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Economic Information Bulletin Number 128

September 2014

Characteristics and Production Costs of U.S. Corn Farms, Including Organic, 2010

Linda Foreman

United States Department of Agriculture

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Characteristics and Production Costs of U.S. Corn Farms, Including Organic, 2010

Linda F. Foreman

Abstract

Data from the 2010 Agricultural Resource Management Survey (ARMS) and ERS cost of production accounts present a snapshot of the production costs, production practices, and characteristics related to U.S. corn production in 2010. This study found considerable variation in the operating and ownership costs for corn, ranging from an average of $1.74 per bushel for low-cost producers to $3.88 per bushel for high-cost producers. In 2010, high corn prices meant that most producers covered their corn production costs from harvest-month prices. The Heartland continues to be the major corn production region with the lowest operating and ownership costs per bushel, mainly because of the region's high corn yields. The operating and ownership costs *per bushel* did not vary significantly by enterprise size where size is measured by the number of planted corn acres per farm. However, these costs *per planted acre* were lowest for farms with the smallest corn enterprises and highest for farms with the largest corn enterprises. Production value less operating and ownership costs per acre from organic corn production was higher than that from conventional corn production because higher prices more than offset lower yields for organic corn.

Keywords: corn, operator characteristics, production costs, production practices, cost variation, organic corn, Agricultural Resource Management Survey (ARMS).

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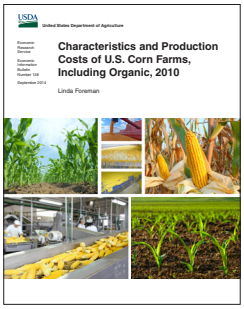
United States Department of Agriculture

A report summary from the Economic Research Service September 2014



Find the full report at *www.ers.usda.gov/publications/eib-economic-information-bulletin-report/eib128*

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Linda F. Foreman

What Is the Issue?

Higher corn prices boosted the returns to corn production and contributed to an increase in corn acres from 76 million in 2001 to 88 million in 2010. Among the various factors boosting prices was an increased share of corn being used to produce ethanol. By 2010, ethanol production consumed 5,019 million bushels or 35 percent of the supply, compared with 707 million bushels or 6 percent of the U.S. corn supply in 2001. Organic corn demand has grown in recent years, although organic corn production remains a small segment of overall corn production.

Higher returns and the boost in planted corn acres have changed the characteristics and practices of U.S. corn producers since 2001—the year assessed by the last comprehensive ERS report on corn production. Because aggregate data mask the diversity among corn growers, this study breaks down the data to examine differences in production costs and practices as well as farm and operator characteristics within various corn producer groups in 2010. In addition, data on corn production in 2010 and 2001 are compared to view the effects of the changing U.S. corn market.

What Did the Study Find?

Corn producers exhibited numerous differences in their production costs, yields, planted acres, farm incomes, and net returns from corn production.

Higher prices and higher yields allowed corn producers to achieve greater returns from corn production in 2010 than in 2001. As a result, 92 percent of corn producers could have covered their operating and ownership costs per bushel for corn based on harvest-month prices in 2010. Of those who did not cover their costs, many were producers in a pocket of the Southeast that experienced low yields due to drought, so they likely would have covered their costs under normal weather conditions. In 2001, only 59 percent of corn producers could have covered their operating and ownership costs per bushel from harvest-month prices.

The Heartland is known for its favorable corn growing conditions and continues to dominate U.S. corn production, with 66 percent of planted corn acres in 2010. Despite a 17-percent increase in planted corn acres between 2001 and 2010, the shares of corn acres and production across regions did not change significantly. Most low-cost producers were located in the Heartland.

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.

In 2010, the average operating and ownership *costs per bushel* did not vary significantly by the number of planted corn acres per farm. In contrast, 2001 producers planting the fewest corn acres per farm had the highest costs per bushel mainly because of their lower yields.

