research Service using USDA, Foreign Agriculture Service data; and U.S. Department of Commerce, Bureau of the Census data.

## *U.S. Organic Grain Markets*

U.S. organic grain and oilseed markets have expanded more slowly than other sectors over the last two decades. For example, while organic corn for grain sales grew by 150 percent and organic soybeans sales grew by 117 percent between 2008 and 2019, U.S. organic vegetable and fruit sales increased 204 and 286 percent, respectively; organic poultry and eggs were up 500 percent; and organic cow's milk sales rose 111 percent (see appendix D, "U.S. Certified Organic Operations, Harvested Acreage and Value, 2008–19"). More than 9,000 operations—mostly in the West, Midwest, and Texas—harvested 2.3 million acres of organic field crops in 2019. Although the northeast region has smaller scale farms than these regions and less organic field crop acreage, field crops were an important component of the organic crop mix in northeast States, especially New York.

Winter wheat (275,000 acres) and corn (320,000 acres) had the highest organic field crop acreage in 2019. Although organic field crops are also grown for human consumption, a large segment of the market is intended for compound feed production. The organic crops typically grown for feed include barley, corn, oats, and soybeans. Feed crops are processed and sold to livestock producers, in response to demand derived from the organic eggs, dairy, and meat industries.

Farmers perceive growing organic crops as inherently riskier than farming conventionally, both in terms of production and marketing (Hanson et al., 2004). Such perceived risk is in part due to low level presence (LLP) of genetically engineered material, which may occur via cross pollination with sexually compatible, genetically engineered volunteers or crops in neighboring operations, or via physical comingling of organic products with genetically engineered products. While most U.S. fruit and vegetable crops are not genetically engineered, most U.S. canola, corn, cotton, and soybean crops are. As predominately self-pollinated crops, risk of cross pollination is low in soybeans (Kim et al., 2019) and cotton (Heuberger et al., 2010). However, canola (Mikhaylova et al., 2018) and corn (Bannert et al., 2008) are wind pollinated and thus present an increased risk for cross pollination, with frequency dependent on weather, crop varieties, isolation measures, and other factors.

While LLP would not cause a grower to lose organic certification, farmers can potentially lose their organic premium when the buyer tests their crop. For this reason, growers typically take precautions to avoid LLP. Some of the added precautions provide additional benefits. For example, farmers may clean equipment between fields to both reduce physical commingling and reduce spread of pests. Growers may use buffer strips to reduce both pollen and pesticide drift from adjacent fields and aid in nutrient recycling (Greene et al., 2016), though such measures can be costly. Other methods include planting late in the season, which can reduce yields (Greene et al., 2016), choosing crop varieties that are sexually incompatible with neighboring crops (González et al., 2012), and purchasing seed that is free from genetically engineered content. Such isolation methods are used for other purposes as well, such as preventing cross pollination in popcorn, sweet corn, and field corn, particularly for seed production.

### *Organic Grain and Oilseed Farm-Level Price Premiums*

The higher production costs associated with the transition to organic production necessitates higher prices relative to conventional crops (table 3.4). Organic buyers must offer a premium over the prices of their conventional counterparts to incentivize growers' stable production of organic crops and attract new growers into the market. The USDA national organic cash grain data show organic feed grain and oilseed prices are higher than their conventional counterparts, and organic food grain prices are higher than organic feed prices. Organic feed-grade corn and soybeans averaged 126 percent and 98 percent higher—respectively—than their conventional counterparts between 2011 and 2021, and even higher for food-grade organic corn and soybeans (table 3.4). Although the feed-grade organic wheat premium (58 percent) was lower than for feed-grade organic corn and soybeans, food-grade organic wheat had a higher additional premium (65 percent). Feed-grade organic oats and barley had premiums of 63 and 114 percent—respectively—over conventional versions between 2011 and 2018. The coefficient of variation (CV) revealed volatility in each organic market has been similar to what is observed in the conventional market. The gap in volatility between the conventional and feed organic market is widest for corn and barley.

Table 3.4
**Selected grain and oilseed monthly prices, 2011–21**

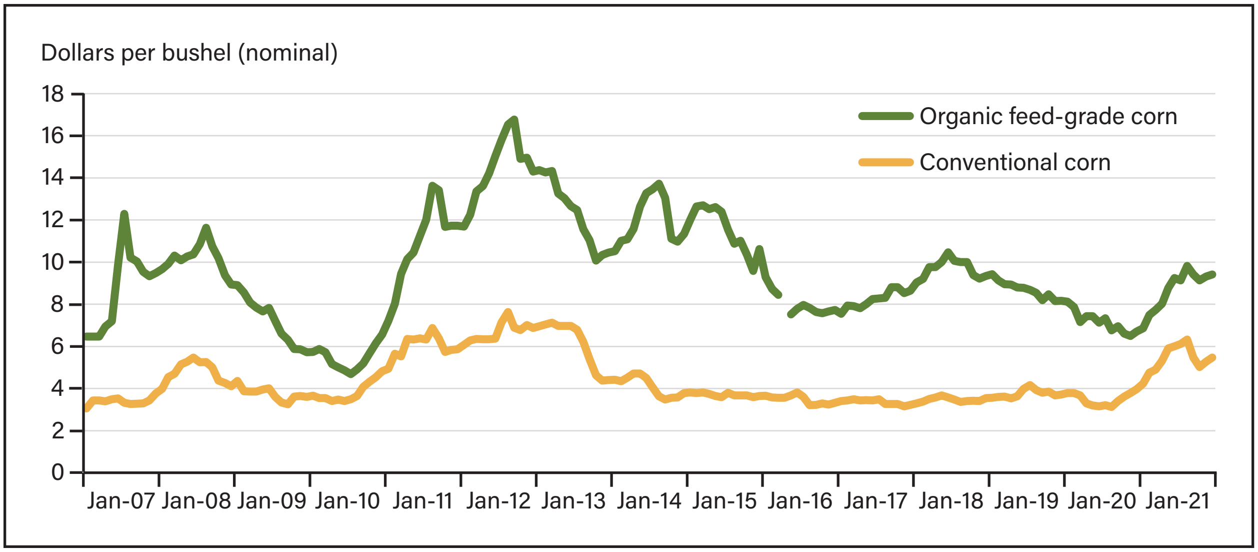
| | Count | Mean price | Median price | Maximum price | Minimum price | Standard Deviation | CV | Average premium (Organic feed to conventional feed) | | Average premium (Organic food to organic feed) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Dollars | Percent | Dollars | Percent |
| Corn (2011–21) | | | | | | | | 5.66 | 125.50 | 3.27 | 32.15 |
| Conventional | 132 | 4.51 | 3.79 | 7.63 | 3.12 | 1.31 | 0.29 | | | | |
| Organic feed | 131 | 10.17 | 9.44 | 16.77 | 6.49 | 2.40 | 0.24 | | | | |
| Organic food | 37 | 13.44 | 13.94 | 17.00 | 6.81 | 2.32 | 0.17 | | | | |
| Soybeans (2011–21) | | | | | | | | 10.84 | 98.64 | 4.45 | 20.38 |
| Conventional | 132 | 10.99 | 9.94 | 16.20 | 8.02 | 2.27 | 0.21 | | | | |
| Organic feed | 125 | 21.83 | 19.54 | 32.89 | 16.69 | 4.16 | 0.19 | | | | |
| Organic food | 52 | 26.28 | 28.34 | 30.41 | 19.41 | 3.66 | 0.14 | | | | |
| Wheat (2011–21) | | | | | | | | 3.39 | 58.15 | 6.03 | 65.40 |
| Conventional | 132 | 5.83 | 5.41 | 8.59 | 3.48 | 1.35 | 0.23 | | | | |
| Organic feed | 60 | 9.22 | 6.73 | 14.25 | 6.05 | 2.46 | 0.27 | | | | |
| Organic food | 44 | 15.25 | 15.17 | 24.00 | 8.40 | 4.05 | 0.27 | | | | |
| Oats (2011–2015) | | | | | | | | 2.23 | 63.36 | — | — |
| Conventional | 56 | 3.52 | 3.58 | 4.45 | 2.04 | 0.51 | 0.14 | | | | |
| Organic feed | 51 | 5.75 | 5.75 | 7.23 | 4.05 | 0.72 | 0.13 | | | | |
| Barley (2011–2015) | | | | | | | | 5.01 | 114.38 | — | — |
| Conventional | 56 | 4.38 | 4.52 | 5.91 | 2.84 | 0.97 | 0.22 | | | | |
| Organic feed | 45 | 9.39 | 9.50 | 12.66 | 5.42 | 1.63 | 0.17 | | | | |

Note: Organic corn, soybean, and wheat prices cover years 2011 to 2021; organic oats and barley cover years 2011 to 2015. The coefficient of variation (CV) is a statistical measure of volatility, calculated by taking the ratio of the standard deviation to the mean. Lower coefficients of variation signify lower volatility in the data.

Source: USDA, Economic Research Service using USDA, Agricultural Marketing Service data; and USDA, National Agricultural Statistics Service data.

The conventional price serves as a lower bound for organic crops because they can be sold in the conventional market. A general rule for organic to conventional crop pricing is prices for organic corn and soy are about double the price of their conventional counterparts (Singerman et al., 2014). This rule has relied on the assumption the organic and conventional prices co-move or an underlying relationship exists and links the two prices. This assumed relationship was confirmed by Raszap Skorbiansky and Adjemian (2021) who showed there has been a stable, linear relationship between conventional and organic prices of corn and soybeans, with the burden of adjustment on the organic prices. In other words, only the organic price adjusts after a shock to the premium.

Figure 3.8
**Organic and conventional corn prices, 2007–21**




Note: Data are expressed in nominal dollars and have not been adjusted for inflation. Organic corn prices reported by USDA, Agricultural Marketing Service (AMS) before 2011 represented simple averages. Prices reported after 2011 represent volume-weighted averages.

Source: USDA, Economic Research Service using USDA, AMS, organic price data; and USDA, National Agricultural Statistics Service, conventional price data.

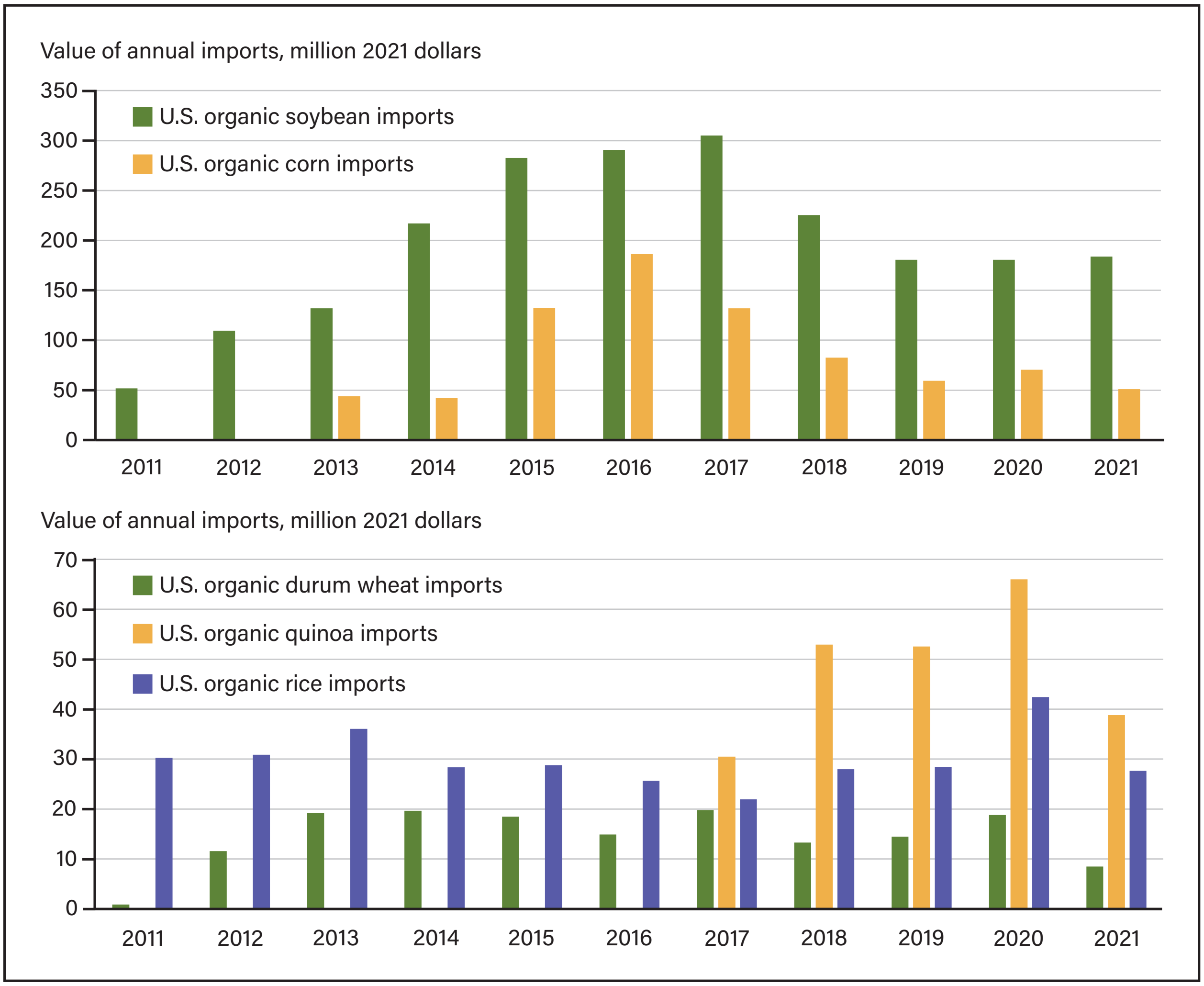
Although high organic premiums alone are not sufficient evidence of profitability in the organic crop market, McBride et al. (2015) found average organic corn and soybean prices were high enough among sampled farmers to cover the total higher economic costs. These higher costs include the annual prorated share of transition costs and annual certification costs during the 2006–10 survey period.

## *Organic Grain and Oilseed Imports*

A large portion of the current U.S. market for organic corn and soybean production has been for feed to support U.S. organic animal production growth. U.S. organic dairy and poultry sectors increased almost fourfold from 2002 to 2011 (USDA, ERS, 2018). Buyers who had difficulty domestically sourcing organic feed turned to imports (figure. 3.9). U.S. organic grain and oilseed imports increased rapidly until 2016–2017, when the U.S. Government began restricting grain and oilseed imports from specific countries in Eastern Europe based on emerging concerns about organic fraud; monitoring of organic imports from these countries continues (USDA, AMS, 2021). The import share (by volume) of the total U.S. organic corn supply dropped from 39 percent in 2015 to 14 percent in 2019[19]—and from 71 percent to 61 percent of the U.S. organic soybean supply. However, these numbers are lower bounds of the imported supply since it is possible for imports of organic corn and organic soybean byproducts to be imported under conventional harmonized codes, such as cracked corn under the "Worked Corn" code or soybean cake under "Soybean Oilcake and Other Solid Residues" (Raszap Skorbiansky et al., 2021).

[19] The United States does not track U.S. organic grain and oilseed exports.

Figure 3.9
**U.S. organic imports of corn, soybeans, rice, and quinoa**




Note: Wheat figures exclude seed imports and organic rice includes semi- and whole-milled rice. The United States began tracking organic corn in 2013 and organic quinoa in 2017. Adjusted for inflation using Consumer Price Index for all Urban Consumers (CPI-U) annual average.

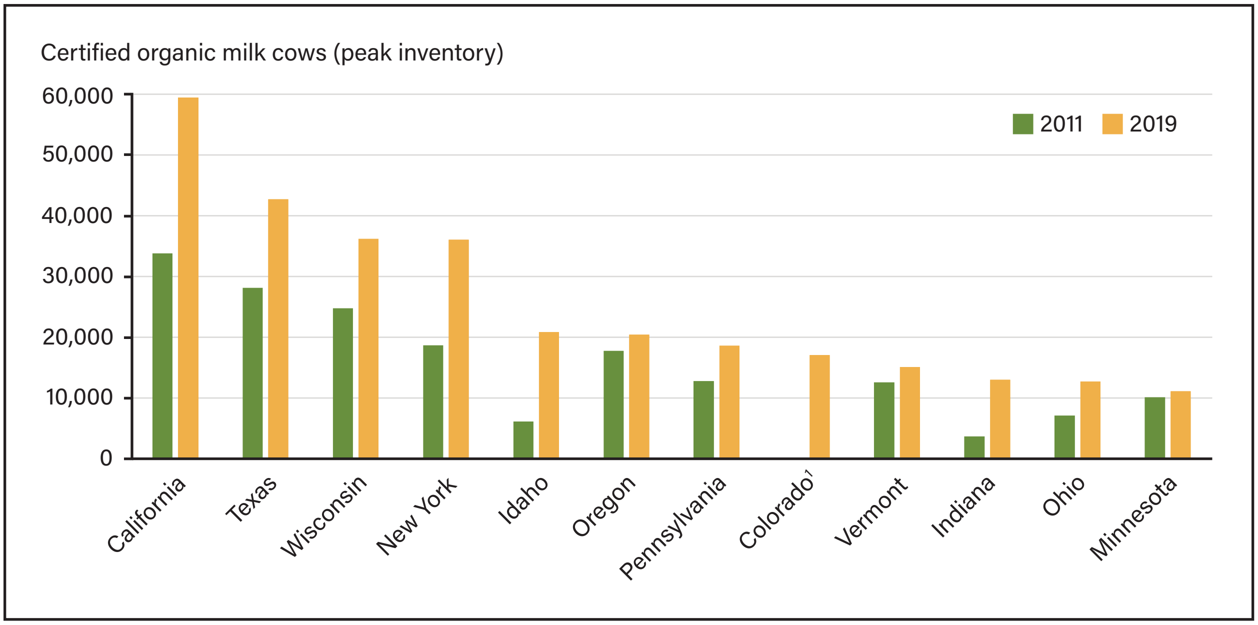
Source: USDA, Economic Research Service using USDA, Foreign Agriculture Service data; and U.S. Department of Commerce, Bureau of the Census data.

The United States also imports other grains primarily used for food, although in lower quantities than grain for feed quantities. While imports of grains used mostly for feed showed substantial annual increases until 2017, annual quantities of organic imports of major food grains, rice, and wheat have been largely stable. In 2017, the United States began tracking quinoa, a food grain produced primarily in mountainous parts of Peru and Bolivia. In 2020, U.S. quinoa imports peaked at $66 million (inflation adjusted to 2021 dollars), nearly as much as U.S. organic corn imports (figure 3.9).

## *U.S. Organic Dairy Markets*

U.S. organic dairy production emerged in the 1990s and expanded rapidly for several decades. The organic dairy sector only had about 2,000 certified organic dairy cows nationwide in the early 1990s and had expanded to over 40,000 certified cows by 2001 (Greene, 2001; Greene and Kremen, 2003). According to USDA's most recent organic survey, over 3,000 certified organic dairy farmers managed a peak inventory of over 360,000 certified milk cows in 2019, accounting for 3 percent of total U.S. milk cows (USDA, NASS, 2019). Organic milk production in the European Union (EU) has shown a similar growth pattern and accounted for 3 percent of total EU milk production in 2017 (Willer and Lernaud, 2019). California has been the top conventional dairy production State for many decades. It is also the top organic dairy production State. Although California had nearly a quarter of the certified organic milk cows in the United States in 2016, traditional U.S. milk-shed States—in the northeast, upper Midwest, and central regions—continue to play a major role in the organic dairy sector (figure 3.10).

Figure 3.10
**Inventory of organic milk cows in top States**




[1]Colorado's peak milk cow inventory was not reported in 2011 due to USDA's confidentiality requirements.

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

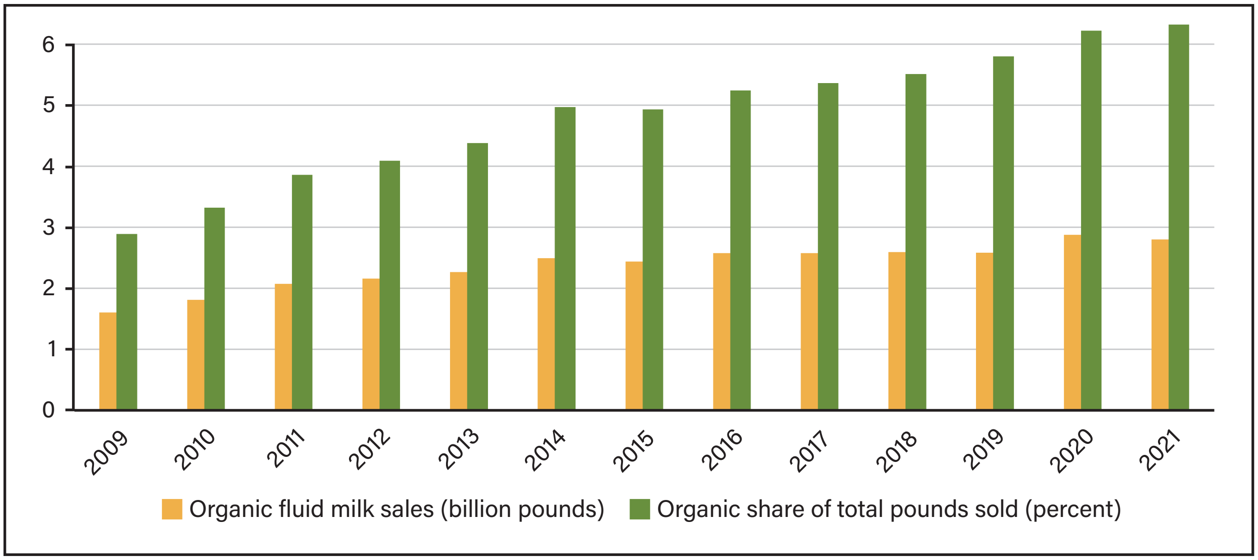
Several business models have been in place in the U.S. organic dairy sector since the early 1990s (Greene and McBride, 2015). Most U.S. organic dairy farms are small-scale family farms. Many belong to a national organic cooperative that sets prices farmers receive and provides equity ownership in its national brand, which may result in additional dividends on cooperative profits. In addition, the United States has had at least one large-scale corporate organic dairy farm since the 1990s. Despite the overall expansion of the organic dairy sector, the United States' average number of organic milk cows per farm has remained relatively flat, with 115 in 2011 and 116 cows per farm in 2019. However, the number dropped to 105 milk cows per farm for years 2014 and 2015 (USDA, NASS, 2012; USDA, NASS, 2016; USDA, NASS, 2017a; USDA, NASS, 2020).

