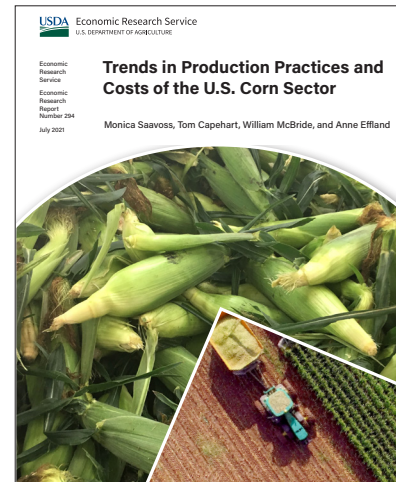


Trends in Production Practices and Costs of the U.S. Corn Sector

Monica Saavoss, Tom Capehart,
William McBride, and Anne Effland

What Is the Issue?

Over the past several decades, the U.S. corn industry experienced developments in seed and precision farming technologies, farm consolidation, and changes in irrigation coverage, which impacted production. Corn accounted for over one-third of the planted acreage for the eight major row crops and was number one in value of production. Corn is a major source of livestock feed, fuel, exports, and a multitude of corn-derived products such as paper and advanced bioproducts such as plastics and cosmetics. This report describes the technological and structural changes in U.S. corn production and describes how these changes have affected farm expenditures, net returns, productivity, yields, and production costs.



What Did the Study Find?

In the last several decades, there was significant structural change in U.S. corn production:

- Over 88 million acres of corn were planted in the United States in 2018, an 11-percent increase from the 79 million acres planted in 1996. The average size of farms that planted corn followed an upward trend, with an average of 501 acres in 1997, 637 acres in 2007, and 725 acres in 2017. In the early part of the period, the average acres planted to corn per farm expanded nearly 50 percent, from 189 acres in 1996 to 280 acres in 2010. There was little change, however, beyond 2010; the average was 278 acres in 2016.
- Across regions, total net returns (value of production less total costs) for corn production fluctuated year to year, with the highest net returns in 2010 and the lowest in 2005 of the 1996-2016 period.

Technological changes in U.S. corn production between 1996 and 2016 (the most recent data available) included:

- Genetically engineered seed varieties. These appeared on the seed corn market in 1996 and, with the introduction of stacked trait seeds—those with genes to produce up to three different traits—became increasingly complex. Steadily, producers increased their adoption of Bt (corn borer)-resistant, corn root worm-resistant, and herbicide-tolerant seed varieties.

ERS is a primary source of economic research and analysis from the U.S. Department of Agriculture, providing timely information on economic and policy issues related to agriculture, food, the environment, and rural America.

- Precision production technologies. Yield monitor and yield map adoption expanded, from 19 and 6 percent nationally (respectively) in 2001 to 52 and 31 percent in 2016. Over the 2001–2016 period, self-propelled machinery with guidance systems (from 3 to 39 percent), variable-rate fertilizer application (about 6 to 19 percent), variable-rate seeding (less than 1 to 15 percent), and variable-rate pesticide application (about 1 to 7 percent) were used on rising percentages of corn-planted acres, with rates of increase varying depending on the region.
- Irrigation. The share of irrigated corn acres declined. The most notable changes were in the Prairie Gateway region, where 77 percent of planted acres were irrigated in 1996 compared with 39 percent in 2017, and in the Northern Great Plains region, where irrigated corn acres dropped from 39 percent in 1996 to 10 percent in 2016.

The effects of structural and technological change in U.S. corn production can be seen in increased average corn yields. The Heartland bolstered the U.S. average throughout most of the period with the highest yield of any region and increases in bushels per acre from 138 in 1996 to 197 in 2016, while the Southern Seaboard region had the lowest average yields across years, at 113 bushels per acre.

Average production costs per acre nearly doubled between 1996 and 2016, with seed, fertilizer, capital (buildings and equipment), and land costs as major drivers.

Corn farm productivity improved. Measured as the cost per bushel of corn a farm produced, adjusted by the cost of inputs, farms were considered more productive when the input-adjusted cost per bushel was lower. Productivity grew 28 percent over the period, at an average annual rate of 1.2 percent.

Cost per bushel of corn production decreased as farm size increased up to and including farms of 750 acres in 2016. However, economies of size appear to level out for farms between 750 and 1,500 acres. Since 58 percent of total planted corn acres were on farms of fewer than 750 acres, this suggests a significant capacity for corn farms to further exploit economies of size.

Higher productivity producers had higher yields, larger farms, lower irrigation rates, and lower per acre expenditures on chemicals, fuels, and fertilizer than lower productivity producers. Corn yields of the most productive producers in 2016 averaged 202 bushels per acre, more than 50 percent higher than the yields of low-productivity producers.

How Was the Study Conducted?

This study uses data from USDA, Economic Research Service (ERS) and USDA, National Agricultural Statistics Service's (NASS) Agricultural Resource Management Survey (ARMS) for corn from the years 1996, 2001, 2005, 2010, and 2016, and from the U.S. Census of Agriculture in 2002, 2007, 2012, and 2017. It also uses costs and returns estimates produced by USDA, ERS in each ARMS corn survey year, as well as 2018/2019 acreage and yield reports from USDA, NASS. These data are summarized for each year to describe changes in corn production practices and productivity. Technological and structural characteristics are summarized for each survey year. Corn export statistics from the ERS Feed Grains database are employed to provide context for production changes. For tractability reasons, figures for all summaries of regional outcomes over time include only a subset of regions. Regions are included either because they are major corn-producing regions or because they demonstrate a particularly notable trend in the outcome of interest (for example, a region that experiences the fastest growth in the outcome of interest may be included).