In 2010, producers with the smallest corn enterprises (fewest acres) had the lowest average operating and ownership costs *per acre*, while producers with the largest corn acreage had higher costs per acre. In 2001, these costs per acre did not vary significantly by corn enterprise size. The higher per-acre production costs in 2010 for producers with larger corn enterprises may have stemmed from the fact that these producers were least likely to rotate corn with other crops (such as soybeans). The addition of 12 million acres of planted corn between 2001 and 2010 may have resulted in some less productive land added to corn production in 2010, which could have boosted average production costs per acre. In 2010, producers planting the most corn acres per farm (1,000 acres or more) held a larger share of total planted corn acres than in 2001**.**

In 2010, net returns from organic corn per bushel and per acre exceeded those from conventional corn. Higher prices for organic corn outweighed the effects from lower yields. Total operating and ownership costs per acre were not statistically different between organic and conventional corn. Most organic corn production occurred in the North, mainly in the Heartland and Northern Crescent. Compared with operators of conventional corn farms, operators producing organic corn planted fewer corn acres per farm while also operating smaller farms.

How Was the Study Conducted?

The author analyzed data from the 2010 Agricultural Management Resource Survey (ARMS) for corn. This survey collected data from conventional and organic corn producers in 2010. ARMS is the major annual economic survey conducted by ERS and the National Agricultural Statistics Service. Commodity versions of ARMS surveys are conducted on a rotating basis every 4 to 8 years to obtain data to support the commodity cost and return estimates. Previous ARMS corn surveys were conducted for the 2005, 2001, and 1996 growing seasons. In addition to comparing data collected in the 2010 ARMS to those from 2001, the author presents regional variation in costs from each of the last three corn surveys (2001, 2005, and 2010). ERS data on the corn production costs and returns, estimated using the ARMS data, were also used in this study.

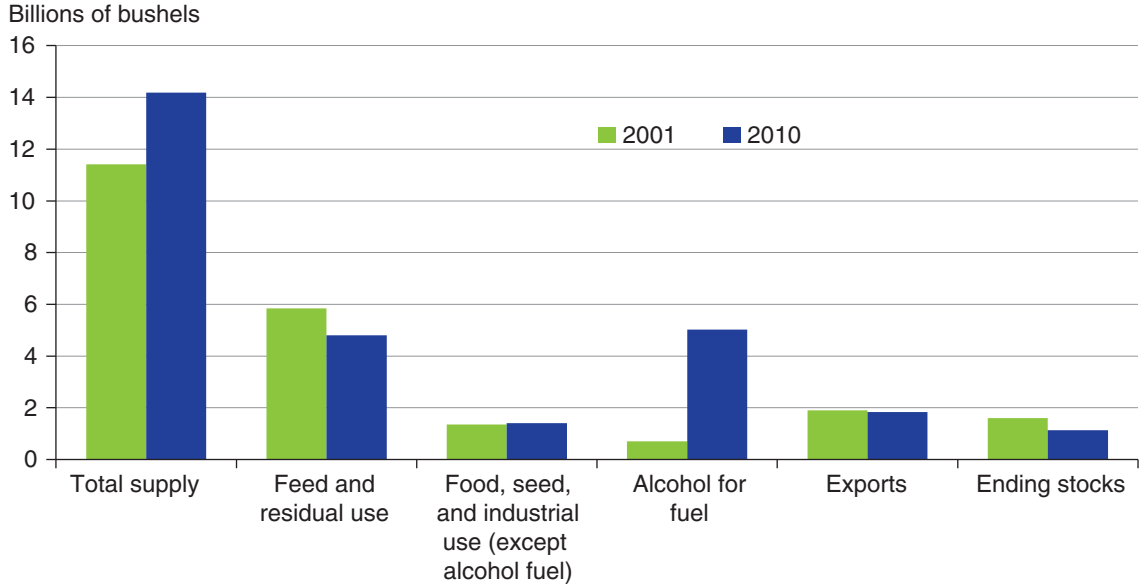
Characteristics and Production Costs of U.S. Corn Farms, Including Organic, 2010

Background

The United States produces more corn than any other country. The United States accounted for 38 percent of the world's corn production in 2010 and 51 percent of the world's corn exports in the 2010/11 marketing year (WAOB, 2012). Corn is a leading U.S.-produced crop, and its role expanded over the last decade as demand rose. Corn accounted for 15 percent of U.S. cash receipts generated from agricultural production in 2010, up from 8 percent in 2001 (USDA, ERS, 2013e). Corn production in the United States rose to 12.4 billion bushels in 2010, up from 9.5 billion bushels in 2001 (USDA, NASS, Quick Stats). Corn prices rose in response to a host of factors including the rising ethanol demand, depreciation of the U.S. dollar, growth in global population and per capita income, and rising world consumption of animal products. The rising ethanol demand affected corn prices because corn is the major starch source for U.S. ethanol production. Higher prices boosted the returns to corn production, creating an incentive to increase corn acreage. Corn acreage rose from 75.7 million in 2001 to 88.2 million in 2010. Corn yields per harvested acre also rose, from an average of 138 bushels in 2001, to an average of 153 bushels in 2010, boosting the supply of corn.