The challenges farmers faced in meeting the more robust USDA pasture standard implemented in 2011 may have temporarily dampened the overall movement to large-scale dairy farms occurring in conventional dairy production. However, the 2019 Organic Survey (USDA, NASS, 2020) found multiple large organic dairy herds in Colorado, Idaho, New Mexico, and Texas with average herd sizes of 2,142; 722; 1,548; and 4,773, respectively. In fact, seven States with high average herd sizes—California, Colorado, Idaho, Mississippi, New Mexico, Oregon, and Texas—accounted for 48 percent of organic dairy cows in the USDA, NASS, 2019 Census of Agriculture. The average herd size in these 7 States is 659 head. Meanwhile in 2019, 10 Midwestern and northeastern dairy States—Indiana, Iowa, Maine, Michigan, Minnesota, New York, Ohio, Pennsylvania, Vermont, and Wisconsin—accounted for 44 percent of organic dairy cows, with an average herd size of 61.

While U.S. conventional fluid milk product sales had negative annual growth for most years between 2007 and 2018, U.S. organic fluid milk sales nearly doubled during that period. The organic market share of total sales increased from 1.92 to nearly 5.5 percent of pounds sold. However, organic fluid milk sales also started to flatten between 2014 and 2021 (figure 3.11). Fluid milk is still the top organic dairy product, but cheese and other processed organic dairy products may become more accessible to consumers as organic dairy processing facilities expand and new products are developed.

The United States is one of the top dairy exporters worldwide. Data on U.S. organic milk exports became available in 2016 and were still small—$2 million in 2019. Similar to overall U.S. milk exports, Mexico is the largest market for organic milk.

Figure 3.11
**The volume of U.S. organic fluid milk[1] sales, 2009–21**




[1]Fluid milk products include whole milk, flavored whole milk, reduced-fat milk, low-fat milk, fat-free milk, flavored reduced-fat milk, buttermilk, and other fluid milk products.

Source: USDA, Economic Research Service using USDA, Agricultural Marketing Service, Federal Milk Marketing Order Statistics.

## *Organic Dairy Price Premiums*

USDA has compared the value of production—minus operating costs—for organic and conventional dairy producers since 2005, based on data from three national dairy surveys. The value of production minus operating costs was higher for organic producers than for conventional producers in 2005, 2010, and 2016 for all size groups (table 3.5). The organic premium was high enough in 2016 to cover the total economic costs of organic dairy producers, including the opportunity cost of unpaid labor, for organic farmers with 100 organic cows or more. In contrast, only conventional farmers with at least 1,000 cows covered their total economic costs; net returns were negative for most size groups in conventional production in 2016.

Table 3.5

**Organic and conventional dairy costs and returns, 2005, 2010, and 2016**

| Item | Year | 10–49 cows | 50–99 cows | 100–199 cows | 200 or more cows | 500–999 cows | 1,000 or more cows | All sizes |
|---|---|---|---|---|---|---|---|---|
| **Organic** | | | | | | | | |
| | | Dollars per hundredweight sold (nominal) | | | | | | |
| Value of production minus operating costs[1] | 2016 | 14.89 | 16.03 | 16.41 | 18.70 | N/A | N/A | 16.97 |
| | 2010 | 8.08 | 9.16 | 7.82 | 10.56 | N/A | N/A | 9.18 |
| | 2005 | 8.72 | 8.41 | 7.65 | 7.19 | N/A | N/A | 7.92 |
| Value of production minus total costs[2] | 2016 | -11.77 | -2.52 | 2.45 | 6.56 | N/A | N/A | 1.64 |
| | 2010 | -19.38 | -11.40 | -7.61 | -0.43 | N/A | N/A | -8.42 |
| | 2005 | -12.91 | -8.45 | -5.63 | -1.20 | N/A | N/A | -6.19 |
| Percent of farms[3] | 2016 | 50 | 33 | 10 | 7 | N/A | N/A | 100 |
| | 2010 | 49 | 34 | 12 | 5 | N/A | N/A | 100 |
| | 2005 | 45 | 42 | 8 | 5 | N/A | N/A | 100 |
| Percent of milk production[3] | 2016 | 17 | 26 | 16 | 41 | N/A | N/A | 100 |
| | 2010 | 19 | 27 | 20 | 34 | N/A | N/A | 100 |
| | 2005 | 18 | 33 | 12 | 37 | N/A | N/A | 100 |
| **Conventional** | | | | | | | | |
| | | Dollars per hundredweight sold (nominal) | | | | | | |
| Value of production minus operating costs[1] | 2016 | 5.17 | 4.58 | 5.07 | 6.49 | 7.26 | 6.81 | 6.02 |
| | 2010 | 2.52 | 3.64 | 4.16 | 3.94 | 5.29 | 5.63 | 4.82 |
| | 2005 | 5.57 | 4.62 | 5.69 | 5.94 | 5.49 | 6.80 | 5.93 |
| Value of production minus total costs[2] | 2016 | -14.01 | -9.24 | -5.29 | -2.07 | -0.13 | -0.05 | 0.38 |
| | 2010 | -20.03 | -11.24 | -5.72 | -3.61 | -0.04 | 1.78 | -2.58 |
| | 2005 | -12.22 | -7.90 | -3.62 | -0.67 | 0.49 | 2.95 | -1.39 |
| Percent of farms[3] | 2016 | 23 | 36 | 19 | 10 | 5 | 7 | 100 |
| | 2010 | 29 | 36 | 19 | 9 | 4 | 3 | 100 |
| | 2005 | 31 | 35 | 19 | 9 | 3 | 2 | 100 |
| Percent of milk production[3] | 2016 | 2 | 8 | 9 | 11 | 15 | 55 | 100 |
| | 2010 | 4 | 11 | 13 | 14 | 16 | 41 | 100 |
| | 2005 | 5 | 14 | 16 | 18 | 15 | 32 | 100 |

N/A=not applicable.

Note: The coefficient of variation (CV) is a statistical measure of volatility, calculated by taking the ratio of the standard deviation to the mean. Lower coefficients of variation signify lower volatility in the data. All CV for category totals—gross value of production and feed, operating, allocated overhead, and total costs—were less than 25 percent. The Agricultural Resources Management Survey only surveys farms with at least 10 cows.

[1]Operating costs include feed, veterinary services, medicine, bedding, fuel, electricity, repairs, certification, and marketing services.

[2]Total costs include operating costs, plus allocated overhead including hired labor, opportunity cost of unpaid labor, capital recovery of machinery and equipment, opportunity cost of land (rental rate), taxes and insurance, and general farm overhead.

[3]Rows may not add up to 100 percent due to rounding.

Source: USDA, Economic Research Service using USDA, National Agricultural Statistics Service, 2005, 2010, and 2016 Agricultural Resources Management Survey data; and MacDonald et al., 2020.

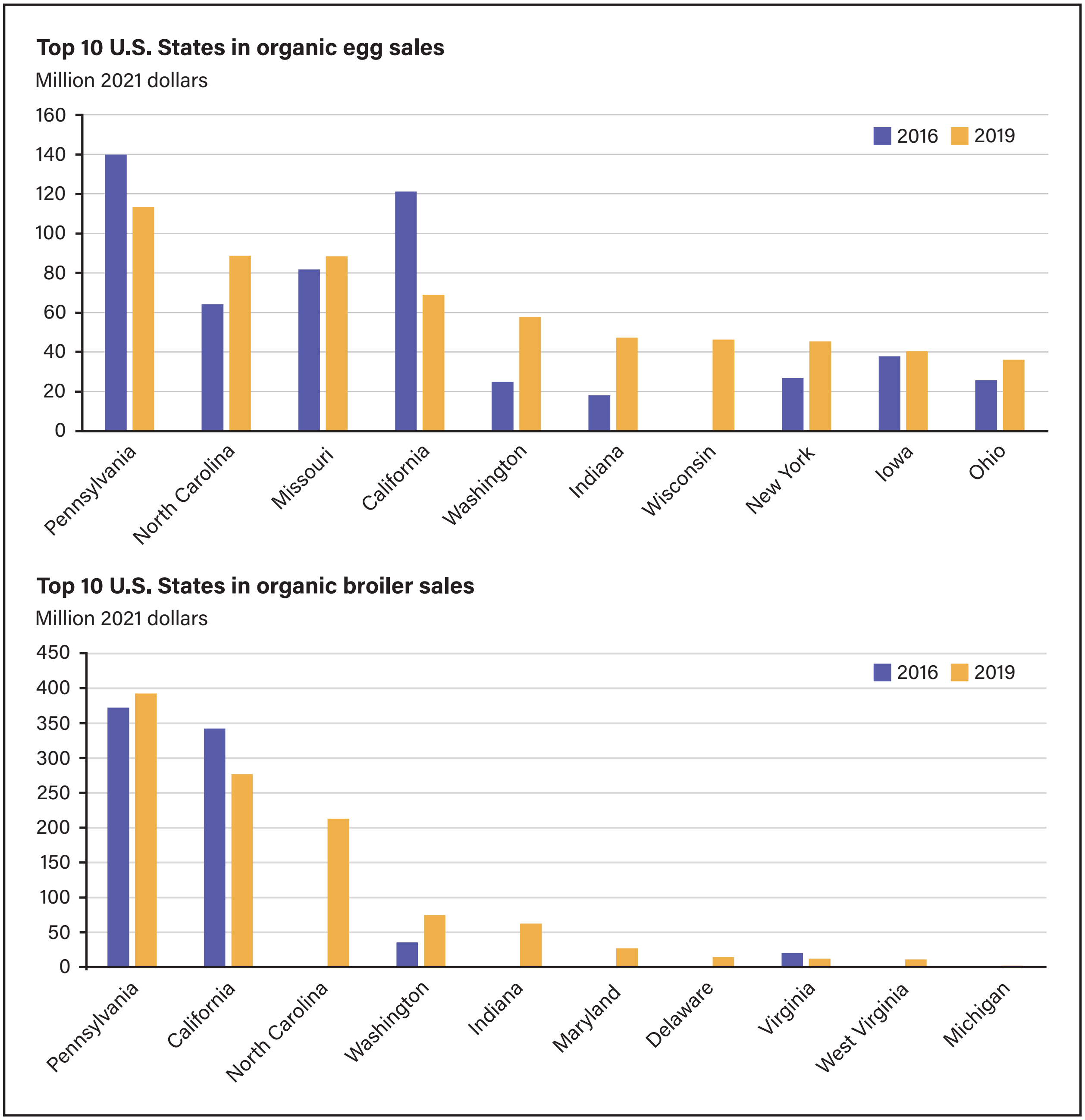
## *U.S. Organic Poultry and Egg Markets*

Since 2016, the U.S. organic poultry and egg sector—which includes broilers, layers, turkey, other poultry, and eggs—now represents nearly a quarter of the organic commodity market (USDA, NASS, 2017a; USDA, NASS, 2020), growing from 16 percent in 2014 (USDA, NASS, 2015). Within this segment, organic eggs and broiler chicken meat have consistently represented more than 90 percent of total sales. Between 2008 and 2019, U.S. organic broiler sales increased nearly five times to $1.2 billion, and U.S. organic egg sales more than quadrupled to nearly $981 million (both numbers adjusted for inflation to 2021 dollars). The increase in sales volume was much higher than the increase in egg and poultry operations during this period (see appendix D and table D.5). Several top U.S. poultry producers, including Perdue Farms and Tyson Foods, Inc., entered the organic poultry sector between 2008 and 2019.

In 2019, Wisconsin had the most organic egg operations[20] (118), followed by Pennsylvania (112), Missouri (102), Iowa (98), New York (71), and California (58). For organic egg sales, Pennsylvania had the most at $113.4 million (inflation adjusted to 2021 dollars), followed by California, Missouri, and North Carolina (figure 3.12). These data suggest organic egg farms in Wisconsin, Iowa, and New York operate on a smaller scale than those in Pennsylvania, California, Missouri, and North Carolina. Pennsylvania also had both the highest organic broiler sales in 2019—with $393 million (inflation adjusted to 2021 dollars)—and the highest number of organic broiler operations (102). Although organic broiler operations are spread across multiple States, the large majority of total U.S. broiler sales volume is concentrated in Pennsylvania (32 percent), California (23 percent), and North Carolina (17 percent) (figure 3.12).

[20] We use "operations with sales of organic," rather than "operations with organic layer inventory" because some operations with layer inventory may focus on supplying organic layers rather than actually producing organic eggs.

Figure 3.12
**Top 10 U.S. States in organic egg and broiler sales**




Note: USDA, National Agricultural Statistics Service survey estimates for organic broilers and eggs were not disclosed for several States before 2016 due to survey confidentiality requirements. In 2019, organic egg sales were $306 million and broiler sales in other States were $119 million.

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

USDA estimated the organic layer flock[21] for table eggs—the shell eggs retailed to consumers—increased from about 2 percent of the U.S. table-egg laying flock in 2007 to 5 percent in 2018. According to USDA estimates, the organic table layer flock size in 2018 was nearly 16 million hens, with weekly organic table egg production around 7 million dozen, approximately 4 percent of the U.S. shell egg total.

[21] USDA, Agricultural Marketing Service estimates the organic share of the U.S. table egg layer flock based on voluntary data from industry cooperators, which likely does not represent all organic shell egg production.

Although USDA has published historical weekly data on estimated chicken slaughter quantities and average bird weights since 2010, data predating 2016 do not appear to be comparable. In 2018, organic chicken slaughter quantities under Federal inspection reached to more than 54 million birds. The share of total U.S. young organic chickens that were slaughtered under Federal inspection was estimated to represent about 0.6 percent, on average—a smaller share than for organic eggs.

In the overall U.S. poultry and egg sector, nearly one-fifth of U.S. domestic broiler production and 4 percent of egg production were exported. While it is possible that the United States exports organic poultry and organic eggs, these are not currently tracked. However, given the rapidly expanding domestic demand exports of these products may be minimal.

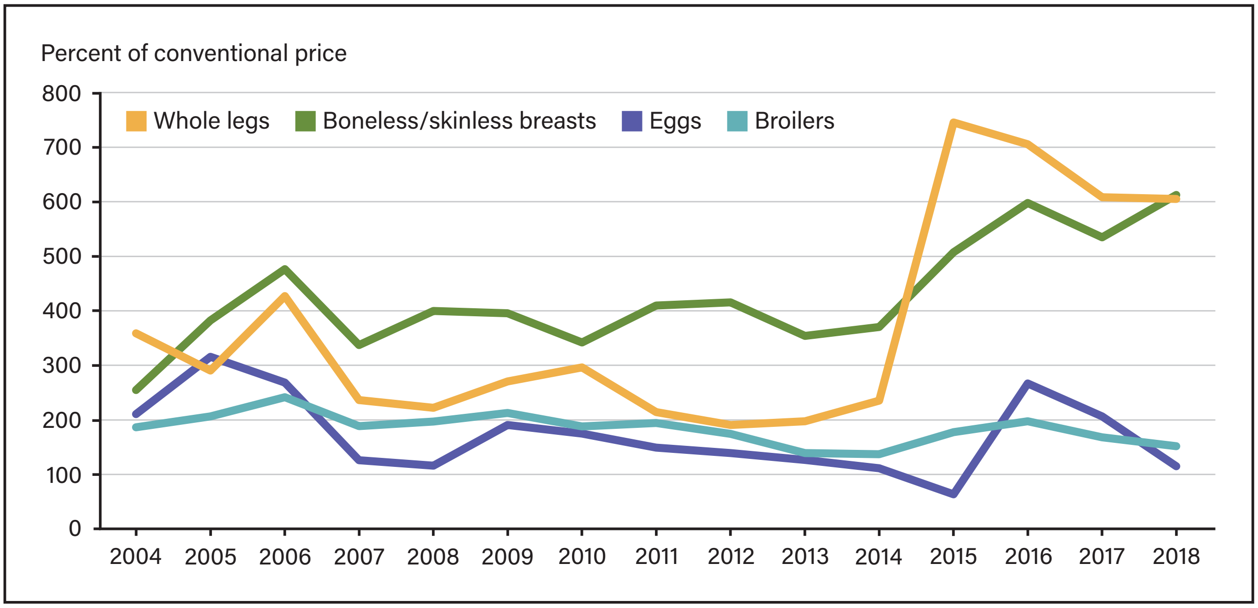
### *Price Trends for Organic Eggs, Broilers, and Chicken Parts*

According to USDA, Agricultural Marketing Service (AMS), wholesale organic poultry and egg prices are contractual and show little-to-no monthly variation. Additionally, wholesale organic poultry and egg prices sometimes show little-to-no annual variation either. In contrast, wholesale prices for conventional products are determined by the spot market. In the case of organic eggs, historical data, dating back to 2004, have indicated wholesale prices[22] have been very stable, with less than 1.4 percent annual growth most years, except in 2008, 2009, and 2014. Organic price premiums for organic eggs have been on a downward trend since 2004, ranging from 315 percent at its peak in 2005, to a low of 63 percent in 2015 (figure 3.13). The low-price premium in 2015 coincided with the outbreak of the highly pathogenic avian influenza (HPAI), which caused significant bird losses. In addition, the 2015 HPAI outbreak resulted in reduced egg production and record-high conventional egg prices, while whole organic egg prices remained constant.

Similar to eggs, wholesale organic whole-bird chicken prices have experienced little-to-no variation, averaging 1.2 percent annual growth from 2004 to 2018. Price premiums for organic broilers have been on a downward trend from 242 percent in 2006 to 152 percent in 2018 (figure 3.13). In contrast, wholesale prices for organic cut-up chicken parts were essentially fixed between 2004 and 2011. However, the price of organic cut-up chicken parts increased substantially—ranging from a 28-percent increase for boneless/skinless breasts to 63 percent for whole legs between 2012–2015. The price premium for organic breast meat has been on an upward trend and has averaged 326 percent (figure 3.13). The price premium for organic whole legs trended down from 2004 to 2014 and averaged 167 percent. Price premiums for organic whole legs peaked in 2015 and have averaged 566 percent since then.

[22] Wholesale prices reflect midpoint of a price range.

Figure 3.13
**U.S. organic wholesale price premiums for poultry and egg products, 2004–18**




Source: USDA, Economic Research Service calculations using USDA, Agricultural Marketing Service data.

# Chapter 4: U.S. Organic Retail Sales, Market Share, and Consumer Characteristics

The consumer market for organic food rose more than fivefold in the United States between 2000 and 2019 (figure 1.1). U.S. policymakers played a role in this expansion by defining and enforcing organic regulatory standards in 2000. Subsequently, policymakers expanded access by widening organic producers' access to risk management and other existing farm programs and by expanding public research and economic data collection on organic agriculture (see chapter 2 for a detailed discussion of U.S. organic policy and research funding changes during this period).

Some countries have used a much broader range of policy measures than the United States to expand organic consumption (Dimitri and Oberholtzer, 2006). The European Union (EU), for example, promoted organic food consumption through public advertisements and broader use in hospitals, schools, and other public institutions (European Commission, 2022). In South America, Brazil approved organic public-school procurement legislation in 2009 and subsequently implemented the National Policy for Agroecology and Organic Production (Borsatto et al., 2020). In North America, several Mexican States have established organic promotion programs under local laws. Even without such promotion polices in the United States, strong consumer demand and willingness to pay organic price premiums has driven the expansion of the organic market, particularly in the retail (grocery store) sector. Organic food sales in the United States have continued to grow at a faster rate than in the overall food market (Nutrition Business Journal, 2021). The food industry has responded to the strong market signals by broadening organic food access across food marketing channels; expanding use of lower-cost private label brands in big-box stores, health and natural foods stores,[23] and traditional supermarkets; and developing new product lines based on ethnic and international food preferences (Dimitri and Oberholtzer, 2009; Organic Trade Association, 2020).

## Organic Food Retailing and Market Structure

Markets for organic food began emerging in the 1970s as consumers became more aware of chemical use in agriculture and organic foods were being featured in small natural food stores[24] (Senauer et al., 1991). Natural food stores, large and small, were the major outlet for organic food sales for decades, until conventional grocery retailers began to surpass them in organic sales by the mid-2000s (figure 4.1). Between 2012 and 2020, this pattern continued with conventional grocery retailers replacing natural food stores. In the conventional retailer category, club and warehouse stores increased the most during this period, from 9 percent in 2012 to 14 percent in 2020. Although overall organic foods sales have increased as conventional retailers have entered the market, some smaller food companies may not be able to keep up with the volume demanded by these larger stores. Consumer direct sales peaked in 2006 with a 10-percent share of the organic market, but they still accounted for 7 percent of total sales in 2019 and dropping to 6 percent in 2020 (figure 4.1). Since the largest share of direct-to-consumer organic sales was made in farmers' markets, the Coronavirus (COVID-19) restrictions may explain the drop in direct-to-consumer sales between 2019 and 2020.