Data in figure 1 show how much the available U.S. corn supply increased from 2001 to 2010 and how the increased corn production went to ethanol production. In 2010, ethanol consumed 35 percent of the larger corn supply, and in 2001, it consumed about 6 percent. From 2001 to 2010, the amount of corn used for feed and residual uses declined, as did ending stocks, due, in part, to higher

Figure 1
Supply and uses of U.S. corn crop in the 2001 and 2010 marketing years



Note: Ending stocks = total supply minus total disappearance.
Source: USDA, Economic Research Service, *Feed Grain Database and U.S. Bioenergy Statistics*.

corn prices. During that period, feed and residual use fell from 51 percent of the total supply to 34 percent, while exports dropped from 17 percent to 13 percent. Ending stocks fell from 14 percent in 2001 to 8 percent in 2010 (USDA, ERS, 2013b).

Differences in crop uses have implications for the welfare of producers (Westcott, 2007). Because a higher share of the total corn supply is used for ethanol, changing corn ethanol demand affects corn producers more profoundly than variations in corn exports. Factors influencing ethanol demand include Government ethanol regulations, consumer acceptance of ethanol blends higher than the traditional 10-percent level used by most fuel retailers, use of hybrid and more energy-efficient vehicles, and annual miles driven.

Information on the 2010 U.S. corn crop may be helpful for interpreting the data. At the end of the 2009/10 corn marketing year, the corn stock-to-use ratio was at the lowest level since the 1995/96 marketing year (ERS, 2013b). In addition, Russia's reduced corn crop in 2010, due to weather, led that country to restrict its exports (Piller, 2010). These factors put upward pressure on 2010/11 U.S. corn prices and helped spur a 2.1-percent increase in U.S. corn acres in 2010 from 2009. Corn prices averaged $5.18 per bushel in 2010/11, up from $3.55 per bushel in 2009/10, and yields averaged 153 bushels in 2010, down from 165 bushels per acre in 2009 (USDA, NASS, Quick Stats). Higher corn prices in 2010 boosted the net production value per acre (USDA, ERS, 2013f).[1]

Annual percentage changes in regional estimates can be larger than annual changes at the national level. The Northern Great Plains and Prairie Gateway producers increased total planted corn acres by 6 to 7 percent from 2009 to 2010, while Southern Seaboard producers decreased their corn acres by 7 percent (see regional definitions in fig. 2). The Eastern Upland producers had sharply reduced yields as a result of hot, dry weather in Kentucky that occurred late in the 2010 corn growing season. Consequently, the increased corn demand during this period was largely met by expanded production in the Plains States.

In recent years, the number of U.S. farms harvesting corn far exceeded the number of farms harvesting any other major food, feed, or oilseed crop. About 16 percent of U.S. farms grew corn in 2010, while the census of agriculture indicates 16 percent of U.S. farms grew corn in 2002 and 2007 (ARMS, 2010). (See box, "Data Sources.") Data from the censuses of agriculture indicate the number of farms harvesting corn in 2002 and 2007 remained about the same. In contrast, the number of U.S. farms harvesting most other major food, feed, or oilseed crops declined significantly from 2002 to 2007. Rising corn demand may be partly responsible for the stability in the number of corn producers.

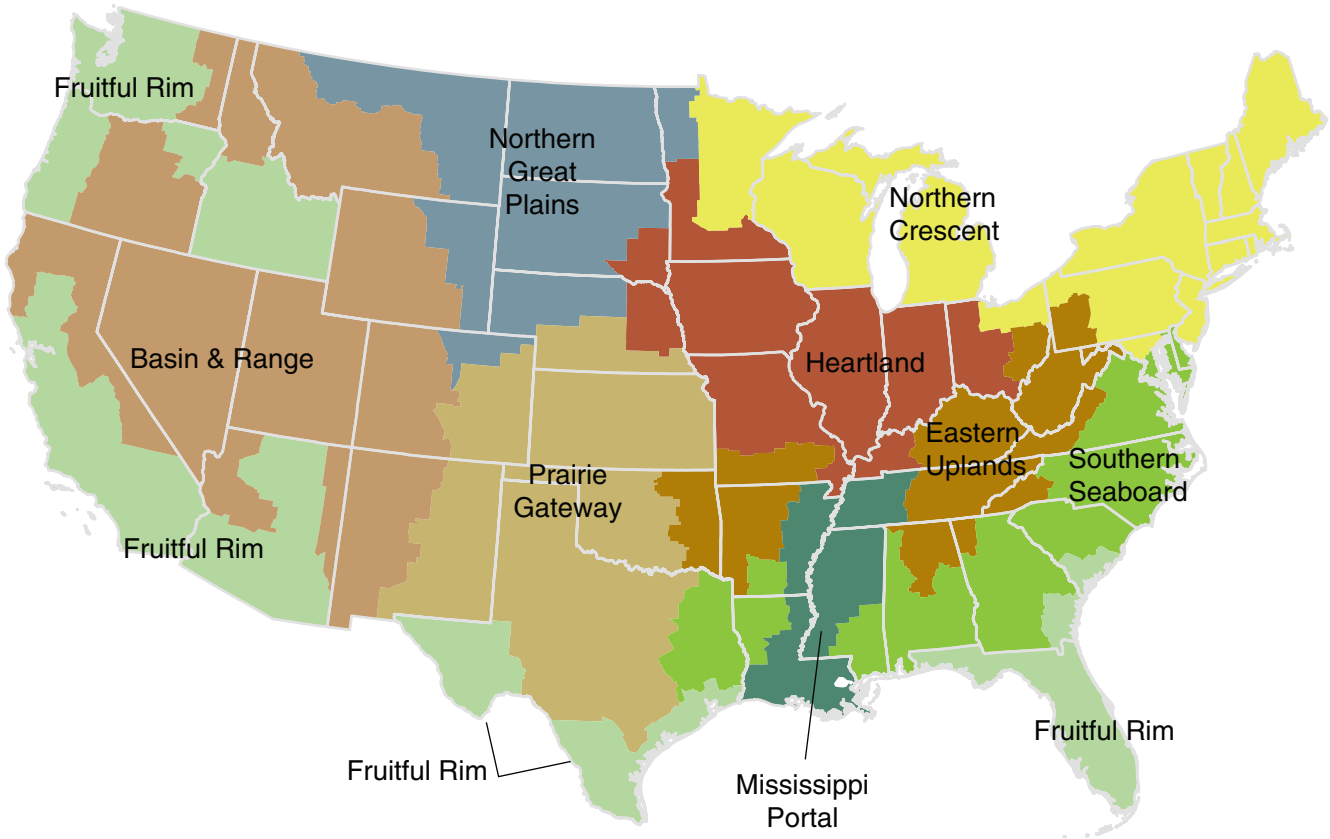
Growing demand for organic food led to an increased interest in organic farming. The number of certified organic acres planted to corn rose from 94,000 in 2001 to 213,000 in 2010 (USDA, ERS, 2013a). Most U.S.-produced organic corn is used for livestock and poultry feed rather than food.

Higher prices and returns to production for corn may have driven changes in corn producer characteristics and/or corn production practices. The author classified various groups of U.S. corn producers in 2010 according to corn production costs, region, enterprise size, and type of farming system used to produce corn. These classifications allowed analysis of factors driving variations in the characteristics of different sets of corn producers. By using data in this report and from previous corn reports (Foreman, 2006; Foreman, 2001; McBride, 1994), one can track the characteristics of

[1]The net production value is the value of production minus the costs.

U.S corn farms over time. Additional historical data on corn production practices can be found at the ERS Web site (USDA, ERS, 2013g).

Figure 2
U.S. Farm Resource Regions



Source: USDA, Economic Research Service.