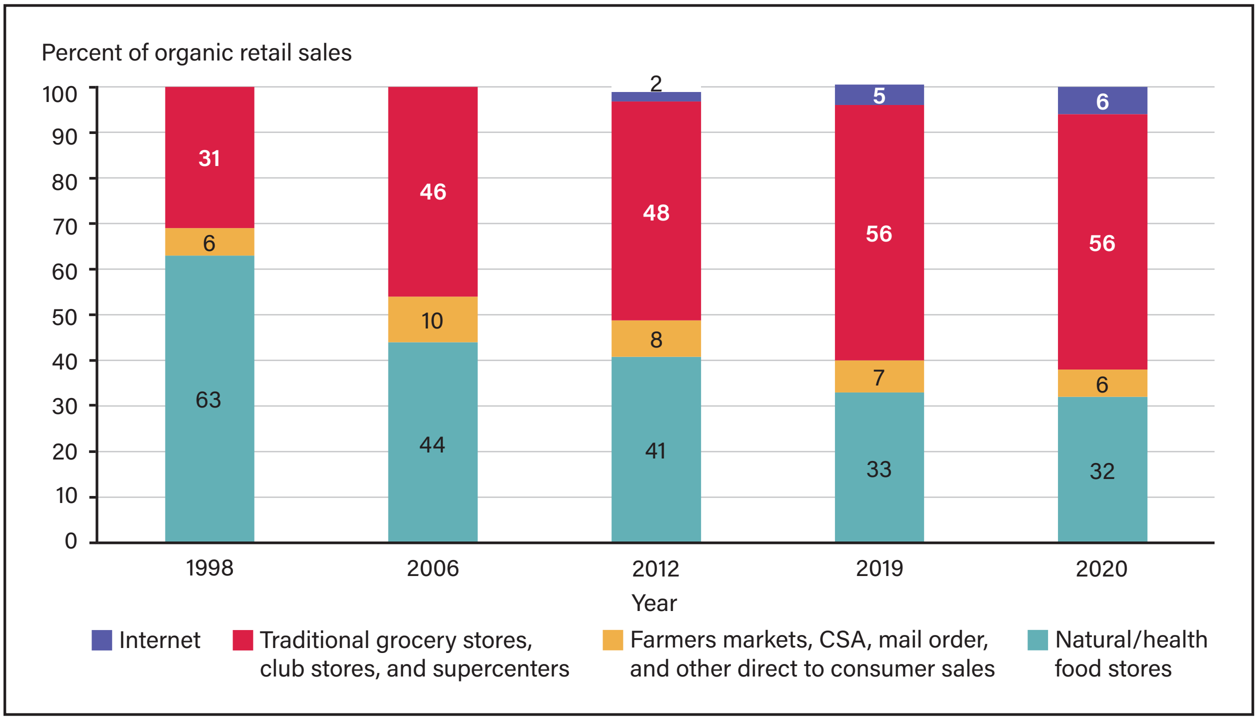
[23] The term "health and natural food stores" refers to a class of stores that tend to focus on organic food as well as foods consumers perceive as being "healthy" or "natural." More information on the term "natural" is in the section "Other eco-labels."

[24] The term "natural" does not have an official definition and has limited regulatory oversight. Before the National Organic Program began, the term "natural food stores" referred to stores that sold products whose ingredients might have followed many of the agricultural practices that fall under the NOP's organic certification. Today natural food stores can refer to stores that specialize in certified organic products as well as stores that sell mostly certified organic and products marketed as "natural."

New supply chains have been growing as consumers try organic food subscriptions with seasonal fruit baskets, online meal boxes and other internet sales becoming a popular source of organic food (Askew, 2020). In 2019, internet sales jumped from 2 percent of total sales in 2012 to 5 percent. The shift toward more organic internet purchases before 2020 (figure 4.1) may be tied to Amazon's 2017 purchase of Whole Foods Market, the largest natural foods supermarket chain in the United States. This action caused a sharp drop in share prices of most publicly-owned traditional grocery stores despite Whole Foods' small share—1 percent—of total U.S. grocery sales (Phillips-Connolly and Connolly, 2017). Industry analysts interpreted Amazon's purchase as a reflection of the company's belief that organic and "natural" are the future, as well as its desire to get into the food business and expand online sales. Amazon rose into the top 10 food retailers in 2018 and has continued to experiment with online and brick and mortar formats (Redman, 2020a). Internet sales rose again in 2020 to 6 percent of the organic market as consumers responded to COVID-19 restrictions. As the COVID-19 pandemic began to impact the United States, virtually all retail chains added or enhanced their online ordering, including curbside pick-up options, which are counted as store sales rather than internet sales (Organic Trade Association, 2021).

Figure 4.1

**Organic food sales by retail market channel**




CSA = Community Supported Agriculture.

Note: The term "traditional grocery stores" refers to supermarkets where consumers can purchase a wide variety of food, usually including both conventional and organic foods. Natural and health food stores sell a mix of organic and seller-defined "natural" products, which consumers may perceive as healthier. Unlike organic, "natural" is not a regulated term in the United States. Internet includes grocery websites with delivery as well as other online sources and was not tracked before 2011. Online ordering with store pickup is counted with stores.

Source: USDA, Economic Research Service using data from Natural Foods Merchandiser, various issues; and 2006, 2020, and 2021 Organic Trade Association data.

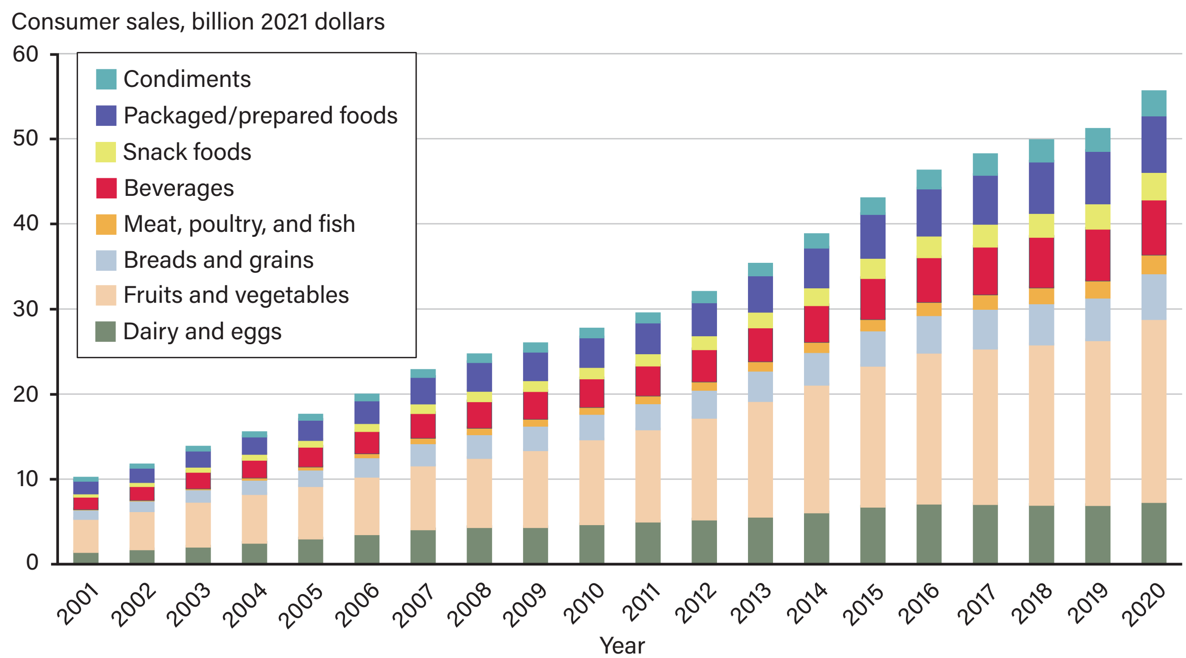
Although individual food retailers do not release their total organic sales, industry analysts estimated the top organic retail chains in the United States are Walmart, Costco, Kroger, Target, and Safeway (Chait, 2019). These 5 chains or their parent companies also rank in the top 10 largest retailers, according to Supermarket News (2020) and Redman (2020b), underscoring the movement of organic food sales into mainstream stores. Research studies found that when stores increased the total number of organic products in a retail category (e.g., beverages, produce, frozen meals), sales increase for the entire category. The same increase has not happened when the number of conventional product choices is expanded because shoppers just substitute within the category (Bezawada et al., 2013). In the 2000s, most major grocery stores introduced organic private label lines—or store brands—to increase sales within product categories (Dimitri et al., 2009).

The way customers acquire their retail food is changing, and the COVID-19 pandemic has forced additional changes. In 2019, only 2 of the top 10 largest food retailers—Amazon and Target—enlarged their brick-and-mortar footprints to experiment with new formats such as smaller stores and technology-enabled no-checkout payment options. Three of the other top 10 food retailers focused on expanding e-commerce (Redman, 2020a).

## Expansion of Organic Food Sales and Market Penetration

Although the U.S. Government does not track organic food purchases at retail stores, an industry group, the Nutrition Business Journal (NBJ), has tracked organic retail sales at natural food stores, conventional grocery stores, supercenters, and other retail stores since the late 1990s.[25] According to NBJ estimates, U.S. organic food and beverage sales passed $55 billion in 2020 (inflation adjusted to 2021 dollars). Fruits and vegetables remained the top organic retail segment, with nearly $22 billion in sales in 2020 (inflation adjusted to 2021 dollars), followed by dairy (including eggs), beverages, and packaged/prepared foods (figure 4.2).

Figure 4.2
**U.S. organic retail food market sales by category**




Note: Fruits and vegetables category includes fresh, frozen, canned, and dried fruits and vegetables; fresh fruits and vegetables account for most of the sales in this category. Sales adjusted for inflation using the Consumer Price Index for all Urban Consumers (CPI-U).

Source: USDA, Economic Research Service using 2021 Nutrition Business Journal data.

[25] Nutrition Business Journal constructs estimates of U.S. organic food sales based on data from industry surveys and interviews, supermarket scanner data, and other sources (Nutrition Business Journal, 2016).

Between 2001 and 2020, U.S. organic food sales showed strong growth and outpaced growth in the overall food market through 2020. Inflation-adjusted annual growth rates for organic food sales were in the double digits from 2001 to 2007, and again between 2013 and 2014. The inflation-adjusted annual growth rate rebounded from 2 percent in 2019 to 8 percent in 2020, led by higher growth rates in fruits and vegetables (NBJ, 2021). The retail market share of organic food now represents nearly 6 percent of overall retail food sales (Organic Trade Association, 2020). Individual food categories showed strong growth from 2001 to 2020; retail sales of organic fruit and vegetables had a nearly fivefold increase during this period. Organic snack foods had an eightfold increase, condiments' increase was nearly elevenfold, and the meat, poultry, and fish segment had a 44-fold increase. The high growth rates for these three categories have been partly due to lower starting sales in 2001; all three combined were about $71 million (inflation adjusted to 2021 dollars), compared with $4 billion (inflation adjusted to 2021 dollars) for organic fruits and vegetables.

U.S. food-away-from-home sales—including restaurants, school cafeterias, and hotels—had accounted for half or more of total U.S. food expenditures since the early 2000's (Elitzak and Okrent, 2018; Saksena et al., 2018) until COVID-19 forced a shift in the food industry in 2020. However, by 2021 food-away-from-home sales were again higher than food-at-home sales (Zeballos and Sinclair, 2022). Organic food-away-from-home sales have not been tracked by government or industry groups but are likely increasing in this market segment (National Restaurant Association, 2018; Gagic et al., 2015).

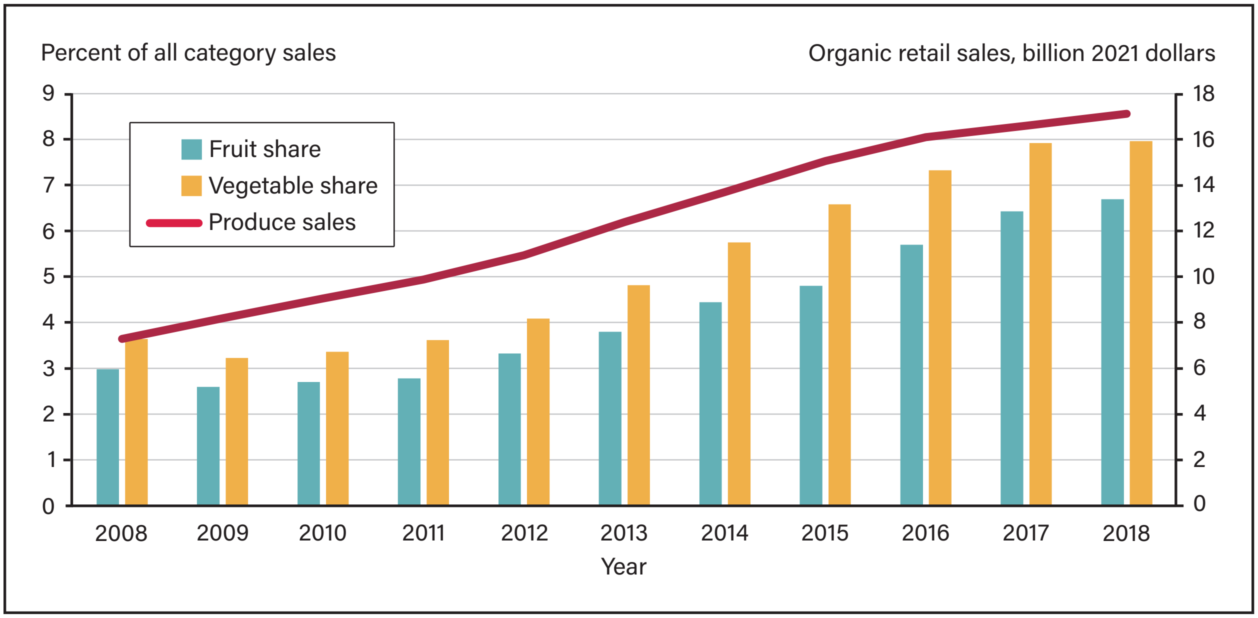
To get an idea of trends in retail penetration of organic products, we began by using NBJ to identify top-selling categories and subcategories. We then used retail point-of-sale food scanner data from Information Resources, Inc. (IRI) InfoScan to estimate retail market penetration. Our estimates of market penetration are not weighted by store because IRI does not include store sample weights. However, the IRI data represent nearly 50 percent of U.S. retail food sales and 20 percent of food outlets (Levin et al., 2018). To estimate market penetration—market share—we divided total organic sales by total retail sales of the product and report the trend in market share for a 10-year period, 2008–18, based on data availability (For more information on IRI InfoScan data, see appendix B, "USDA and Industry Data Sources on U.S. Organic Production, Marketing, and Trade").

### *Organic Fresh Fruits and Vegetables: U.S Retail Sales and Market Penetration*

The share of U.S. retail sales of organic fresh fruits increased from about 3 percent in 2001 to nearly 7 percent in 2018, with retail sales of over $17 billion (inflation adjusted to 2021 dollars) (figure 4.3). The growth in organic sales of fresh vegetables and retail market share has followed a similar pattern as organic fresh fruits. The increased retail produce sales and market share mirrored the growth in domestic production and tracked imports of organic fruits and vegetables from 2001–18 (see chapter 3 for more discussion of organic commodity markets and trade). Produce can be classified as one of the gateways to other organic food purchases, partly due to the lower premiums for produce compared with other organic products such as eggs, dairy, and processed foods (Organic Trade Association, 2020; Hartman Group, 2010). In addition, the market share trends, and total sales indicated that fruits and vegetables, are the largest retail organic categories (figure 4.2).

The use of organic agricultural practices during production, as well as the procedures to prevent co-mingling of organic and conventional produce during processing and retailing, typically adds extra costs, which may be partially passed on to the consumer. Estimates of organic produce price premiums at the retail level vary widely—from less than 10 percent to more than 120 percent. These price premiums have been dependent on which fruit and vegetables are examined, the method and data used to estimate the premium, and the timeframe of the study (Çakır, et al., 2022). A mid-2000s study of U.S. organic produce price premiums for 18 fruits and 19 vegetables found premiums were less than 30 percent for over two-thirds of the items examined—and exceeded 100 percent only for blueberries (Lin et al., 2008). A more recent study found organic premiums ranged from 7 to 44 percent for organic produce (Carlson and Jaenicke, 2016). Organic price premiums for produce may have declined since the COVID-19 pandemic began in the early part of 2020. According to industry analysts, organic produce sales have increased since the pandemic started, but volume sales are growing faster than dollar sales products (Nickle, 2020; Organic Trade Association, 2020; Redman, 2020b; Roerink, 2020).

Figure 4.3
**U.S. retail sales and market shares of organic produce between 2008 and 2018**




Note: Sales (solid line) are represented on the right vertical axis and shares (bars) are represented on the left vertical axis. Inflation adjusted using the Consumer Price Index for all Urban Consumers (CPI-U).

Source: USDA, Economic Research Service using Information Resources, Inc. (IRI) InfoScan data; and Nutrition Business Journal, 2020.

The produce category represents a wide range of individual products, each with its own production challenges. Some products, such as potatoes, carrots, and greens, are grown as annual crops and can be rotated with other crops, while fruit trees require years of tree growth before producing marketable crops. Thus, individual fruits are expected to have a wide variety of market shares. For example, we estimated the market share for the top 10 most-consumed fruits and top 10 vegetables in the United States (table 4.1). Organic apples and berries had the highest market share between 2008 and 2017, while organic lemons and bananas have been rapidly gaining market share since 2014. Once limited to seasonal consumption, many berries—especially blueberries and strawberries—now have year-round availability. The import share of all blueberries consumed in the United States in 2019 was 60 percent and may be even higher for organic blueberries, while the majority of U.S. strawberries (organic and conventional) are grown domestically, primarily in California (Kramer, 2020). The increased availability and growing awareness of health benefits has increased consumer demand for berries (Kramer, 2020).

Table 4.1

**Organic retail market share for the top 10 fruits and vegetables sold in the United States, 2008–18**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Percent of all sales) | | | | | | | | | | |
| **Fruit** | | | | | | | | | | | |
| Apples | 4.78 | 4.42 | 4.94 | 5.27 | 5.71 | 6.72 | 7.60 | 8.82 | 9.51 | 10.49 | 10.74 |
| Avocados | 2.36 | 1.87 | 1.85 | 1.85 | 2.10 | 2.23 | 3.06 | 3.35 | 3.82 | 4.84 | 5.21 |
| Bananas | 3.60 | 2.54 | 2.82 | 2.61 | 2.82 | 3.47 | 4.14 | 5.40 | 7.34 | 8.66 | 9.02 |
| Berries | 5.35 | 4.51 | 5.21 | 5.31 | 6.55 | 7.18 | 8.49 | 8.44 | 10.05 | 11.94 | 11.71 |
| Grapes | 1.98 | 1.45 | 1.50 | 1.56 | 2.04 | 2.33 | 3.30 | 3.17 | 4.02 | 4.13 | 4.51 |
| Lemons | 2.01 | 1.80 | 2.00 | 2.53 | 2.40 | 2.53 | 3.45 | 4.51 | 5.92 | 7.46 | 6.51 |
| Nectarines | 1.52 | 1.83 | 1.58 | 2.07 | 2.05 | 2.93 | 3.18 | 3.82 | 4.98 | 4.97 | 5.58 |
| Oranges | 2.77 | 1.84 | 2.02 | 1.98 | 3.53 | 4.55 | 4.38 | 4.60 | 4.55 | 4.31 | 4.63 |
| Peaches | 1.71 | 1.70 | 1.58 | 1.83 | 1.93 | 2.31 | 2.82 | 3.23 | 4.72 | 3.95 | 3.69 |
| Pears | 4.46 | 3.41 | 3.27 | 3.73 | 4.44 | 4.75 | 5.74 | 5.84 | 6.71 | 6.64 | 6.02 |
| **Vegetables** | | | | | | | | | | | |
| Broccoli | 4.23 | 3.55 | 3.75 | 4.25 | 4.76 | 5.42 | 6.78 | 7.71 | 8.59 | 8.74 | 8.57 |
| Carrots | 14.72 | 13.08 | 14.00 | 15.93 | 17.73 | 19.72 | 21.83 | 25.59 | 27.13 | 28.91 | 29.34 |
| Celery | 8.27 | 7.13 | 7.96 | 9.04 | 9.52 | 9.69 | 10.91 | 9.87 | 9.67 | 10.62 | 12.47 |
| Kale | 8.05 | 8.74 | 11.28 | 13.58 | 17.07 | 25.05 | 29.74 | 37.10 | 36.39 | 39.53 | 37.91 |
| Lettuce | 5.30 | 5.96 | 6.65 | 6.89 | 7.64 | 8.56 | 9.19 | 9.87 | 12.23 | 12.24 | 11.38 |
| Mushrooms | 1.41 | 1.62 | 1.78 | 1.93 | 2.00 | 3.63 | 4.79 | 6.33 | 7.53 | 8.56 | 10.49 |
| Onions | 2.47 | 2.68 | 2.45 | 3.04 | 3.35 | 3.27 | 3.96 | 3.99 | 3.76 | 4.27 | 4.40 |
| Peppers | 1.26 | 0.96 | 1.02 | 1.29 | 1.58 | 2.14 | 2.75 | 3.50 | 4.47 | 4.97 | 5.09 |
| Potatoes | 1.31 | 1.02 | 1.37 | 1.34 | 1.56 | 1.78 | 2.49 | 3.20 | 3.55 | 3.87 | 4.08 |
| Tomatoes | 4.18 | 3.50 | 3.22 | 3.08 | 3.49 | 4.05 | 4.48 | 4.69 | 5.64 | 5.64 | 5.08 |

Source: USDA, Economic Research Service using Information Research, Inc. (IRI) InfoScan data.