Data Sources

Data in this report hail from two primary sources, ARMS and the Economic Research Service (ERS) commodity cost and return accounts (USDA, ERS, 2013f). Conducted jointly by ERS and NASS, ARMS is USDA's major annual economic survey of U.S. agricultural producers. Before 2010, ARMS surveys of corn producers were conducted for the 2005, 2001, and 1996 growing seasons. This report contains cost comparisons between 2010 and 2001 because the increase in corn acres started after 2001 and had reached a new level by 2010, the latest time for which corn ARMS data are available. Data from the 2001, 2005, and 2010 corn ARMS are also presented in a comparison of operating costs, operating and ownership costs, and total costs by selected regions for each of these years. Additional data derived from the previous corn versions of ARMS may be found in numerous ERS reports on www.ers.usda.gov under Farm Structure and Organization (USDA, ERS, 2013h) and Farm Practices & Management (USDA, ERS, 2013i).

The 2010 ARMS survey of corn producers was used to collect data in 19 States: Colorado, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, New York, North Carolina, North Dakota, Ohio, Pennsylvania, South Dakota, Texas, and Wisconsin. Data in this report refer to corn production in these surveyed States. Corn acreage in these States represented 93 percent of NASS's estimate of planted U.S. corn acreage in 2010. In addition to the sample of conventional corn producers, a targeted sample of organic corn producers was included in the survey.

The 2010 ARMS survey of corn producers had three phases:

- Phase I: Determined the farm's operating status and whether the producer grew corn in 2010.
- Phase II: Collected data on the acreage, production practices, input use, and costs related to a randomly selected corn field on the sampled farm. Weights were applied to each producer's field acreage so that the sum of the acres across farms equaled the number of planted corn acres reported in the surveyed States (USDA, NASS, Quick Stats).
- Phase III: Collected data related to the whole farm operation that focused on the farm's financial status and characteristics associated with the farm operation and operator. Weights were used to ensure the data represented corn producers in the surveyed States.

Phase II data were collected in the fall of 2010 while phase III data were collected in the spring of 2011. Usable data from the survey's phase II portion were obtained from 2,250 corn producers growing corn for grain (see glossary, "corn farm"), including 353 producers growing organic corn. A total of 1,603 usable observations were obtained from corn producers in phase III with 266 of these from organic corn producers. All corn producers sampled in phase II were contacted again in phase III, so producer matches could be made between phase II and phase III data.

The ERS-generated data on farm-level corn cost and return estimates and data generated from the ARMS phase II on the farm production practices appear in the first two tables in each section of this report. Variables on the characteristics of the farm operation and farm operator—such as the value of Government payments, value of cash receipts from agricultural production, and farm operator characteristics—were computed from phase III ARMS data and appear in the third table in each section. The phase III data and the computed variables from phase III appear in the third table of each section. All estimates presented in this publication's tables were computed using unrounded data and then rounded for presentation. This process may result in components not adding to the presented totals. Data in figures 1 through 6 and tables 1 through 9 represent all corn, which includes conventional and organic corn. Farms growing organic corn made up about 1.0 percent of all corn farms and accounted for 0.2 percent of all corn production in 2010.

Continued—

The ERS cost of corn production account is based on different prices and yields than those published by NASS. NASS U.S. annual and monthly corn prices are based on weighted prices for all States where corn is produced. The price in the ERS cost of production account is based on NASS harvest-month prices in the ARMS-surveyed States. Yield measurements also significantly differ between NASS and the ERS cost of production account. Yields in the ERS account are based on acres planted with the intention of harvesting them for grain in the ARMS-surveyed States. In contrast, NASS yields are based on all U.S. harvested acres for grain. NASS yields are very often higher than yields shown in ERS accounts.

When data comparisons are made in this report, the differences are statistically significant unless otherwise stated (see glossary, "statistically significant differences"). Estimates with a large coefficient of variation are not discussed since these estimates may not reflect the true value.

Many Factors Influence Costs per Bushel

The operating and ownership costs per bushel of corn in 2010 varied widely among producers, and these variances were driven strongly by differences in yields per planted acre and input use. This section of the report focuses on differences in the major characteristics of producers who were grouped by their costs per bushel. Producers were ranked from lowest to highest operating and ownership costs per bushel of corn harvested for grain and grouped into quartiles (see box, "ERS Corn Costs and Returns"). Mid-cost producers are producers who ranked in the two middle quartiles while low- and high-cost producers ranked in the first and last quartiles, respectively.