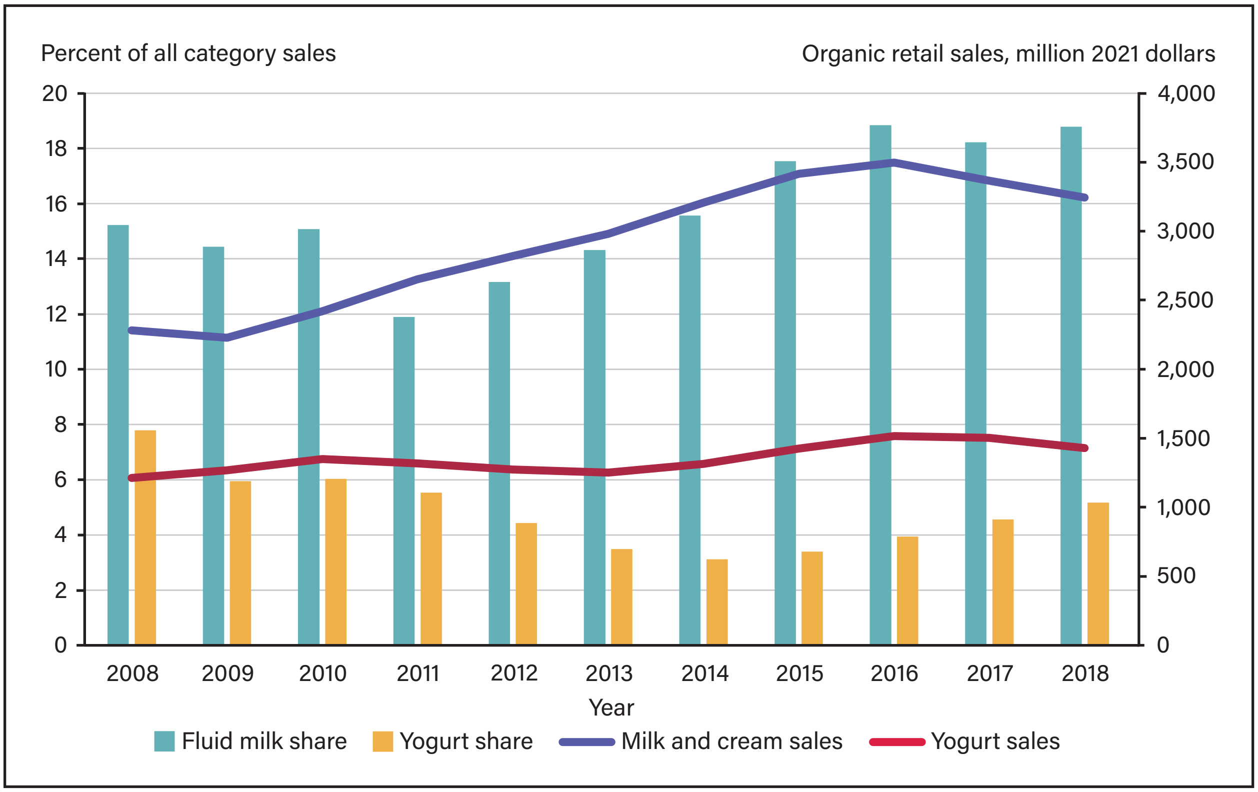
Vegetables have shown a wider range of market shares across products and time. The highest organic market share from 2008 to 2018 was for kale, which accounted for nearly 40 percent of overall U.S. kale sales in 2017 and 38 percent in 2018, followed by organic carrots—30 percent of overall sales in 2018. The rapid rise in organic kale's market share between 2008 and 2018 may be due, in part, to its rise in popularity among consumers as shown in the USDA, ERS Vegetables and Pulses Yearbook tables (USDA, ERS, 2021) (table 4.1). Spinach was a popular vegetable during the late 2000s and showed a similar rapid rise in the organic share of the total market (Carlson and Jaenicke, 2016). The organic market share of other vegetables popular with consumers—including broccoli and mushrooms—has also grown rapidly since the mid-2000s.

### *Organic Milk and Other Dairy Products: U.S. Retail Sales and Market Penetration*

In contrast to fruits and vegetables, dairy products have some of the highest organic price premiums but the lowest volume sales. Production costs are often higher for animal-based than plant-based products because organic producers must allocate grazing land and provide organic feed for the animals. A study using 2006 data found U.S. organic milk premiums varied widely depending on fat content, container size, and branding; for a half-gallon of milk premiums ranged from 60 percent for private-label organic milk above branded conventional milk to 109 percent for branded organic milk above private-label conventional milk (Smith et al., 2009). More recent studies found average price premiums for organic milk have been steady between 2004 and 2016, at around 50 percent of the conventional price (Badruddoza et al., 2021; Carlson and Jaenicke, 2016).

U.S. retail sales of organic milk were $3.3 billion in 2018 (inflation adjusted to 2021 dollars)—19 percent of total retail dairy sales—following significant industry growth for much of the last two decades (figure 4.4). Unlike the conventional dairy sector, beverage milk is the most popular organic dairy product. In the organic dairy sector, higher-fat organic milk costs more than lower-fat milk, and the highest growth rates have been for higher fat beverage milk and cream (Smith et al., 2009; Organic Trade Association, 2020). While U.S. organic milk sales dropped in response to the 2007–2009 Great Recession as consumers briefly switched to lower cost products, the organic sector rebounded quickly (figure 4.4). Similar to the conventional sector, where milk sales have trended down for decades, organic milk sales and market share started falling in 2017, (figure 4.4).

Figure 4.4
**U.S. retail sales and market shares of organic dairy products, 2008–18**




Note: Sales (solid lines) are represented on the right vertical axis and shares (bars) are represented on the left vertical axis. Inflation adjusted using the Consumer Price Index for all Urban Consumers (CPI-U).

Source: USDA, Economic Research Service using Information Research, Inc. (IRI) InfoScan data; and the Nutrition Business Journal, 2020.

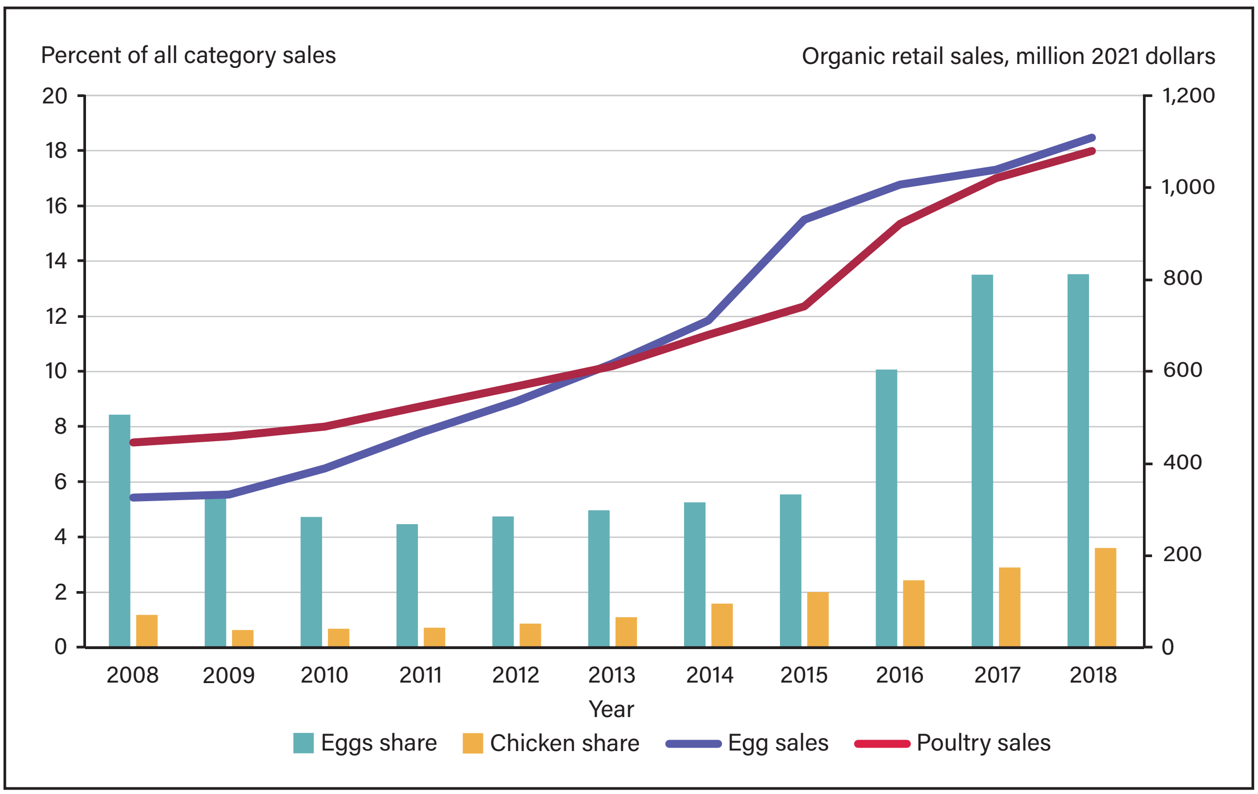
Price premiums for organic yogurt—the second most popular organic dairy product—fluctuated between 25 and 50 percent of the conventional price in the early 2000s and dropped to around 26 percent by 2016 (Carlson and Jaenicke, 2016; Badruddoza et al., 2021). The market share for regular organic yogurt rose steadily through the 2000s but started to drop in the early 2010s when consumers began switching to Greek yogurt (Carlson and Jaenicke, 2016). Greek yogurt requires more milk than regular yogurt to produce, and manufacturers initially had difficulty sourcing enough organic milk. Organic Greek yogurt became more readily available again in the mid-2010s after milk production increased, and organic yogurt started to regain market share (figure 4.4)

### *Organic Eggs and Poultry: U.S. Retail Sales and Market Penetration*

Like organic milk, organic egg and poultry production generally incurred additional costs compared with conventional production because producers need to purchase organic feed, provide access to the outdoors, and keep chickens in a cage-free setting. In the early 2000s, the higher costs also reflected shortages of organic feed grains and lack of organic poultry and egg processing capacity. Organic retail price premiums compensated poultry producers for these higher organic production costs (see the section titled "United States Organic Poultry and Egg Markets" in chapter 3).

Between 2002 and 2017, retail price premiums for organic eggs dropped from more than 100 percent of conventional prices to around 50 percent by 2016 (Badruddoza et al., 2022; Carlson and Jaenicke, 2016). U.S. retail sales of poultry and eggs have tripled since 2008, to about $1 billion each in 2018 (inflation adjusted to 2021 dollars) (figure 4.5). Organic eggs accounted for nearly 14 percent of all U.S. retail sales of eggs in 2018, and organic chicken—excluding breaded and niche products—was nearly 4 percent of all U.S. chicken sales. Three of the top four poultry companies in the United States—Tyson Foods, Inc., Pilgrim's Pride Corporation, and Perdue Farms—have acquired organic brands since 2000 (Souza, 2019) (table 2.1).

Figure 4.5
**U.S. retail sales and market shares of organic eggs and chicken, 2008–18**




Note: Sales (solid lines) are represented on the right vertical access and shares (bars) are represented on the left axis. The chicken category includes frozen, canned, and cooked products as well as fresh chicken. More-processed products, such as sausage and breaded chicken, are not included. Inflation adjusted using the Consumer Price Index for all Urban Consumers (CPI-U).

Source: USDA, Economic Research Service using Information Research, Inc. (IRI) InfoScan data; and the Nutrition Business Journal, 2020.

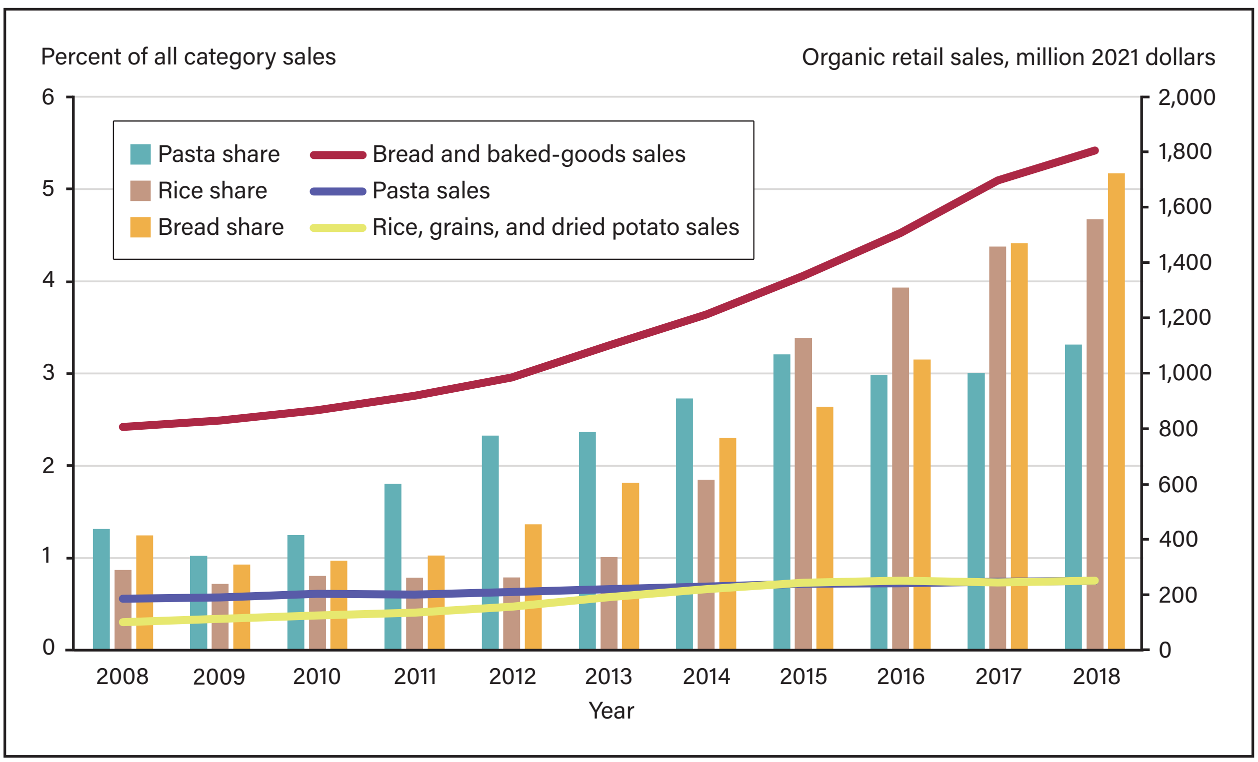
## *Organic Bread, Rice, and Pasta: U.S. Retail Sales and Market Penetration*

The majority of U.S. grain crop production is grown primarily for animal feed or industrial uses, although a few crops, such as rice and wheat, are used primarily for food production. Most of the food grains are processed into bread, baked goods, pasta, cereal, and other products before consumers purchase them. U.S. field crop producers have adopted organic systems at much lower levels than U.S. fruit, vegetable, dairy, and poultry producers (see chapter 3 for a discussion of commodity market challenges and trends).

U.S. retail sales of organic bread and baked goods reached $2 billion in 2020 (inflation adjusted to 2021 dollars), more than any other category of grain-based products (Nutrition Business Journal, 2020). Organic cereal and oatmeal were also top sellers, whereas organic baking products—such as flour and cake mixes—cookies, pasta, and rice had lower sales (Nutrition Business Journal, 2021). In this report, we examined the U.S. organic retail market share of three specific products—pasta, rice, and bread—between 2008 and 2018 (figure 4.6). The organic share of U.S. rice sales increased from under 1 percent to nearly 5 percent, with the higher levels of growth between 2014 and 2018 reflecting the large increase in U.S. organic rice production during that period. The organic share for bread showed a similar growth trend, while the organic share for pasta plateaued in 2015, echoing the slower growth in the inflation adjusted sales from 2014 to 2020 when compared with the other two grain categories.

Figure 4.6

**U.S. retail organic market share for grain-based products, 2008–18**



Note: Sales (solid lines) are represented on the right vertical axis and shares (bars) are represented on the left axis. Inflation adjusted using the Consumer Price Index for all Urban Consumers (CPI-U).

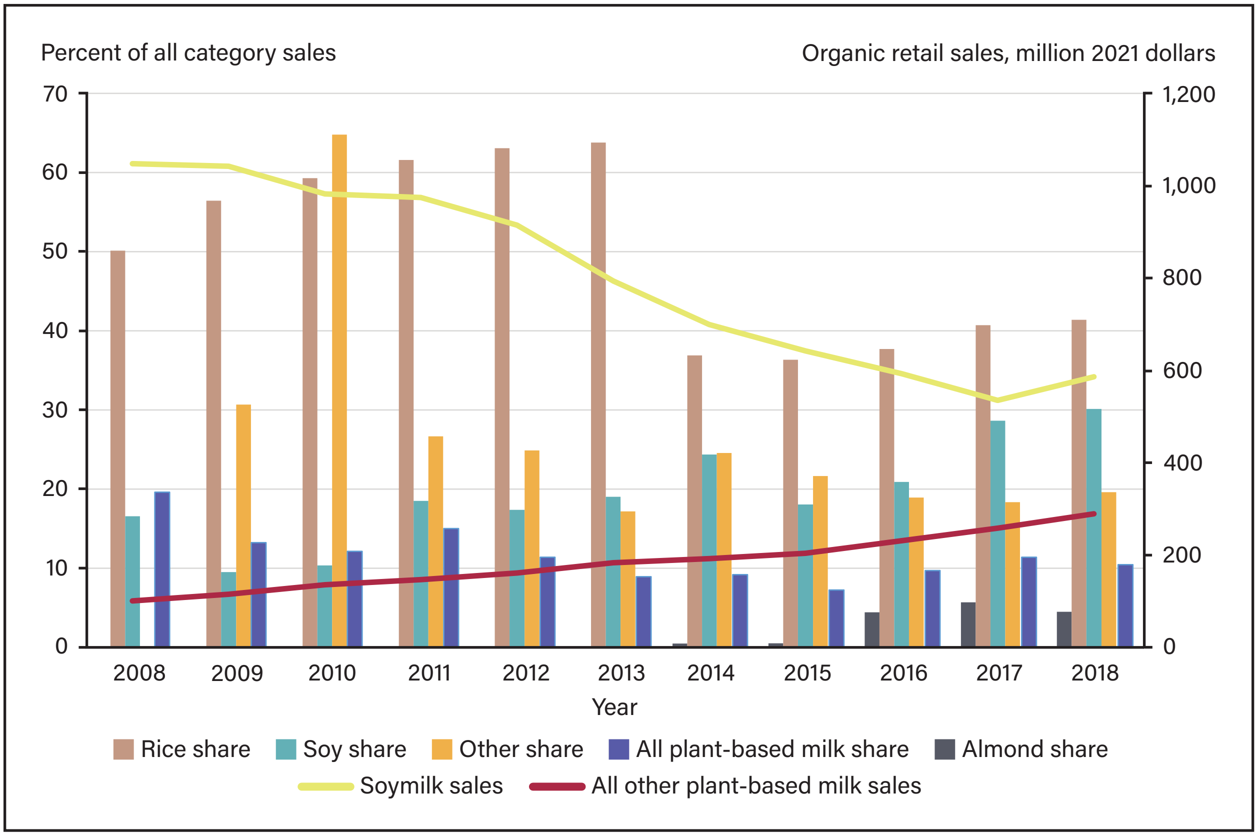
Source: USDA, Economic Research Service using Information Research, Inc. (IRI) InfoScan data; and the Nutrition Business Journal, 2020.

### *Organic Plant-Based Milk Alternatives: U.S. Retail Sales Market Penetration*

Once a niche product available only in health-food stores, plant-based milk has become so mainstream that some dairy farmers have expressed concern about the market share loss of dairy milk to alternative milks (Stewart et al., 2020). However, studies have suggested that although plant-based milks and dairy milk are competitors, the rise in plant-milk consumption does not fully explain decreasing dairy milk consumption (Stewart et al., 2021). Sales of organic plant-based milk from all sources were around $806 million in 2020 (inflation adjusted to 2021 dollars), significantly lower than the over $3 billion (inflation adjusted to 2021 dollars) in organic fluid milk sales. U.S. retail sales of organic plant-based milk products peaked in 2011 at $1.3 billion (inflation adjusted to 2021 dollars), when organic soymilk sales began decreasing faster than the sales of other organic plant-based milk increased (figure 4.7). The share of all U.S. organic plant-based milk sales dropped from nearly 20 percent to just over 10 percent. According to industry analysts, private label and entry-level products have begun to enter the plant-based milk market, but industry analysts believe there is still room for growth in this category (Organic Trade Association, 2020).

Although soymilk still leads in the organic plant-based milk category—with $586 million (inflation adjusted to 2021 dollars) more in sales than all other organic plant-based milks in 2020—after adjusting for inflation organic soymilk sales dropped by more than half between 2008 and 2020, while other plant-based milk sales nearly tripled. Nonorganic almond milk began drawing consumers away from soymilk by 2011 in both the conventional market and the organic. Organic almond milk was introduced a few years later, after almond producers had time to meet USDA's 3-year transition period requirement to qualify for organic production and labeling. Although organic rice milk had the highest market share of total rice milk sales in 2018 (figure 4.7), it had only a small share of overall plant-based milk consumption.

Figure 4.7
**U.S. retail market share of organic plant-based milks, 2008–18**




Note: Sales (solid lines) are represented on the right-hand y-axis and shares (bars) are represented on the left-hand y-axis. Although organic rice milk has a high market share, rice milk is a small sector of plant-based milk sales. For computing shares, the "Other share" includes coconut, oat, flax, other grains, hemp, hazelnut, macadamia, cashew, walnut, pecan, pistachio, pea, and banana. Inflation adjusted using the Consumer Price Index for all Urban Consumers (CPI-U).

Source: USDA, Economic Research Service using Information Research, Inc. (IRI) InfoScan data; and the Nutrition Business Journal, 2020.

## Characteristics and Motivations of Organic Consumers

Sustained growth in the organic food market suggests that many consumers feel the extra cost is worth paying. According to a 2018 Gallop U.S. poll (July 23–29, 2018), 47 percent of respondents reported they try to include organic foods in their diets, while 41 percent say they do not think about organic foods when eating food (Brenan, 2018). Another recent study, based on household food purchase data from a large, nationally representative sample of U.S. households, found organic food was purchased by more than 80 percent of households in 2016 (Organic Trade Association, 2017).[26]

## Characteristics of Organic Consumers

By 2010, consumer profiling research began eroding the stereotype that most organic consumers were high-income, White, and in households with young children (Stevens-Garmon et al., 2007). The Hartman Group (2010) and others found in the early years of the National Organic Program that these demographic identifiers likely reflected their access to organic food in upscale markets, rather than serving as defining

[26] This study is based on data collected by The Consumer Panel, a joint partnership of the market research companies Nielsen and IRI. The panel consists of 100,000 participating households in the 48 contiguous States that are geographically and demographically diverse to represent the national population. Participating households track all retail food purchases using a home bar-code scanner or smartphone app.

organic food consumers (Lipson, 2008). Industry analysts also found organic consumers were linked more by personal values than by demographics (Lipson, 2008).

Recent studies have continued indicating organic shoppers come from all types of consumer demographics, including education, presence of children, household income, age, and race/ethnicity[27] (table 4.2). Most studies that have examined the presence of children in a household found the households are more likely to purchase organic foods but not necessarily willing to pay more than households without children. One finding that has remained consistent across all recent studies is the largest living generation—millennials[28]—are much more likely to purchase organic food than older cohorts. Millennials' fruit expenditure shares are equivalent to those born before 1946. As millennial incomes rise, they have apportioned more of their food budgets to vegetables, which has suggested a strong preference for fruits and vegetables. They also have had a stronger preference for eating out[29] (Kuhns and Saksena, 2017). As more millennials become parents, they may follow previous generations of parents and increase their organic purchases.

Table 4.2
**Characteristics of organic consumers based on major studies, 2001–20**

| Authors and publication date[1] | Year(s) study conducted | Type of study | Education | Presence of children | Household income | Age | Race/ethnicity |
|---|---|---|---|---|---|---|---|
| Dimitri, C., and R.L. Dettmann. 2012. | 2006 | Household scanner data (n=44,000 households); discrete choice model | Households with higher education were more likely to purchase organic | Not statistically significant | Findings mixed: lower-income (< $30,000) shoppers purchased organic, but higher-income purchased more and the amount purchased increases with income | Included but not discussed | Findings on organic food purchases are mixed |
| Stevens-Garmon, J., C.L. Huang, and B.H. Lin. 2007. | 2001, 2004 | Household scanner data panel (n=8,164 and 8,430) | Households with at least a college degree more likely to be in the 2nd–4th quartile of organic expenditure | Not addressed | Higher-income shoppers more likely to purchase organic, but statistical association with income is inconsistent | Households with heads less than 30 more represented in the highest quartile of organic expenditure | Asian Americans highest spending, per capita on organic produce in 2001; African Americans highest in 2004 |

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[27] In 1997, the U.S. Office of Management and Budget set the standards used by Federal statistical agencies to collect data on race and ethnicity. These standards specified five categories for race and two for ethnicity (i.e., "Hispanic or Latino" and "Not Hispanic or Latino") and indicated the categories are sociopolitical constructs, not scientific or anthropological concepts.

[28] Defined as born between 1981 and 1996 or 1997.

[29] This study was conducted before the COVID-19 pandemic impacted U.S. food markets in 2020 and 2021.

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| Authors and publication date[1] | Year(s) study conducted | Type of study | Education | Presence of children | Household income | Age | Race/ ethnicity |
|---|---|---|---|---|---|---|---|
| Katt, F., and O. Meixner. 2020. | Jan. 1999–Mar. 2019 | Literature review of 138 Willingness to Pay (WTP) studies | Inconclusive results between Willingness to Pay (WTP) and education | Inconclusive results between WTP and presence of children | Inconclusive results between WTP and household income | Inconclusive results between WTP and age | Not addressed |
| Kim, G., J. Seok, and T. Mark. 2018. | 2010–2014 | Household scanner data, consumers who purchased organic at least once (n=154,308 house-holds); multilevel model | Households with higher education more likely to purchase organic food | Presence of children increases consumption | Less variation in impact of income for lower income consumers than higher income | Younger shoppers purchase more organic than older shoppers | Asian Americans purchase more organic food than White shoppers |
| Kuhns, A., and M. Saksena. 2017. | 2014 | Household scanner data panel, consumers who record random weight purchases (n=28,000); American Time Use Survey, Healthy Eating Module (n=25,000) | Not addressed | Not addressed | Not addressed | Millennials (1981–1996) largest living generation | Not addressed |
| Mascaraque, M. 2018. | 2017 | Review of Euromonitor International business industry data in the Health and Wellness Packaged Food cat-egories | Not addressed | Absence of pesticide residue especially important in purchases for babies/ young children | Not addressed | Not addressed | Not addressed |
| Organic Trade Association. 2020 | 2019 | Uses point of sale data; interviews with industry experts; survey of manufacturing community | Not addressed | Expecta-tion is that as Millen-nials have children, organic purchases will increase | Not addressed | Millennials remain growth drivers | Not addressed |

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| Authors and publication date[1] | Year(s) study conducted | Type of study | Education | Presence of children | Household income | Age | Race/ ethnicity |
|---|---|---|---|---|---|---|---|
| Organic Trade Association. 2015. | 2014, 2017 | Survey of all households (2017); survey of households with children (2014) | Not addressed | Households with children, 82 percent purchased at least once | Not addressed | Younger shoppers, especially Millennials, purchase more organic food than older shoppers | Share of Hispanic and African American households purchasing organic is increasing |
| Rifkin, R. 2014. | 2014 | Gallup's Consumption Habits annual survey | Not addressed | Not addressed | Among households with less than $30,000 annual income, 42 percent try to include organic food while 24 percent try to avoid. For households with incomes over $75,000, 49 percent try to include while only 11 percent try to avoid | Over half of Americans 18–29 actively try to include organic, but only one-third of 65 and older actively try | Not addressed |
| Vilceanu, M.O., O. Grasso, and K. Johnson. 2019. | Oct. 2014–June 2015 | Estimated indexes comparing one subset with larger group (e.g., organic shoppers versus population) based on Simmons National Consumer Study NHCS surveys | Not addressed | Women whose households consume organic more likely to have children under 5 | Higher incomes (>$75,000) overrepresented among organic consumers, especially men; residence value over $500,000 also over-represented | Millennials are over-represented, Baby Boomers and Silent Generation (b. 1928–1945) are under-represented among organic consumers | Asian Americans overrepresented among organic consumers, as are "not White or Black" and "Other" Americans |

n = Number of households or individuals included; NHCS = National Hospital Care Survey

Note: In 1997, U.S. Office of Management and Budget set the standards used by Federal statistical agencies to collect data on race and ethnicity. These standards have specified five categories for race and two for ethnicity (“Hispanic or Latino” and “Not Hispanic or Latino”), and have indicated the categories are sociopolitical constructs, not scientific or anthropological concepts. Nongovernmental studies may use different standards.

[1]Full citations for studies include: Dimitri, C., and R.L. Dettmann. 2012. “Organic Food Consumers: What Do We Really Know About Them?” British Food Journal 114 (8):1157–1183.

Katt, F., and O. Meixner. 2020. "A Systematic Review of Drivers Influencing Consumer Willingness to Pay for Organic Food," Trends in Food Science & Technology 100:374–388.

Kim, G. et al. 2018. "New Market Opportunities and Consumer Heterogeneity in the U.S. Organic Food Market," Sustainability 10 (9):3166.

Kuhns, A., and M. Saksena. 2017. Food Purchase Decisions of Millennial Households Compared to Other Generations, EIB-186, U.S. Department of Agriculture, Economic Research Service.

Mascaraque, M. 2018. "The World Market for Health and Wellness Packaged Food," Euromonitor International, London, UK.

Organic Trade Association. 2020. "2020 Organic Industry Survey," Organic Trade Association, Washington DC.

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Stevens-Garmon, J. et al. 2007. "Organic Demand: A Profile of Consumers in the Fresh Produce Market," Choices 22 (2):109–116.

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Source: USDA, Economic Research Service using cited reports.

### *Consumer Motivation Research*

Consumers purchase organic food for many reasons, including environmental protection, a desire to avoid pesticides, and perceptions about the role of organic food in a healthy diet. Researchers have examined consumers' motivations to purchase organic goods using consumer surveys, focus groups, and economic experiments. Table 4.3 summarizes some of the literature published over the past two decades that has examined consumers' motivations to purchase organic goods, such as personal values, environmental impact, avoidance of pesticide residue and antibiotics, healthy diets and nutrition, and the role of price. Findings were found in several studies, as well as one major meta-analysis published in 2018, and three literature reviews, including two published in 2019 and 2020.

The three most common reasons consumers give for purchasing organic food include a belief that organic foods are safer for the environment, a desire to avoid pesticide residue and antibiotics, and a belief that organic food is more nutritious than conventional food. To our knowledge, there are no studies specifically examining why consumers do not purchase organic food, other than the higher price.

### *Antibiotics and Pesticide Residue*

Some researchers have found using antibiotics in livestock and poultry production may increase the number of persistent organisms that are resistant to the set of antibiotics approved for humans (Sneeringer et al., 2015; Forman et al., 2012). Using 72 retail samples of organic and conventional milk collected across the United States in 2015, Welsh et al. (2019) found evidence of antibiotics above the U.S. Food and Drug Administration (FDA) limit in one-third of conventional samples but not in the organic samples. Welsh et al. (2019) cited that other studies at the time did not find antibiotics in the milk supply and their study is a small sample. In 2015, FDA conducted a survey of nearly 1,000 samples of milk from farms and found a small number (<1 percent) contained levels above the FDA limits. Most of these cases came from farms that had previous issue violations from slaughtered dairy cows. None of the antibiotics detected were part of routine testing at the time, and they had not been evaluated by FDA for use in lactating dairy cattle. The FDA study stated, "Although the small number of positive drug residues is encouraging, the fact that residues of a variety of non-Beta lactam drugs were detected affirms the importance of ongoing efforts to further strengthen existing milk safety safeguards" (FDA, 2015). In 2016, antibiotics used in human medicine required a prescription for dairy cows and could not be prescribed for production purposes. When conventional dairy cows are treated with antibiotics, their milk cannot be sold for some time, which is determined either by the veterinarian or the drug manufacturer (FDA, 2021). As a result of this policy change, total use of medically-important antibiotics[30] fell 43 percent between 2015 and 2017 (Sneeringer et al., 2020). According to the Public Health Service and FDA's "Grade 'A' Pasteurized Milk Ordinance" (Grade "A" PMO) all raw milk must be tested by the industry for antibiotics, and antibiotic-contaminated milk must be discarded. Since it is expensive for a farmer to have an entire load of dairy milk discarded, there is a clear economic incentive to keep milk from treated cows out of the dairy load.

In 2012, the American Academy of Pediatricians (AAP) reported there was not sufficient evidence linking lower levels of pesticide consumption to better health although several resources on how to lower pesticide-residue consumption were included in the report (Forman et al., 2012). Studies exploring links between human health and pesticide residue consumption in food have been nuanced. Mesnage et al. (2020) reported evidence that negative health outcomes were strongest due to pesticide residue consumption through occupational exposure and in utero; however, the authors only presented a few studies published in the early 2010s. The Environmental Protection Agency (EPA) has set safe limits on the acceptable level of pesticide residue exposure through food and occupational duties, based on continuing expert synthesis and assessment of internal and peer-reviewed studies as well as reported incidents. These EPA limits for food residue have been recognized and enforced by USDA and FDA[31] for acceptable levels of exposure.

Four studies (Fagan et al., 2020; Welsh et al., 2019; Forman et al., 2012; Smith-Spangler et al., 2012) found the risk of detectable pesticide residue consumption has been lower for organic than conventional food, although this finding has varied by commodity. USDA, Agricultural Marketing Service's (AMS) Pesticide Data Program sampled 9,697 products from terminal markets across the United States and rinsed the produce samples for 20 seconds under cold running water (USDA, AMS, 2019b). The analysis found nearly 99 percent of detected samples were below the tolerances established by the EPA, and 43 percent of the samples had no detectable residue (USDA, AMS, 2019b). The USDA's analysis of FDA's refusals of food import shipments for 1998–2004 found the highest percentage (20.6 percent) of total violations during this period was for above-tolerance pesticide residues on vegetables and vegetable products (Buzby et al., 2008; Bovay, 2016).

[30] FDA defines medically-important antibiotics as those given to treat a sick animal and under the care and supervision of a veterinarian.

[31] FDA enforces tolerances for plant commodities, including animal feed. USDA's Food Safety Inspection Service is responsible for enforcing residues in meat, poultry, catfish, and certain egg products that are not covered by FDA. For more information, please see the page "Pesticide Residue Monitoring Program: Questions and Answers" on the FDA website.

Table 4.3

**Organic Consumers' motivations based on major studies, 1985–2020**

| Authors and publication year[1] | Years study conducted | Type of study | Personal values | Environmental impact | Avoid pesticide residue, antibiotics | Healthy diets and nutrition | Impact of price premium |
|---|---|---|---|---|---|---|---|
| Hughner, R.S., P. McDonagh, A. Prothero, C.J. Shultz, and J. Stanton. 2007. | 1985–2005 | Literature review | Several studies found the perception that organic food tastes better, supports the local economy, or were more wholesome and fashionable were factors in choosing organic foods | Lighter buyers of organic food tend to perceive a higher value. Many studies found environmental concerns and to a lesser extent animal welfare a factor, but others found it was not a driving factor | For heavy buyers of organic food, pesticide residue has a high impact on perceived quality. Some consumers believed "chemicals and pesticides used in conventional food products were environmentally harmful | Majority of studies found health to be a primary reason consumers purchase organics | Studies found it to be the main obstacle to purchase organic food |
| Lee, H.-J., and J. Hwang. 2016. | 2011 | Structural Equation Modeling of an online household panel of primary household grocery shoppers who purchased organic food in the past year (n=725 ) | Not addressed | Consumers who perceive or believe organic is better for the environment are more likely to purchase organic food | For heavy buyers of organic food (organic food at least 16.7 percent of grocery purchases) there is a high impact of pesticide residue on the perceived quality of organic food | If organic foods are perceived as healthier than conventional food, then more likely to purchase organic food | Higher price premiums have more negative impact on the perceived value of light organic purchasers than for heavy purchasers. Light organic purchasers spent less than 16.7 percent of their grocery budget on organic food, while heavy purchasers spent at least 16.7 percent |

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| Authors and publication year[1] | Years study conducted | Type of study | Personal values | Environmental impact | Avoid pesticide residue, antibiotics | Healthy diets and nutrition | Impact of price premium |
|---|---|---|---|---|---|---|---|
| Benard, M., J. Baudry, C. Mejean, D. Lairon, K.V. Giudici, F. Etile, G. Reach, S. Hercberg, E. Kesse-Guyot, and S. Peneau. 2018. | 2014 | Multiple logistic regressions of survey of French adults (n=27,634) | Consumers who look to the future more than other consumers are more likely to purchase organic food | Not addressed | Not addressed | Not addressed | Not addressed |
| Vilceanu, M.O., O. Grasso, and K. Johnson. 2019. Proceedings 2019. | Studies published Oct. 2014–Jun. 2015 | Estimated indexes comparing one subset to larger group (e.g., organic shoppers versus population) based on Simmons OneView Research National Consumer Study NHCS surveys | Not addressed | Consumers with a higher-share of organic food purchases (compared with conventional food) believe eco-friendly products are higher quality and they choose environmentally friendly transportation | Not addressed | Diet characteristics that are over-represented among organic consumers include: prefer no artificial additives, use friends as a top source of nutrition advice, rate that nutrition is a top factor in food choice, and are vegetarians | Not addressed |
| Massey, M., A. O'Cass, and P. Otahal. 2018. | Studies published 1991–2016 | Meta-analysis of intentional and actual behavior, 150 studies, (n=124,353); measured percent of pooled estimates with positive perceptions | Not addressed | Of the pooled respondents, 57 percent have a positive perception that organic products are more environmentally friendly, and 55 percent believed they are more considerate of animal welfare when compared with conventional products | Of the pooled respondents, 62 percent have a positive perception that organic products are safer for consumption when compared with conventional products | Of the pooled respondents, 66 percent perceived that organic products provided more health benefits when compared with conventional products | Of the pooled respondents, 57 percent believed that organic products have a higher price and 46 percent perceived that they are less available than conventional products |

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| Authors and publication year[1] | Years study conducted | Type of study | Personal values | Environmental impact | Avoid pesticide residue, antibiotics | Healthy diets and nutrition | Impact of price premium |
|---|---|---|---|---|---|---|---|
| Mascaraque, M. 2018. | 2017 | Review of Euromonitor industry data from the Health and Wellness Packaged Food categories | Consumers looking for holistic approach to health and diet more likely to turn to organic packaged food products | Organic packaged foods seen as a more sustainable option than other packaged foods. | Pesticide-residue absence especially important in emerging markets like China, and for products purchased for children | Many consumers perceive organic food as more natural, healthier, and sustainable than conventional food | Not addressed |
| Kushwah, S., A. Dhir, M. Sagar, and B. Gupta. 2019. | Studies published 2005–18 | Systematic Literature Review, 89 studies examining the association between motives and barriers and purchasing organic food | Personal values, future orientation, organic food involvement, and attitudes about the food system used in 5 studies as explanatory variables | Social value for environmental concerns is high-ranking motivator in majority of studies; positive relationship with environment (in 13 studies); animal welfare (3 studies) | Functional value, including avoidance of harmful ingredients and devoid of chemical contaminates one of most important consumer motivators | Health attributes are most critical influencer, especially for organic buyers; 9 studies positive relationship for health; 4 for nutrient content | Price consciousness has a negative impact on outcome, and higher price is most crucial cause of consumer resistance |
| Katt, F., and O. Meixner. 2020. | Studies published 1999–Mar. 2019 | Literature review of 138 Willingness to Pay (WTP) studies | Less than 30 studies examined relationship of consumer attitudes towards corporate responsibility and WTP but found mixed results | Of more than 30 studies, more than 75 percent find a positive relationship between environmental concern and WTP | Of more than 30 studies, more than 75 percent find a positive relationship between health attitude and WTP | Of more than 30 studies, more than 75 percent find a positive relationship between health attitude and WTP | Price examined by more than 30 studies with mixed results on the relationship between price and WTP |

WTP = Willing to pay. n= Number of observations in the study. NHCS = National Hospital Care Survey

[1]Full citations for studies include: Benard, M. et al. 2018. "Association between Time Perspective and Organic Food Consumption in a Large Sample of Adults," British Journal of Nutrition 17(1):1.

Hughner, R.S. et al. 2007. "Who Are Organic Food Consumers? A Compilation and Review of Why People Purchase Organic Food," Journal of Consumer Behaviour 6 (2/3):94–110.

Katt, F., and O. Meixner. 2020. "A Systematic Review of Drivers Influencing Consumer Willingness to Pay for Organic Food," Trends in Food Science & Technology (100):374–388.

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Mascaraque, M. 2018. "The World Market for Health and Wellness Packaged Food," Euromonitor International, London, UK.

Massey, M. et al. 2018. "A Meta-Analytic Study of the Factors Driving the Purchase of Organic Food," Appetite (125):418–427.

Vilceanu, M.O. et al. 2019. "Bridging the Gap between Public Opinion Research and Consumer Marketing Research: Insights into U.S. Shoppers of Organic Foods," in conference proceedings of Association of Marketing Theory and Practice 2019.

Source: USDA, Economic Research Service using cited reports.

Perceived cancer risk may be part of the reason organic consumers wish to avoid pesticides, although evidence of a causal link is very weak, and the EPA's science-based risk assessment processes includes cancer risk. The 2008–10 annual report of the U.S. President's Cancer Panel recommended individuals reduce their environmental cancer risk by choosing, "to the extent possible, food grown without pesticides or chemical fertilizers and washing conventionally grown produce to remove residues" (U.S. Department of Health and Human Services, National Institutes of Health, 2010). However, to the best of our knowledge, this recommendation has not been reviewed by subsequent panels. Research on the association between organic food consumption and cancer is based on the type of cancer. Because cancer develops over several years, it is often difficult to pinpoint specific causes without very large and long studies. Two studies that examined links between the frequency of organic food consumption and cancer risk found the risk of non-Hodgkin's lymphoma decreased (Baudry et al., 2018; Bradbury et al., 2014). Breast cancer risk with organic food consumption is mixed. Bradbury et al. (2014) found no links between organic food and cancer risk, but Baudry et al. (2018) found reduced risk for post-menopausal breast cancer. To our knowledge, there are no studies identifying an association between organic food consumption and other types of cancer, although several studies have examined possible links. One complicating factor for research on organic food consumption and cancer risk has been that higher organic food consumption is associated with a diet rich in fiber, vegetable proteins, micronutrients, fruits, vegetables, nuts and legumes, and lower intake of processed meat—which are dietary practices that have been linked to reduced cancer risk (Dietary Guidelines Advisory Committee, 2020).