The net production value per acre (gross production value after costs are subtracted) was significantly greater for low-cost corn producers than for other groups. Table 1 shows that low-cost corn producers averaged $463 per acre in net production value after operating and ownership costs, compared with $313 per acre for mid-cost producers and $69 per acre for high-cost producers in 2010.

Significant differences in the gross production value per acre and the operating and ownership costs per acre existed among the cost groups. Low-cost producers had higher gross production values per acre and lower costs per acre than mid-cost producers. The same pattern existed between the mid- and high-cost groups. Likewise, higher yields per planted acre pushed up the gross production value per acre for lower cost groups. In 2010, yields averaged 182 bushels per planted acre for low-cost producers, 164 bushels for mid-cost producers, and 111 bushels for high-cost producers. The average price per bushel of corn was higher for the higher cost groups, which blunted some of the effect of their lower yields.

With harvest-month corn prices averaging $4.33 per bushel and yields averaging 159 bushels per planted acre in 2010, most corn producers would have covered their production costs if they sold their corn at that price. For 99 percent of corn producers, their production value, based on harvest-month prices, exceeded their operating costs. Production value exceeded operating and ownership costs for 92 percent of corn producers. The gross production value exceeded total production costs (including economic costs) for 74 percent of corn producers. This situation stands in contrast to 2001 when harvest-month corn prices averaged $1.84 per bushel and average yields were 144 bushels per planted acre. In 2001, 59 percent of producers would have covered their operating and ownership costs if they sold their corn at harvest-month prices.

In 2010, high-cost corn producers had the largest gap between their average expected yields per acre (160 bushels) and their actual yields (111 bushels) (see Glossary, "expected yields"). Had more of these producers achieved their expected yields, many of them would have covered their costs, but their costs would still have been significantly higher than those for producers in the low- and mid-cost groups.

Heartland producers accounted for the largest share of high-cost producers (fig. 3). Above normal temperatures in the Heartland during 2010 reduced the region's yields, pushing some producers into the high-cost group. Southeast producers made up higher shares of the high-cost group compared with low- and mid-cost groups (see Glossary, "corn production regions"). Parts of the Southeast experienced drought in 2010, pushing some Southeast corn producers into the high-cost group because of reduced yields. Southeast producers averaged 114 bushels per acre in 2010—25 bushels below their average expected yields.

ERS Corn Costs and Returns

ERS net returns from corn production are measured by subtracting costs from the gross value of corn production, which is estimated using harvest-month prices. Harvest-month prices are used because corn costs are estimated up to the point of storage or sale. Thus, the costs and returns associated with marketing corn are excluded. ERS cost and return estimates include the value of production and costs for all participants in the production process, including producers, landlords, and contractors. Crop commodity costs and returns estimates are based on the number of planted acres because costs are incurred on planted acreage regardless of whether they are harvested.[1]

Several measures of commodity costs exist, each with a different purpose. Total production costs are broken into three components: operating, ownership, and economic. Operating costs are those that vary with the amount of corn produced. Usually, producers will not plant corn unless they expect at least to cover their operating costs, which include costs for seed, fertilizers, chemicals, custom operations, fuel, repairs, interest, and hired labor. Ownership costs are costs for capital items used during production, such as capital recovery, insurance, and property taxes on farm machinery and equipment. Capital recovery costs are an estimate of the costs to replace machinery and equipment that was used in producing the annual crop plus interest on the remaining value. In the short term, producers only need to meet their operating costs. However, over a period of several years, producers must be able to recover their operating and ownership costs of production if they wish to replace their machinery and equipment, and stay in business.

Economic costs are the opportunity costs for land (using cash rental rate for farmland) and unpaid labor (using off-farm wage rates), and general farm overhead costs. Producers and analysts may add these costs to the operating and ownership costs when considering long-term decisions such as land purchases, long-term rental arrangements, starting and stopping agricultural production, or reallocation of producer's time or investments.

Corn production costs in this report refer to the sum of the operating and ownership costs unless otherwise stated. The focus is on operating and ownership costs since these are the costs that producers must meet over a period of several years to continue growing the crop. Total costs are included in the tables, but these are not emphasized because they include economic costs. Many producers accept different rates of return than the ones ERS uses to estimate the opportunity costs for land and unpaid labor in economic costs. U.S. and selected regional production cost data—operating, operating and ownership, and total—from the three most recent corn versions of the ARMS are shown in the table on page 8.