### *Healthy Diets and Nutrition*

One early meta-analysis (Dangour et al., 2009) did not find any difference between organic and conventional foods for nine nutrients. In 2012, AAP also reviewed the literature and identified a few nutrients higher in organic food compared with conventional, but most nutrients were consistent in both food types (Forman et al., 2012). The academy noted that the nutrient content of plant-based foods—especially fresh fruits and vegetables—is a function of many factors such as climate, geographic region, ripeness, freshness, and soil type, and it is important to control for as many of them as possible.

Studies that have examined specific nutrients in animal products have indicated organic agricultural practices contribute to higher levels of omega-3 fatty acids and other polyunsaturated fatty acids (PUFAs) and protein in fluid milk (Benbrook et al., 2013; Mayo Clinic, 2018; Palupi et al., 2012; Srednicka-Tober et al., 2016). Another study used samples purchased at Spanish retail stores to examine whether organic beef has less cholesterol and fat than conventional beef (Ribas-Agusti et al., 2019). PUFAs and omega-3 fatty acids are related to lower risk of cardiovascular disease (CVD). These studies have indicated the differences result from organic animals' higher fresh-forage intake compared with conventional livestock that is typically grain-fed. Studies did not compare organic animal products to nonorganic grass-fed animals.[32]

[32] USDA defines grass-fed beef products as those coming from cattle that were fed grass their entire life, other than milk consumed as a calf.

Some organic crops—like fruits, vegetables, and cereal grains—have been found to have higher concentrations of antioxidants (for fruits and vegetables) and total carbohydrates but some cereals contain lower concentrations of protein and fiber, compared with their conventional counterparts (Baranski et al., 2014). Antioxidants are linked to a lower risk of CVD, neurodegenerative diseases, and certain cancers. The toxic metal cadmium is also lower in organic foods than in conventional foods because organic agriculture does not allow the use of mineral fertilizers, which may contain cadmium.

### *Organic Halo Effect*

Consumers' perception that organic is healthier than conventional food is called the halo effect and a potential drawback of this effect is that consumers feel less guilty about consuming foods high in added sugars, sodium, and solid fats if it is labeled organic (Apaolaza et al., 2017; Faulkner et al., 2014). Although the snack food category accounts for only 6 percent of total organic food sales, it includes savory snacks and candy, as well as cereal bars,[33] which is the top selling item in this category. These foods are generally higher in fat, sodium, and added sugars than other food categories—nutrients that the *U.S. Dietary Guidelines for Americans 2020–2025* (USDA and DHHS, 2020; Dietary Guidelines Advisory Committee, 2020) recommends eating in moderation because of their association with obesity.

*Other Eco-Labels May Confuse Consumers and Not Provide Expected Food Traits*

Consumers can confuse the USDA-regulated organic eco-label with newer eco-labels developed by food processors and other private firms to suggest that the product has low environmental impacts. Consumers may also confuse other terms on labels with organic such as "natural" which have little regulatory oversight and lower production costs (Kuchler et al., 2018). Although the organic label is still the dominant eco-label in the United States and worldwide, the private sector now advertises over 200, mostly single-trait, eco-labels (Willer and Lernaud, 2019).

Market research and observations have noted an increasing trend in the use of "clean labels," generally identified as organic and other foods that are "free from" certain ingredients (Mascaraque, 2018), such as chemical additives, preservatives, and allergens (Phillips-Connolly et al., 2017). In contrast to the comprehensive, multi-trait Federal organic requirements, many private-sector food label claims are for a single farming or food-processing practice—such as "shade grown" coffee—that do not currently have a Federal Government definition. Other labels such as "raised without antibiotics" are overseen by the Federal Government. All label claims are subject to intervention from the Federal Trade Commission if a fraudulent claim is suspected or reported (Kuchler et al., 2017).

[33] Cereal bars are among the top five contributors of added sugar intake among people living in the United States (Dietary Guidelines Advisory Committee, 2020).

# Chapter 5: Conclusions

Over the last two decades, the U.S. Government has helped facilitate a large, growing market for organic food in the United States by administering organic regulations, adjusting USDA farm programs to meet the needs of organic farmers, collecting economic data on organic production and markets, and conducting research on organic food and agriculture. Strong demand from consumers, along with their willingness to pay organic price premiums to cover extra production costs, has driven a major expansion in U.S. organic production since 2000—particularly for produce, dairy, and poultry—by giving farmers the opportunity to improve their financial well-being and deliver key environmental benefits.

Growth in the U.S. organic food sector is expected to continue during the next decade. Consumers' trust in the organic label hinges on enforcement of USDA standards and fraud prevention measures that expand with sector growth. Organic consumers are diverse in terms of race, ethnicity, education, and income, though the millennials purchase organic food at larger rates than other generations. Households with children are also more likely to purchase organic food than households without children. If these trends play out as the industry has observed in earlier studies, millennials will purchase even more organic foods as they have children. Organic consumers have many motivations, though the major drivers seem to be a desire to avoid pesticide residue and antibiotics in food, supporting sustainable agriculture, and a belief that organic food is more nutritious. Although there is some scientific evidence to support these motivations, many results require more nuanced interpretation and more research is needed.

After adjusting for inflation, organic food sales increased every year between 2000 and 2020, but the rate of growth was faster between 2001 and 2007. The Coronavirus (COVID-19) pandemic—and the associated economic recession—had the opposite reaction where organic sales grew by more than 8 percent from 2019 to 2020, after adjusting for inflation. As with previous health scares, consumers sought out foods they believed were healthier and safer. Industry analysts believe changes that the food industry has already made to broaden organic food access, such as increased use of private label products for organic food, may have helped budget-conscious shoppers during the COVID-19 pandemic. The previous expansion of online food options may also have made the industry better prepared for the changes in food retailing during the pandemic. According to the market research firm SPINS, more than 15 million new customers entered the organic and natural foods market between early-March and mid-April 2020.[34] The long-term impacts of the COVID-19 pandemic on the organic sector are still unknown.

Before the 2002 Farm Act and the creation of the Organic Agriculture Research and Extension Initiative (OREI), Government support for organic research was limited. This meant the early organic pioneers were mostly farmers and researchers working with nonprofits, particularly the Organic Farming Research Foundation (OFRF) (Bull, 2006). OFRF—founded in 1990 with the goal of advancing organic agriculture through scientific research—played a groundbreaking role in the development of the U.S. organic research sector by encouraging farmer-scientist research partnerships, providing small organic research grants that help seed larger research projects, and developing national research priorities based on farmer needs.

One outcome of new and emerging research efforts may be to reduce the gap between organic and conventional crop yields. While public research over the past two decades (2000–20) has improved productivity in organic cropping systems, it has been historically limited. However, research findings from long-term cropping system experiments in the United States have suggested greater yields are possible. The foundations for growing organic research in Government agencies as well as in private firms have been building for many

[34] This study used National Consumer Panel data, an annual survey of 100,000 households jointly sponsored by the market retail companies Nielsen and IRI.

decades. The increased public funding the 2018 Farm Act established could jump-start organic research on more priority topics and in more universities and U.S. regions. This research could help solve 21st-century agricultural challenges by expanding knowledge regarding ecologically based farming systems, which are foundational to organic farming systems, and has the potential to inform innovation and practices in conventional systems as well.

In addition to more research on organic food and agriculture, more data collection on organic production, marketing, trade, and consumers could help researchers understand the sector. More data collection could also provide better decision-making tools for organic farmers and for the broader industry. While analytical services on organic agriculture have emerged in recent years, publicly collected data are the primary component for many firms' research work.

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# Appendix A: Organic Provisions, 2002–18 Farm Acts

This table includes provisions related to organic agriculture in each of the four Farm Acts since 2002. For ease of comparison, the table is arranged by title of the Farm Acts. Text includes both a summary of the provision and additional context.

| | |
|---|---|
| **Commodity Programs** *(Title I)* | |
| **USDA Noninsured Crop Assistance Program** | |
| 2018 | Provision clarifies that the market prices used to calculate Noninsured Crop Disaster Assistance Program (NAP) payments include organic prices. |
| **Conservation Programs** *(Title II)* | |
| **USDA Environmental Quality Incentives Program (EQIP)—Organic and Transition Initiative** | |
| 2018 | Conservation practices related to organic production and transition continue to be eligible for EQIP payments. Payment limits for the EQIP Organic Initiative targeted at organic and transitional farmers are increased $140,000 during the 5-year period of the 2018 Farm Act. Organic and transitioning farmers can continue to apply to the regular EQIP with a cap of $450,000, though the applicant pool is significantly larger. |
| 2014 | Conservation practices related to organic production and transition continue to be eligible for EQIP payments. |
| 2008 | Makes conservation practices related to organic production and transition eligible for EQIP payments, subject to a $20,000 annual limit and an $80,000 cap over a 6-year period for farmers applying under the Organic Initiative. These farmers are also eligible to participate in the regular program where the cap is significantly higher, though they must compete with a larger pool of applicants. |
| **USDA Conservation Reserve Program (CRP)—Organic Transition Incentives** | |
| 2018 | Allows farmers to begin transitioning to organic production prior to contract CRP expiration to meet USDA's organic certification requirement for a 3-year period. |
| 2008 | Allows special treatment of CRP land transitioning from retiring farmers or ranchers to beginning or socially disadvantaged farmers or ranchers: Beginning 1 year prior to the CRP contract termination date, a new farmer or rancher would be allowed to make land improvements and begin the organic certification process. |
| **USDA Conservation Stewardship Program (CSP)—Cross-Link to Organic Program** | |
| 2018 | Adds funding to States to support organic and transitioning farmers under CSP, with funding allocation based on number of certified and transitioning operations and acres within States. |
| 2008 | Allows producers to initiate organic certification while participating in CSP and requires development of CSP program specifications that are appropriate for organic producers. |
| **USDA Technical Assistance on Organic Conservation Practices** | |
| 2008 | Specifies technical assistance will be made available for implementing conservation practices on organic farms and specifies development of conservation-practice standards that are designed specifically for organic farming systems. |

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| **Trade** *(Title III)* | |
| **USDA Market Access Program (MAP)—Amendment on Organic Products** | |
| 2018 | Clarifies again that organic products are included in the MAP program. |
| 2008 | Amends the MAP program to explicitly include organic commodities. MAP was created in 1978 to provide cost-share funding to expand markets for U.S. agricultural products through technical assistance, market research, and promotion. Participating organizations include nonprofits, regional trade groups, and U.S. private companies. |
| **Credit Programs** *(Title V)* | |
| **USDA's State Agricultural Mediation Programs—Services Expanded for Organic Producers** | |
| 2018 | Expands the list of issues covered to include National Organic Program, family farm transition, and farmer-neighbor disputes. |
| **USDA Conservation Loan and Loan Guarantee Program—Organic Credit Provision** | |
| 2008 | Gives priority to qualified beginning farmers, ranchers, socially disadvantaged farmers or ranchers, owners, or tenants who use the loans to convert to sustainable or organic agricultural production systems, and producers who use the loans to build conservation structures or establish conservation practices. |
| **Research and Extension** *(Title VII)* | |
| **USDA Organic Agriculture Research and Extension Initiative (OREI)** | |
| 2018 | Establishes permanent (baseline) funding—annual funding remains at $20 million in fiscal year (FY) 2019, grows to $50 million by FY 2023, and remains at $50 million each subsequent year. |
| 2014 | Total mandatory funding is set at $100 million for the period from FY 2014 to 2018, or $20 million per year. The program was allowed to fund education activities. |
| 2008 | Increases mandatory funding from $15 million over the life of the previous 2002 legislation to $78 million spread out over fiscal years 2009–12, 2009 ($18 million for fiscal year 2009 and $20 million each for fiscal years 2010–12). An additional $25 million annually for fiscal years 2009–12 is authorized, subject to appropriations. Two new priorities were also added to the purpose of this initiative: (1) to study conservation and environmental outcomes of organic practices; and (2) to develop new and improved seed varieties for use in organic production systems. |
| 2002 | Creating the Organic Agriculture Research and Extension Initiative (OREI) to fund extramural research through a competitive grants program. The 2002 Farm Act set mandatory funding at a total of $15 million for fiscal years 2003–2007 and included specific priorities including: determining desirable traits for organic commodities; identifying the marketing and policy constraints to expanding organic agriculture; and conducting advanced research on organic farms. |
| **Horticulture** *(Title X)* | |
| **USDA National Organic Program (NOP) Support** | |
| 2018 | Authorization for appropriations increases from $16.5 million in FY 2019 to $24 million in FY 2023. Several new provisions are added to improve program enforcement. |
| 2014 | Authorized funding for the program expands to $15 million annually. |
| 2008 | Authorized funding for NOP is included in the Farm Act for the first time—increasing from $5 million in FY 2008 to $11 million in FY 2012. (NOP funding was $2.6 million in FY 2007). |

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| **Horticulture** *(Title X)* | |
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| **USDA National Organic Certification Cost-Share Program** | |
| 2018 | Mandatory funding drops to $24 million in FY 2018, to remain available until expended. |
| 2014 | Mandatory funding more than doubles to $57.5 million in FY 2014, to remain available until expended. |
| 2008 | Mandatory funding quadruples to $22 million in FY 2008, remaining available until expended. Maximum Federal cost share remains at 75 percent, but the cap increases to $750/certification scope. Recordkeeping requirements are added, and the Secretary is required to submit an annual report to Congress on State expenditures. |
| 2002 | Establishes assistance for producers and handlers to obtain organic certification from a USDA-accredited certifier, the program is funded at $5 million in FY 2002, remaining available until expended. Maximum Federal cost share is set at 75 percent annually, with payments up to $500 per certification scope for each producer or handler. |
| **USDA Organic Production and Marketing Data Initiative** | |
| 2018 | Total mandatory funding to improve economic data on the organic sector continues at $5 million over FY 2019 through FY 2023; another $5 million in mandatory funding is reserved for the National Organic Program to upgrade database and technology systems and improve tracking and verification of organic imports. |
| 2014 | Total mandatory funding to improve economic data on the organic sector continues at $5 million over the lifespan of the Act; another $5 million is added to upgrade the database and technology systems of USDA's National Organic Program. |
| 2008 | Includes first-time mandatory funding, set at $5 million over the lifespan of the Act, to expand organic production and marketing data collection, to be available until expended over 5 years. The purposes of this initiative are to collect and distribute comprehensive reporting of prices on organic products; to conduct surveys and analysis and publish reports on organic production, handling, distribution, retail, and trend studies (including consumer purchasing patterns); and to develop surveys and report statistical analysis on organically produced agricultural products. The Secretary is to submit a progress report on implementation of this initiative. |
| 2002 | Authorizes the collection of segregated data on organic production and marketing as part of ongoing data collection efforts. |
| **USDA Commodity Research and Promotion Orders—Organic Provisions** | |
| 2014 | Clarifies that all certified organic producers, including those that also have conventional farming operations, may be exempted from commodity promotion orders on their organic production. Establishes the option for the organic sector to develop an organic commodity research promotion order. |
| 2002 | Certified organic producers who produce and market only organic products and do not produce any conventional or nonorganic products are exempt from paying an assessment under any commodity promotion law. Organic growers had concerns about paying assessments that did little or nothing to market organic products. Methods for improving the treatment of certified organic agricultural products under Federal marketing orders will be evaluated as part of the research and extension provisions authorized under the Farm Act. |
| **USDA's National Organic Standards Board (NOSB)** | |
| 2018 | Clarifies an employee of a farmer can serve as a member of this Federal organic advisory board—and codifies current NOSB voting procedures for making changes to the list of materials that are acceptable in organic production. |

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| **Crop Insurance Program Provisions** *(Title XI)* | |
|---|---|
| 2018 | The 2018 Farm Act establishes continuing education requirements for crop insurance agents and loss adjusters to ensure that they are familiar with the conservation activities and agronomic practices used in organic and other production systems. |
| 2014 | Crop Insurance for Organic Crops—USDA's Risk Management Agency (RMA) is required to expand organic price elections for producers insuring crops by 2015. Producers choose a percentage of the maximum price set by USDA, RMA for their commodity, which is used to determine the value of insurance coverage. For many commodities, the maximum price election does not reflect the price premium growers receive for their organic production in years without a loss. |
| 2008 | Requires Federal Crop Insurance Corporation (FCIC) to contract for studies of organic production coverage improvement. Unless studies document "significant, consistent, and systemic variations in loss history between organic and nonorganic crops," requires FCIC to eliminate or reduce premium surcharge for organic production. Studies to include development of procedure to offer additional price election that reflects actual prices received for organic crops. |

Source: USDA, Economic Research Service using the various laws cited in the table.

# Appendix B: U.S. Data Sources on U.S. Organic Production, Marketing, and Trade

U.S. Department of Agriculture (USDA) began collecting data on U.S. organic cropland, pasture, and livestock from State and private certifiers soon after the Organic Foods Production Act of 1990 was enacted. Organic certifiers received comprehensive data on crop acreage and livestock from the farmers they certify each year as a requirement for certification. Since 2000, USDA has substantially expanded data collection on organic production and marketing. In 2002, USDA added two organic questions to the Census of Agriculture and—in 2008—conducted the first national organic producer survey. Many countries use certifier data for official organic acreage estimates (Willer and Lernaud, 2019) because countries may not conduct annual organic producer surveys and the methodology may vary from year to year. The United States currently conducts a national organic producer survey on a routine basis once every 5 years.

## USDA Organic Certifier Data and Producer Surveys

### *USDA Organic Certifier Surveys (1992–2015)*

USDA's longest running organic data series of U.S. certified acreage and livestock includes estimates for most years between 1992 and 2015. U.S. organic certifiers provide data on crop acreage, pasture, and number of animals that will be certified based on information in the organic system plans that each certified producer must submit on an annual basis. USDA published U.S. estimates for aggregate farm sectors (1992–1994); U.S. and State-level estimates for over 40 crop and livestock commodities (1997–2011); and U.S. and State-level estimates for aggregate farm sectors (2014–2015).

Availability: Estimates for 1992–2011: See the "Organic Production" page on the USDA, Economic Research Service (ERS) website.

Estimates for 2014–2015: See the "Organic Agriculture" page on the USDA, National Agricultural Statistics Service website.

### *USDA Organic INTEGRITY Database, Certified Operations List with Ongoing Updates (2010–present)*

The USDA, Agricultural Marketing Service (AMS), National Organic Program (NOP) produces the Organic INTEGRITY Database of U.S. certified organic farms, ranches, food processors, and other businesses around the world. Data include each certified operation's name, location, scope of certification, certifying agent, and products certified. This list is updated regularly based on data provided by NOP accredited certifying agents. For 2015, approximately 31,000 operations were listed, and the number grew to almost 46,000 in 2021.

*Availability:* Database is searchable and available on the USDA Organic INTEGRITY Database page on the USDA's Agricultural Marketing Service website for all public audiences to view and download as an Excel spreadsheet. Historic data are posted back to 2010.

### *USDA Agricultural Resources Management Survey (ARMS) 2005–present*

The Agricultural Resource Management Survey (ARMS) is USDA's primary source of information on the production practices, resource use, and economic well-being of farms and ranches in the United States. Since 2005, USDA, ERS has periodically included targeted organic oversamples in ARMS. Oversamples of organic producers have been included to examine the dairy sector (in 2005, 2010, 2016, and 2021), soybeans (2006), apples (2007), wheat (2009), and corn (2010). USDA, ERS has used ARMS data to calculate estimates of production costs and returns for both organic and conventional production systems for dairy, soybeans, wheat, and corn.

*Availability:* Published findings on U.S. organic costs and returns in U.S. dairy, corn, wheat, and soybean sectors are posted on the Organic Costs and Returns page on the USDA, ERS website. (Note: ARMS data are available for use by USDA researchers and researchers in academic institutions under agreements with USDA that protect the confidentiality of the data.)

### *USDA Census and National Organic Producer Surveys (2007–present)*

In the 2007 Census, USDA's National Agricultural Statistics Service (NASS) began asking all U.S. farmers if they had organic crop or livestock production, and if they did, the value of their organic sales. The following year, USDA, NASS began conducting a national survey of organic producers approximately every 5 years as a follow-up to the Census to examine trends in organic production and marketing. USDA, NASS conducted several additional national organic producer surveys[35] to gather additional information on organic production and marketing.

*Availability:* Findings from USDA, NASS's ongoing national organic survey, published approximately every 5 years, along with other special-purpose organic surveys are available on the "Organic Agriculture" page on the USDA, NASS website for the years 2008, 2011, 2014, 2015, 2016, 2019, and 2021. Census findings on the value of organic sales are available on the "Census of Agriculture" page on the USDA, NASS website.

## USDA Trade Data

### *U.S. Organic Trade Data (2011–present)*

In January 2011, the U.S. Department of Commerce began adding codes for selected organic products to the U.S. trade code system. The number of organic products tracked is still small but continues to expand. For organic exports, the number of tracked products has increased from 23 in 2011 to 36 in 2021. For organic imports, tracked products increased from 16 in 2011 to 48 in 2021.

*Availability:* USDA's Foreign Agricultural Service (FAS) reports monthly trade statistics on product volume and value in the Global Agricultural Trade System (GATS) database (choose "Standard Query" and then "Organics-Selected" under Product Groups).

## USDA Wholesale Market and Price Reports

### *USDA Organic Market/Price Reports (1998–present)*

USDA, AMS Market News Program publishes reports and periodicals on wholesale prices, shipping prices, demand, shipments from Mexico, and other market information. Since the late 1990s—when USDA, AMS market reports covered only a few organic fruits and vegetables—USDA, AMS expanded coverage to include organic poultry, eggs, grains, dairy, and cotton. USDA, AMS analyzes information from a variety of sources, including USDA, AMS market reporters who collect wholesale prices and other market data through regular contact with buyers and sellers. Organic fruit and vegetable reports cover the most commodities—nearly 120 individual organic fruits and vegetables for thousands of specific varieties, container sizes, and other product characteristics.

*Availability:* Most reports are available on a daily, biweekly, or weekly basis and posted on the "Organic Reports" page on the USDA, AMS website.

[35] The 2016 Certified Organic Survey was conducted by USDA, NASS in conjunction with USDA, Risk Management Agency.

## Private Sector Organic Data Sources

Proprietary data on organic production and marketing from several sources were also used to analyze organic trends in this report:

### *Mercaris Data Service*

Mercaris is a firm that offers a sustainable agriculture trading platform, as well as data and analysis of non-GMO and organic production in the United States. Mercaris has produced an annual "U.S. Organic and Non-GMO Acreage Report" since 2017. Mercaris constructs their estimates based on data from USDA's organic producer and certifier surveys and Organic INTEGRITY Database, as well as on data directly collected by Mercaris from the organic industry.

### *Information Resources, Inc. (IRI)*

IRI is a market research firm that offers household and retail scanner data. The InfoScan data used in this report are retailer point-of-sale records of consumer food purchases. IRI collects weekly revenues and quantities of each UPC (Universal Product Code) sold for each store. The dataset includes detailed information for both packaged food and random-weight fresh food. The retail sales data are available for individual store locations or market areas, covering a variety of outlet types, including grocery, club, convenience, dollar, drug, and mass merchandiser stores. The purchase data are linked to detailed product characteristics and nutrition data for food products. The InfoScan data are compiled into a dataset with billions of transaction records, covering a large portion of retail food-at-home sales in the United States (Muth et al., 2016). The data are available for the years 2008–present, but there is a lag for ERS to prepare the data for researchers. Please see the "Using Proprietary Data" page on the USDA, ERS website.

### *Nutrition Business Journal*

Nutrition Business Journal (NBJ) constructs estimations of U.S. organic food sales based on data from industry surveys and interviews, supermarket scanner data, and other sources (Nutrition Business Journal, 2016). NBJ uses a wide array of primary and secondary data sources to serve as the foundation for its industry estimates. NBJ's primary direct-to-the-source research is based on detailed sales survey data and expert information from experts in retail, manufacturing, and raw material supplies. NBJ's external sources include data from market research companies such as IRI, SPINS, and Nielsen, as well as information from Euromonitor, public company filings, press releases, and industry-related media.

# Appendix C: Research Findings: Agronomic and Environmental Characteristics of Organic Production and Improving Crop Yields

Since 2000, considerable research has been conducted on the agronomic and environmental sustainability characteristics of farming systems. This research has provided sufficient data to support global meta-analyses on various aspects of organic production: crop yields (Seufert et al., 2012; de Ponti et al., 2012; Ponisio et al., 2014), biodiversity (Bengtsson et al., 2005; Fuller et al., 2005; Hole et al., 2005), soil carbon (Gattinger et al., 2012), nutrient losses (Mondelaers et al., 2009; Tuomisto et al., 2012), greenhouse gas emissions (Skinner et al., 2014), and energy balances (Tuomisto et al., 2012). However, little data remain on difficult-to-measure metrics such as soil erosion. Although meta-analyses generally rely on global datasets, they are often heavily biased to data collected in Europe, North America, Australia, and New Zealand since there are limited datasets from other parts of the world (Gattinger et al., 2012; Tuomisto et al., 2012).

Long-term agroecological research (i.e., long-term experiments) is critical for evaluating sustainability of all agricultural systems since soil organic carbon and other measures of sustainability change slowly over time (Kleinman et al., 2018; Spiegal et al., 2018). It is also valuable because of the high interannual variability of crop yield, nitrous oxide ($N_2O$) emissions, erosion, and other measures of agricultural sustainability. Although a limited number of long-term experiments include organic cropping systems, this type of research is especially important for evaluating organic farming systems because a fundamental goal of organic farming is to build and manage soil carbon and create systems resilient to interannual variability such as weather.

This appendix examines findings from long-term experiments and other research on the agronomic and environmental aspects of sustainability. In the United States, the earliest long-term experiment that included organic farming systems began in 1981. Since then, 10 other long-term experiments including organic systems have begun in California, the Midwest, and other parts of the country (table C.1). Europe also has several ongoing long-term experiments that include organic farming systems (Raupp et al., 2006). Our focus in this section is on U.S-based research on crops since there are more data on crops than livestock production.

## Agronomic and Environmental Indicators of Sustainability

The productivity of agricultural systems has historically been measured per unit of land and has been a principal measure of agricultural system performance. Widespread recognition of the global impact of agricultural systems on larger ecological systems, however, has led to calls to substantially reduce the environmental footprint of agriculture (Rockstrom et al., 2009; Godfray et al., 2010; Foley et al., 2011; Reganold et al., 2011; Amundson et al., 2015).

USDA defines organic production as ecologically based production (see box 1.1, “USDA National Organic Program: Production and Processing Standards”). One of the stated goals of organic farming is to foster biodiversity to help create resistant and resilient systems that improve the delivery of ecosystem services (National Research Council, 2010; The Organic Center, 2022). Since synthetic pesticides, fertilizers, and other inputs have been implicated in the decline of ecological systems, they are largely restricted in organic farming since organic agriculture is commonly offered as a means of improving agricultural sustainability (Pimentel et al., 2005; Badgley et al., 2007; Scialabba and Müller-Lindenlauf 2010; Gomiero et al., 2011). Consumers' perceptions that organic farming is better for the environment than conventional farming is an important reason for many consumers to buy organic products (Hughner, et al., 2007; Lee and Yun, 2015; Lee and Hwang, 2016).

Assessing the potential of organic farming to contribute to global agricultural and environmental sustainability, however, is complex (Seufert and Ramankutty, 2017). One key piece of this complexity is crop yields in organic systems are—on average—lower than in conventional systems (Badgley et al., 2007; de Ponti et al., 2012; Seufert et al., 2012; Ponisio et al., 2015). The environmental impacts of organic farming are often lower per unit of land than for conventional methods, although that may not be the case per unit of production. Assessments based on land area are helpful for assessing overall impacts of agriculture, whereas assessments on a production basis integrate tradeoffs, if any, between agricultural production and environmental harms.

### *Biodiversity*

Meta-analyses have shown organic farming usually increases biodiversity compared with conventional farming, although the impacts vary for different plant and animal groups (Bengtsson et al., 2005; Fuller et al., 2005; Hole et al., 2005). For example, these authors found the abundance and species richness of soil organisms such as carabid beetles, earthworms, and other soil fauna, and fungi are generally greater in organic systems than conventional systems. These differences were largely related to greater inputs of plant residues and/or animal manures—which serve as the basis of the soil food web—and likely to the absence of synthetic agricultural chemicals in organic compared with conventional systems. The three studies also found biodiversity of some groups was greater in conventional than organic systems, whereas some groups had similar biodiversity in the two systems.

Plant diversity, however, seems to be consistently greater in organic systems when compared with conventional systems, reflecting the generally greater weed biomass in organic systems. Although weeds are usually considered detrimental in agricultural systems, they may provide some of the same ecosystem services as cover crops, such as reduced soil erosion and increased soil health due to increased inputs of organic matter to soil, especially after harvest. Ryan et al. (2009) proposed that managing weeds below a yield penalty threshold may help provide these benefits without reducing crop yields. There is renewed interest in using greater plant diversity as a tool to increase ecosystem services, such as promoting cover crop mixtures and intercropping strategies to augment ecosystem services such as weed suppression, nitrogen fixation, and habitat for beneficial insects (Fiedler et al., 2008; Bergkvist et al., 2010; Poffenbarger et al., 2015).

Since organic farms tend to be smaller and more spatially diverse than conventional farms, organic farming may benefit biodiversity independent of the specific management practices that define it. This is because landscape-level diversity alone increases biodiversity and the provision of ecosystem services such as biocontrol, pollination, and nutrient retention (Dinnes et al., 2002; Gabriel et al., 2005; Tscharntke et al., 2005; Rundlöf and Smith, 2006). A landscape composed of smaller, more spatially complex farms will therefore support greater biodiversity than one composed of larger, more homogenous farms.

### *Pesticides*

Organic farming has the potential to reduce pesticide exposure in the environment since fewer pesticides—and often more labile and less toxic ones—are used in organic compared with conventional production (Edwards-Jones and Howells, 2001; Zehnder et al., 2007). Less exposure to pesticides is often cited by farmers as a leading reason they convert to organic methods—based on personal communications with many farmers. Due to lower pesticide use, organic food has substantially fewer chemical residues than conventionally produced food (Baker, 2002; Baranski et al., 2014; Benbrook and Baker, 2014).

It is difficult, however, to generalize about the environmental benefits of limiting pesticide use in organic farming since pesticides used in conventional farming reflect diverse chemistries that differ in toxicity, environmental persistence, and biological impacts and because complex combinations of pesticides and other "designed bioactive chemicals" are commonly found in the environment (Schroeder et al., 2017; Bradley et al., 2019). Nonetheless, the environmental impacts of pesticides used in conventional farming have been well studied and include contamination of groundwater (Kolpin et al., 1998) and surface water (Gilliom et al., 2006; Bradley et al., 2019), sometimes at great distances from the pesticides' point of application (Mast et al., 2007). However, some pesticides used in organic production, such as copper-based fungicides, used primarily for horticultural crops, may also have detrimental environmental effects (Kiaune and Singhasemanon, 2011). The amount of use of pesticides on organic farms is too low to report (Greene et al., 2016).

The impacts of pesticides on biodiversity have recently been more widely documented. Current rates of biodiversity loss are unprecedented, with 40 percent of insect species showing population declines (Pimm and Raven, 2000; Barnosky et al., 2011; Ceballos et al., 2017). Although 13 percent of this decline is attributed to pesticides while habitat changes—such as converting land to agriculture and including subsequent intensification; urbanization, and industrial uses; pollution; invasive species, parasites and pathogens; and climate change—also contribute to this decline (Sanchez-Bayo and Wyckhuys, 2019). Another recent study revealed a 76 percent to 82 percent decline over 27 years in German nature reserves' insect biomass, and pesticides were speculated to be the dominant cause (Hallman et al., 2017). Since insects serve as the basis of food webs, as important pollinators, crucial decomposers, and nutrient recyclers, insect declines have cascading effects across ecosystems. Extensive use of pesticides has also been implicated in declines of bird diversity in grasslands and aquatic organisms in streams (Beketov et al., 2013; Mineau and Whiteside, 2013). To the extent that pesticides used in organic farming are less harmful to biotic diversity, organic farming may contribute less to biodiversity losses than conventional farming. In one study, the abundance and diversity of moths increased when intensive farming was replaced by organic farming (Taylor and Morecroft, 2009).

### *Soils: Soil Organic Matter and Soil Organic Carbon*

Accruing soil organic matter (SOM), which is about 58 percent carbon, has been recognized as the most important mechanism within the agricultural sector to mitigate climate change by removing carbon dioxide ($CO_2$) from the atmosphere (Smith et al., 2007). Global meta-analyses conclude organic farming results in greater soil organic carbon (SOC) and soil quality than conventional farming (Gattinger et al., 2012; Tuomisto et al., 2012). The climate mitigation benefits of this increased SOC in organic farming has been challenged (Leifeld et al., 2013) because greater SOC in organic systems is often due to imported carbon (C) inputs (e.g., animal manure) that could have contributed to increased SOC if applied elsewhere (Powlson et al., 2011). In addition, SOC's contribution to climate mitigation in organic systems has been questioned because lower yields mean benefits are lower per unit of production.

The meta-analyses cited above only include tilled organic and conventional systems. However, about 28 percent of corn, 40 percent of soybean, and 44 percent of wheat crop acreage in the United States in a given year is planted without tillage (no-till: NT) (Claassen et al., 2018). Additionally, rates of carbon accrual in NT systems in the Eastern and Central United States (0.36–0.58 Mg C ha-1 yr-1) (Eve et al., 2002; Johnson et al., 2005; Franzluebbers, 2010; Cambardella et al., 2012; Dell and Novak, 2012) are generally greater than those reported for organic systems (0.35 Mg C ha-1 yr-1) (Marriott and Wander, 2006). A caveat, however, is that only about 18 percent of corn, 21 percent of soybean, and 29 percent of wheat acreage was managed using NT methods for 4 years continuously (Claassen et al., 2018), and data on soil carbon accrual noted above are from continuous NT systems in place for more than 4 years.

Data comparing SOC in organic and NT systems are not common and show divergent results based on management details, particularly carbon input sources. In Michigan, SOC after 10 years was 22 percent greater in a NT system than an organic system where carbon inputs were similar and no manure was applied in either system (Robertson et al., 2000). In Wisconsin, SOC to a 20-cm depth was similar in a reduced-till conventional and an organic system after 18 years despite lower carbon and no manure inputs in the organic system. In Maryland, SOC to 30 cm depth after 9 years was 36 percent greater in an organic system with cover crops and dairy manure applied than in a NT system with no cover crops or manure applied (Teasdale et al., 2007). Also in Maryland, SOC to a depth of 1 meter was 11 percent greater after 11 years in an organic system that used poultry litter and legume cover crops than in a conventional NT system with no legume or manure use but both systems had similar carbon inputs (Cavigelli et al., 2013). Since most farmers using NT do not use continuous NT (Spargo et al., 2008; Claassen et al., 2018), results from continuous NT research sites represent an upper limit to carbon sequestration levels likely achieved on farm. Additional research is needed to better understand how conventional NT and organic farming compare regarding SOC and to understand the factors that contribute to differences in SOC levels.

### *Soils: Erosion*

Reviews and meta-analyses show organic farming also results in lower rates of soil loss than observed in tilled conventional systems (Pimentel et al., 2005; Gomiero et al., 2011). Examining the limited number of studies comparing soil erosion in organic versus conventional systems has indicated it is not greater soil organic matter (SOM) but greater use of cover crops in organic than conventional systems that is responsible for lower erosion rates (Reganold et al., 1987; Cavigelli et al., 2013). There do not seem to be any direct measurements of erosion in organic versus NT systems, but the Water Erosion Prediction Project (WEPP) model showed that NT reduced soil erosion by 80 percent compared with a tilled organic system with a similar crop rotation (Green et al., 2005). A separate Environmental Policy Integrated Climate (EPIC) model simulation showed similar soil erosion in a reduced-tillage organic system to that in a conventional NT system (Watkins et al., 2002).

### *Soils: Nutrient Losses*

Although sources of plant nutrients used in organic systems (e.g., cover crops, animal manures, etc.) may be retained for longer in the soil system than mineral fertilizers commonly used in conventional systems (Mallory and Griffin, 2007), organic systems are not immune to nutrient losses. Potential nutrient losses occur via multiple mechanisms. Nitrogen losses occur via runoff, erosion, leaching, and as various gases (ammonia volatilization and nitrous oxide emissions having the largest environmental impacts). Phosphorus (P) is largely lost via runoff and erosion. Nutrient losses via runoff, erosion, and volatilization can result in eutrophication (excessive nutrient buildup) and hypoxia of surface waters. Leaching—primarily of nitrate—can degrade groundwater, and nitrous oxide is a greenhouse gas (see "Greenhouse Gases") and catalyst of stratospheric ozone ($O_3$) decay. Meta-analyses indicate nitrogen (N) leaching, ammonia ($NH_3$) volatilization, and eutrophication potential, on average, are lower in organic systems on a per area basis but not per unit of production (Mondelaers et al., 2009; Tuomisto et al., 2012).

### *Nutrient Balances*

One of the fundamental goals of sustainable agriculture is to balance nutrient inputs with those in harvested products. Organic systems vary widely in nutrient balances (Watson et al., 2002), reflecting, in part, access to animal manures (Carr et al., 2019). In areas with ready access to animal manures and other byproducts, nutrient application rates are more likely to exceed nutrient removal in harvested products. In areas with limited availability of economically affordable animal manures and byproducts, nutrient balances are more likely to be negative. Since nutrient losses are partially controlled by nutrient balances, nutrient balances can provide some indication of the potential for nutrient losses via various loss pathways (Snyder et al., 2009).

### *Greenhouse Gases*

Greenhouse gas (GHG) emissions from U.S. agriculture accounted for 9.6 percent of total U.S. emissions in 2019 (U.S. Environmental Protection Agency, 2021). Keeping global temperature increases below 2.0°C requires both decarbonizing the economy and limiting emissions of other greenhouse gasses, including methane ($CH_4$) and nitrous oxide ($N_2O$) (IPCC, 2018; Hemes et al., 2021). Agriculture can contribute to both strategies. Since agricultural GHG mitigation is generally relatively inexpensive, currently scalable, does not involve substantial energy inputs, and has important co-benefits, agriculture often plays a prominent role in mitigation pathways (Hemes et al., 2021). As noted, increasing SOC in agriculture is one strategy to mitigate climate change. Since agriculture is the dominant source of non-carbon dioxide ($CO_2$) GHGs—i.e., nitrous oxide and methane (Smith et al., 2014)—reducing these emissions is also an important sustainability goal. Agricultural soils are the dominant source of nitrous oxide, whereas ruminants, manure management, and rice paddies are the dominant agricultural sources of methane (U.S. Environmental Protection Agency, 2021). Nitrous oxide and methane are both produced by microorganisms, and factors controlling these emissions can be complex and challenging to manage (Cavigelli and Parkin, 2012; Venterea et al., 2012).

A meta-analysis of nitrous oxide and methane emissions from agricultural soils found nitrous oxide emissions were lower in organic than conventional farming when based on a per area basis but larger when based on a per unit of production basis (Skinner et al., 2014). Soils may also serve as a small sink or source for methane, and the authors (Skinner et al., 2014) found—based on a small number of studies—organically farmed soils increased methane uptake slightly compared with conventionally farmed soils. Skinner et al. (2014) identified only one study comparing methane emissions from organic and conventional rice paddies, which found greater methane emissions from organic rice fertilized with pelleted poultry litter than from conventional rice fertilized with urea (Qin et al., 2010). Lower nitrous oxide emissions in the organic system did not make up for higher methane emissions when both emissions are expressed on a carbon dioxide equivalent basis.

As with other environmental impacts, crop rotation also impacts nitrous oxide emissions from organic systems. In Maryland, measured nitrous oxide emissions were greater in 2- and 3-year organic crop rotations than in a 6-year organic crop rotation or conventional systems (Cavigelli and Parkin, 2012). Total modeled GHG emissions (direct and indirect but not including changes in SOC) were also greatest in the two shortest organic rotations and lowest in the longest organic rotation, which was slightly lower than in two conventional rotations (Hoffman et al., 2018).

### *Water Balances*

Efficient use of water resources is another tenet of agricultural sustainability. There are very few data comparing water balance in organic and conventional systems. However, one study from California showed soil water availability was greater in an organic than a conventional system, which is likely due to greater water-holding capacity of soils with greater SOC (Seufert and Ramankutty, 2017). By contrast, a recent analysis of 18 years of data from USDA's oldest long-term trial in Maryland showed corn and soybean grain yields per unit of precipitation were higher under two conventional systems than under three organic grain-cropping systems (table C.1) (Teasdale and Cavigelli, 2017). Additional work is needed in this area.

### *Energy Use*

Efficient use of fossil fuel energy is also fundamental to agricultural sustainability. Smith et al. (2014)—by summarizing the results of almost 50 studies—showed that energy use in organic systems is consistently lower than in conventional systems when expressed on a per area basis. Differences are largely due to the high energy costs of synthetic fertilizers, particularly nitrogen (Schnepf, 2004). On a per crop yield basis, however, results are variable, largely reflecting differences in crop yields. For crops where the difference between conventional and organic yields are large—such as wheat in Europe—energy use per unit of production may be greater for organic production (Küstermann et al., 2008).

A factor impacting energy use in organic systems—that is rarely accounted for—is the application of nutrients that originated through industrial processes used in conventional agriculture (e.g., nutrients in manure from livestock raised using conventional methods). Hoffman et al. (2018), in an analysis accounting for energy use, showed energy use in two conventional systems was 17 to 43 percent greater than in 3 organic systems when expressed on a per area basis. However, when expressed per unit of crop yield, energy use was greatest in a 2-year organic corn-soybean rotation, lowest in a 6-year organic corn-soybean-wheat-alfalfa rotation, and intermediate in organic and in conventional NT and tilled 3-year corn-soybean-wheat-legume rotations.

## Research Efforts to Improve Organic Crop Yields

### *Organic Crop Yields*

Several global meta-analyses have indicated crop yields, on average on a global basis, are 19–25 percent lower in organic than in conventional systems (Badgley et al., 2007; de Ponti et al., 2012; Seufert et al., 2012; Ponisio et al., 2014). A recent study found similar results in the United States, showing average commercial organic crop yields are 20 percent lower than their conventional counterparts (Kniss et al., 2016).

Crop yield differences between organic and conventional systems vary by crop, region, and management details (de Ponti et al., 2012; Seufert et al., 2012). For example, Seufert et al. (2012) showed similar oilseed yields in conventional and organic systems (though variability was high), and organic yields approach those of conventional systems when best-management practices are used. The impact of crop rotation on organic grain yields is illustrated by results from the Farming Systems Project, one of USDA's long-term experiments in Beltsville, Maryland (see table C.1 for project characteristics). Average organic corn and grain yield during the first 10 years of this study was 30 percent greater in a corn-soybean-wheat-hay rotation than in a corn-soybean rotation and 10 percent greater than in a corn-soybean-wheat rotation; these yield differences are largely due to reduced weed pressure and nitrogen limitation as rotational crop diversity increased (Cavigelli et al., 2008; Teasdale and Cavigelli, 2008, 2010). Current data show a continuing impact of crop rotation length on crop yields (White et al., 2019).

Some studies show greater yield stability in organic systems than in conventional systems (Lotter et al., 2003), while other studies show the opposite (Clark et al., 1999; Delmotte et al., 2011; Smith et al., 2007; Teasdale and Cavigelli, 2017). These contrasting results may be due to high interannual variability in factors impacting crop yields—weed pressure, pest outbreaks, and soil nitrogen availability—in organic systems (Seufert and Ramankutty, 2017). The impact of this variability is illustrated by findings from the University of Wisconsin's long-term experiment, which shows that tillage-based weed control after planting was not possible in one-third of the years, over a 21-year period, due to wet soils. Corn and soybean yields were only 75 percent and 79 percent, respectively, of those in conventional systems in those years; however, in the 14 years with good early-spring weed control, yields were 98 percent and 94 percent of conventional yields, respectively (Posner et al., 2008).

Lower yield potential of some organic crop varieties might explain some of the yield gap between conventional and organic systems since varieties used in organic production have often been optimized for use in conventional chemical-intensive systems (Wolfe et al., 2008; Cavigelli, 2013; Skinner et al., 2019). One study showed that selecting wheat varieties grown in an organic setting resulted in higher yield than selecting varieties within a conventional setting (Murphy et al., 2007).

The various factors that seem to limit crop yields in organic systems point to areas of future research: improved organic crop breeding (Murphy et al., 2007; Wolfe et al., 2008), weed control (Posner et al., 2008), and nutrient management (Carr et al., 2019). Some of the data discussed above also suggest organic management has the potential to produce crop yields similar to those in conventional systems.

### *Improving Crop Yields*

Because of the large variability in management practices among both organic and conventional systems, there is also large variability in the performance of organic and conventional systems. In addition—as noted—many measures of sustainability are greater in organic than conventional systems when expressed per unit of land, but the opposite is often true when expressed per unit of production. These results indicate that if organic crop yields could be improved without increasing the environmental footprint per unit of land, the sustainability of organic production would be improved.

Research efforts to improve crop yields in organic systems have been limited, and the large interannual variability in crop yields suggests greater yields are possible. The Organic Farming Research Foundation has found the biggest challenges to improving crop yields are weed control and nutrient management (Sooby et al., 2007; Tuomisto et al., 2012; Jerkins and Ory, 2016). The Organic Farming Research Foundation, organic food companies, and other private groups are conducting some research to address these critical research needs, and a substantial funding increase for USDA's extramural organic research program was included in the 2018 Farm Act (see the Organic Research Trends section), which could help target this issue.

Table C.1
**U.S. long-term agroecological research trials with organic and conventional comparisons[1]**

| Trial name (location) | Lead institution | Year initiated[2] | Organic treatments[3] | Conventional treatments[4] | Climate |
|---|---|---|---|---|---|
| **Farming Systems Trial** (Kutztown, PA) | Rodale Institute | 1981[5] | ▪ C-S-C-W/RC-RC, manure, conv. tillage<br>▪ C-S-C-W/RC-RC, manure, red. tillage<br>▪ C-S-O/RC-C-O/RC, legume, conv. tillage<br>▪ C-S-O/RC-C-O/RC, legume, red. tillage | C-S rotation | Humid Continental |
| **Long-Term Ecological Research in Row Crop Agriculture** (Hickory Corners, MI) | Michigan State University | 1989 | ▪ C-S-W/RC | Similar systems and rotation | Humid Continental |
| **Variable Input Crop Management Systems** (Lamberton, MN) | University of Minnesota | 1989 | ▪ C-S-W<br>▪ C-S-W-A | C-S rotation | Humid Continental |
| **Wisconsin Integrated Cropping Systems** (Arlington, WI) | University of Wisconsin-Madison | 1990 | ▪ Cash grain: C-S-W/RC<br>▪ Dairy forage: C-O-A-A | Two grain systems and two dairy systems | Humid Continental |
| **Century Experiment** (Davis, CA) | University of California-Davis | 1994 | ▪ C-Tomato | Eight systems with varying inputs, rotations, use of native grass | Mediterranean |
| **USDA Farming Systems Project** (Beltsville, MD) | USDA Agricultural Research Service (ARS), Beltsville Agricultural Research Ctr. | 1996 | ▪ C-S<br>▪ C-S-W<br>▪ C-S-W-A-A-A | CT and NT, C-S-W/S rotations | Humid Subtropical |
| **Farming Systems Research Unit, Center for Environmental Farming Systems** (Goldsboro, NC) | NCSU, NCA&TSU, and NC DA&CS[6] | 1998 | ▪ 3-year row crop + 3-year hay<br>▪ C-S-cover<br>▪ C-S-Su, conv. tillage<br>▪ C-S-Su, red. tillage | Two systems: plantation forest and successional ecosystem | Humid Subtropical |

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| Trial name (location) | Lead institution | Year initiated[2] | Organic treatments[3] | Conventional treatments[4] | Climate |
|---|---|---|---|---|---|
| **Neely-Kinyon Long-Term Agroecological Research** (Greenfield, IA) | Iowa State University | 1998 | ▪ 3-year<br>▪ 4-year | C-S rotation | Humid Continental |
| **Field Crops Organic Transition Experiment** (Wooster, OH) | The Ohio State University | 2000 | ▪ C-S-O/RC+T | Conventional C-S rotation | Humid Continental |
| **Organic Grain Cropping Systems Experiment** (Aurora, NY) | Cornell University | 2005 | S-Spelt/RC-C<br>▪ High compost<br>▪ Low compost, minimal inputs<br>▪ Low compost, int. weed management<br>▪ Low compost, perm. ridge tillage | Conventional system on nearby farm | Humid Continental |
| **USDA Cover Crop Systems Project** (Beltsville, MD) | USDA, ARS, Beltsville Agricultural Research Center | 2014 | ▪ C-S-W, conv. tillage<br>▪ C-S-W, reduced tillage | Four NT systems with incr. cover crop intensity | Humid Subtropical |

[1]Crop abbreviations: A = alfalfa, C = corn, O = oats, RC = red clover; S = soybean; Su = sunflower; T = timothy; W=wheat.

Input abbreviations: N=nitrogen.

Tillage abbreviations: CT=conventional tillage; NT=no tillage.

[2]Year research plots were established; the experimental design or plot layout at some sites reflected findings from an initial uniformity trial evaluating site variability.

[3] Treatments used in 2019; aspects of some treatments changed over time at some sites.

[4]Cover crops are not included in crop rotation designations.

[5]Tillage comparison added in 2008.

[6]North Carolina State University, North Carolina A & T State University, and North Carolina Department of Agriculture and Consumer Services.

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

# Appendix D: U.S. Certified Organic Operations, Harvested Acreage and Value, 2008–19

Table D.1

**U.S. certified organic vegetable farms, harvested acreage and sales, 2008–19**

| | 2008 | 2011 | 2014 | 2015 | 2016 | 2019 |
|---|---|---|---|---|---|---|
| **Number of operations with harvested acres** | | | | | | |
| All vegetables | 2,499 | 1,998 | 3,315 | 2,999 | 3,121 | 3,300 |
| Lettuce | 939 | 810 | 934 | 806 | 819 | 1,129 |
| Potatoes | 868 | 732 | 828 | 688 | 681 | 886 |
| Spinach | 454 | 311 | 374 | 311 | 344 | 603 |
| Sweet potatoes | 170 | 177 | 281 | 229 | 285 | 401 |
| Tomatoes[1] | 1,149 | 928 | 1,496–1,563 | 1,226 | 1,057 | 1,238 |
| **Acres harvested** | | | | | | |
| All vegetables | 130,436 | 118,071 | 163,746 | 185,325 | 186,178 | 224,122 |
| Lettuce | 34,915 | 22,673 | 32,099 | 37,916 | 37,641 | 38,525 |
| Potatoes | 7,848 | 9,088 | 12,046 | 13,281 | 17,244 | 23,612 |
| Spinach | 7,668 | 9,162 | 17,994 | 22,843 | 17,547 | 23,018 |
| Sweet potatoes | 4,217 | 4,348 | 6,001 | 6,998 | 9,647 | 9,130 |
| Tomatoes[1] | 8,517 | 5,997 | 7,548 | 8,978 | 12,435 | 10,751 |
| **Value of sales** (thousand nominal dollars)[2] | | | | | | |
| All vegetables | 685,311 | 1,071,694 | 1,247,667 | 1,361,747 | 1,644,431 | 2,084,302 |
| Lettuce | 186,290 | 278,480 | 263,837 | 262,246 | 277,345 | 400,117 |
| Potatoes | 29,729 | 50,959 | 61,735 | 66,306 | 150,579 | 154,936 |
| Spinach | 37,364 | 71,727 | 117,053 | 154,471 | 118,162 | 179,498 |
| Sweet potatoes | 24,656 | 26,618 | 68,043 | 70,753 | 100,993 | 77,187 |
| Tomatoes[1] | 58,566 | 57,887 | 67,149 | 86,692 | 174,973 | 132,332 |

[1]Greenhouse tomatoes are not included. The 2014 survey separated fresh from processing tomatoes, and some farms may produce both. The bottom end of the range assumes complete overlap, while the top end represents no overlap.

[2]USDA reports the value of utilized production (in dollars) for conventional vegetables, and the value of sales (in dollars) for organic vegetables.

Source: USDA, Economic Research Service using USDA, National Agricultural Statistics Service, National Organic Producer Surveys (NASS) data; and USDA, NASS, Quick Stats data.

Table D.2

**U.S. certified organic farms harvesting fruits, tree nuts, and berries, 2008–19**

| | 2008 | 2011 | 2014 | 2015 | 2016 | 2019 |
|---|---|---|---|---|---|---|
| **Number of operations with harvested acres**[1 2] | | | | | | |
| Almonds | 85 | 74 | 90 | 81 | 76 | 73 |
| Apples | 654 | 377 | 700 | 699 | 583 | 728 |
| Blueberries[4] | 292 | 279 | 516–559 | 587 | 455 | 539 |
| Grapes | 683 | 515 | 764 | 714 | 712 | 742 |
| Strawberries | 476 | 356 | 554 | 603 | 611 | 580 |
| **Acres harvested**[1] | | | | | | |
| Total fruits, tree nuts, and berries[1] | 96,997 | 80,537 | 114,408 | 107,072 | 115,618 | 156,428 |
| Almonds | 4,887 | 5,196 | 6,157 | 6,209 | 5,897 | 5,915 |
| Apples | 19,312 | 13,363 | 16,086 | 15,763 | 15,037 | 27,311 |
| Blueberries[4] | 1,736 | 2,780 | 4,898 | 5,706 | 5,359 | 10,313 |
| Grapes | 26,889 | 31,771 | 27,223 | 27,912 | 27,358 | 37,400 |
| Strawberries | 1,516 | 1,638 | 2,961 | 4,031 | 6,249 | 5,158 |
| **Value of sales** (thousand nominal dollars)[3] | | | | | | |
| Total fruits, tree nuts, and berries | 524,051 | 923,449 | 1,032,292 | 1,203,382 | 1,407,403 | 2,022,454 |
| Almonds | 12,449 | 21,123 | 32,307 | 40,600 | 32,014 | 32,976 |
| Apples | 136,122 | 122,212 | 251,084 | 302,404 | 327,423 | 474,703 |
| Blueberries[4] | 16,019 | 39,744 | 69,272 | 124,488 | 100,482 | 205,227 |
| Grapes | 121,775 | 160,624 | 195,289 | 209,568 | 218,401 | 332,487 |
| Strawberries | 43,442 | 66,472 | 89,095 | 151,318 | 241,621 | 320,794 |

[1]Harvested acreage is recorded for organic operations, whereas bearing acreage is recorded for conventional operations. Because not all bearing acreage is necessarily harvested, the organic and conventional operations are not comparable.

[2]The organic census totals separate fruit and tree nut total farms by citrus, tree nuts, apples, grapes, and berries and other fruits. Since some operations have crops across one or more categories, we cannot provide total number of operations.

[3]With the exception of strawberries, for conventional fruits, tree nuts, and berries, the value of utilized production is recorded in dollars as opposed to value of sales in dollars.

[4]Blueberries do not include wild harvest. The 2014 Census of Agriculture separates processing and fresh blueberries, and some farms may produce both. The lower number of farm counts represents complete overlap while the upper end represents no overlap.

Source: USDA, Economic Research Service using USDA, National Agricultural Statistics Service, National Organic Producer Surveys (NASS) data; and USDA, NASS, Quick Stats data.

Table D.3

**U.S. certified organic field crop farms, harvested acreage, and sales, 2008–19**

| | 2008 | 2011 | 2014 | 2015 | 2016 | 2019 |
|---|---|---|---|---|---|---|
| **Number of operations with harvested acres** | | | | | | |
| Field crops | N/R | 4920 | 6,168 | 6,403 | 7,403 | 9,024 |
| Barley (for grain or seed) | 574 | 415 | 531 | 505 | 510 | 487 |
| Corn (for grain or seed) | 2,108 | 1,903 | 2,705 | 2,720 | 3,275 | 3,985 |
| Oats (for grain or seed) | 1,040 | 805 | 994 | 1,000 | 1,206 | 1,200 |
| Rice | 101 | 70 | 85 | 106 | 109 | 114 |
| Soybeans (for beans) | 1,331 | 1,203 | 1,429 | 1,420 | 1,748 | 2,135 |
| Spring wheat (for grain or seed) | 475 | 301 | 295 | 337 | 354 | 448 |
| Winter wheat | 861 | 713 | 822 | 713 | 824 | 906 |
| **Acres harvested** | | | | | | |
| Field crops | N/R | 1,288,637 | 1,399,501 | 1,458,706 | 1,684,047 | 2,268,646 |
| Barley (for grain or seed) | 47,205 | 41,645 | (D) | 50,826 | 51,254 | 63,839 |
| Corn (for grain or seed) | 143,074 | 134,877 | 167,702 | 166,841 | 213,934 | 319,953 |
| Oats (for grain or seed) | 41,016 | 34,700 | (D) | 39,647 | 50,732 | 54,147 |
| Rice | 26,763 | 28,626 | 25,013 | 28,642 | 31,911 | 39,993 |
| Soybeans (for beans) | 98,113 | 96,080 | (D) | 94,841 | 124,591 | 170,074 |
| Spring wheat | 93,082 | 76,372 | 79,912 | 82,976 | 101,484 | 175,773 |
| Winter wheat | 202,848 | 178,541 | 173,190 | 208,430 | 222,890 | 275,081 |
| **Value of sales** (thousand nominal dollars) | | | | | | |
| Field crops | N/R | 464,884 | 717,229 | 660,044 | 762,613 | 1,180,235 |
| Barley (for grain or seed) | (D) | 12,276 | (D) | 19,272 | 16,866 | 27,794 |
| Corn (for grain or seed) | 111,389 | 101,482 | 154,896 | 129,067 | 163,878 | 278,157 |
| Oats (for grain or seed) | 8,570 | 6,505 | 12,153 | 10,451 | 13,343 | 13,523 |
| Rice | 27,533 | 34,842 | 34,813 | 41,269 | 42,737 | 44,106 |
| Soybeans (for beans) | 50,184 | 49,410 | 71,530 | 62,543 | 78,491 | 108,999 |
| Spring wheat | 32,731 | 24,436 | 32,597 | 28,464 | 34,853 | 59,288 |
| Winter wheat | 68,706 | 53,976 | (D) | 72,659 | 64,170 | 89,825 |

(D) = withheld to avoid disclosing data for individual farms; N/R = field crop totals not reported for 2008

Note: Spring wheat includes durum.

Source: USDA, Economic Research Service using USDA, National Agricultural Statistics Service, National Organic Producer Surveys (NASS) data; and USDA, NASS, Quick Stats data.

Table D.4

**U.S. inventory and sales of operations producing certified organic livestock, 2008–19**

| | 2008 | 2011 | 2014 | 2015 | 2016 | 2019 |
|---|---|---|---|---|---|---|
| **Operations with certified organic livestock inventory and sales** | | | | | | |
| Number of operations with inventory | | | | | | |
| Milk cows | 2,301 | 1,848 | 2,296 | 2,282 | 2,559 | 3,134 |
| Beef cows | 713 | 488 | 683 | 455 | 490 | 533 |
| Other cattle | 2,172 | 2,180 | 2,825 | 2,753 | 3,048 | 3,667 |
| Number of operations with sales | | | | | | |
| Milk cows | 1,617 | 1,778 | 2,180 | 2,202 | 2,239 | 2,452 |
| Beef cows | 367 | 332 | 476 | 353 | 360 | 329 |
| Other cattle[1] | 1,596 | 1,894 | 2,533 | 2,587 | 2,621 | 2,912 |
| Peak inventory (number of animals) | | | | | | |
| Milk cows | 218,895 | 213,376 | 241,955 | 241,112 | 279,021 | 363,404 |
| Beef cows | 44,779 | 35,367 | 42,047 | 40,600 | 46,014 | 41,780 |
| Other cattle | 185,462 | 199,354 | 242,592 | 228,630 | 256,031 | 323,767 |
| Value of sales (thousand nominal dollars) | | | | | | |
| Milk cows | 33,457 | 39,197 | 69,480 | 65,361 | 57,801 | 71,731 |
| Beef cows | 5,595 | 7,894 | 15,767 | 8,982 | 10,531 | 9,112 |
| Other cattle | 53,513 | 71,949 | 130,926 | 158,251 | 164,408 | 211,797 |
| **Operations with certified organic milk sales** | | | | | | |
| Organic milk | | | | | | |
| Number of operations | 2,004 | 1,823 | 2,255 | 2,258 | 2,531 | 3,100 |
| Quantity (thousand pounds) | 2,757,085 | 2,797,846 | 3,406,046 | 3,406,421 | 4,034,990 | 5,122,685 |
| Sales (thousand nominal dollars) | 750,136 | 764,686 | 1,082,228 | 1,173,504 | 1,385,790 | 1,585,157 |

[1]"Other cattle" includes organic replacement milk heifers, beef calves, and bulls.

Source: USDA, Economic Research Service using USDA, National Agricultural Statistics Service, National Organic Producer Surveys data.

Table D.5

**U.S. certified organic poultry and egg farms, inventory, and sales, 2008–19**

| | 2008 | 2011 | 2014 | 2015 | 2016 | 2019 |
|---|---|---|---|---|---|---|
| **Number of operations with inventory** | | | | | | |
| Broilers | 193 | 153 | 245 | 187 | 215 | 369 |
| Layers | 540 | 413 | 795 | 730 | 818 | 1,057 |
| Turkeys | 91 | 70 | 127 | 74 | 103 | 129 |
| **Number of operations with sales** | | | | | | |
| Broilers | 168 | 143 | 220 | 181 | 212 | 361 |
| Layers | 180 | 143 | 293 | 293 | 389 | 463 |
| Turkeys | 85 | 68 | 117 | 69 | 96 | 126 |
| Eggs | 466 | 384 | 722 | 684 | 788 | 1,015 |
| **Inventory, peak** (1,000 head) | | | | | | |
| Broilers | 6,352 | 4,213 | 8,567 | 9,077 | 21,733 | 29,345 |
| Layers | 4,464 | 6,740 | 9,592 | 14,214 | 17,516 | 19,903 |
| Turkeys | 228 | 498 | 1,351 | 1,501 | 1,512 | 1,847 |
| **Value of sales** (thousand nominal dollars) | | | | | | |
| Broilers | 195,771 | 115,269 | 371,471 | 420,312 | 749,930 | 1,115,102 |
| Layers | 2,180 | 2,633 | 3,283 | 1,461 | 2,462 | 11,316 |
| Turkeys | 8,648 | 22,626 | 49,704 | 70,021 | 83,129 | 139,301 |
| Eggs | 154,518 | 275,778 | 419,604 | 732,037 | 815,881 | 886,698 |
| Other poultry | 11,023 | 4,754 | 12,608 | 12,194 | 79,266 | 95,131 |
| Total poultry | 372,140 | 421,060 | 856,670 | 1,236,025 | 1,730,668 | 2,247,548 |
| **Product sales** (number of units) | | | | | | |
| Broilers (1,000 head) | 30,592 | 19,654 | 43,255 | 47,424 | 105,261 | 162,449 |
| Layers (1,000 head) | 1,467 | 3,086 | 4,688 | 3,242 | 5,484 | 4,750 |
| Turkeys (1,000 head) | 318 | 791 | 1,169 | 1,579 | 1,984 | 2,938 |
| Eggs (1,000 dozen) | 80,236 | 134,304 | 166,314 | 292,482 | 345,269 | 399,139 |

Source: USDA, Economic Research Service using USDA, National Agricultural Statistics Service, National Organic Producer Surveys data.