The total production costs for corn rose more sharply between 2005 and 2010 than in the 2001 to 2005 period mainly because of increases in operating costs and, to a lesser extent, increases in the opportunity cost of land. Operating costs rose faster in the 2005 to 2010 period mostly because of rapid increases in seed and fertilizer prices. Seed and fertilizer costs are the two major components of the operating costs for corn production. The opportunity costs of land rose significantly faster after 2005 partly because of rising returns from corn production. Increases in the gross value of corn production per acre exceeded those for the operating and ownership due to rising corn prices and yields. In 2001, the Heartland producers had the lowest

[1]For more detail on the construction of ERS cost of production account estimates, see http://www.ers.usda.gov/data-products/commodity-costs-and-returns/documentation.aspx

Continued—

operating costs among the regional producers but, since they applied the highest amounts of seed and fertilizer per acre in 2010, they had higher than average operating costs per acre by 2010.

U.S. and selected regional corn cost-of-production estimates for 2001, 2005, and 2010

Item	Heartland	Northern Crescent	Prairie Gateway	United States
		Dollars per planted acre		
2001				
Operating costs	154	162	198	161
Operating and ownership costs	211	225	274	221
Total production costs	340	343	389	344
2005				
Operating costs	185	198	219	188
Operating and ownership costs	251	267	309	259
Total production costs	388	394	417	387
2010				
Operating costs	295	295	273	289
Operating and ownership costs	384	378	384	382
Total production costs	572	514	512	550

Source: USDA, Economic Research Service cost of production accounts for corn developed from the 2001, 2005, and 2010 corn versions of the Agricultural Resource Management Survey.

Table 1

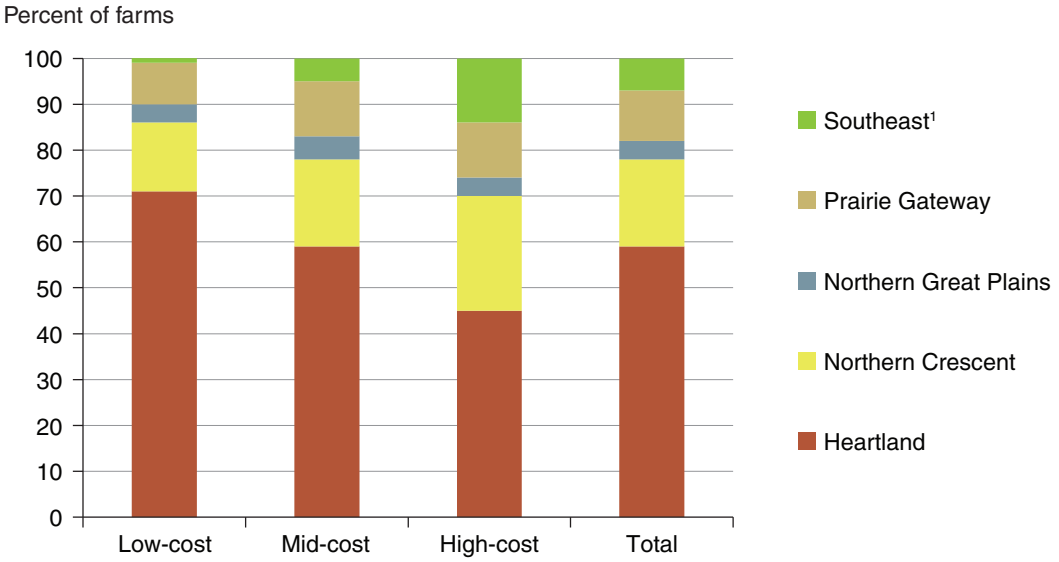
Costs and returns per planted acre for corn in 2010, by cost groups

Item	Low (a)	Mid (b)	High (c)	Total
Percent of corn farms	25	50	25	100
Percent of corn acres	28	53	19	100
Percent of corn production	32	55	13	100
Percent of corn acres planted for:				
Food	^ 11	5	^ 6	^ 7
Feed	19 bc	28 ac	^ 39 ab	27
Ethanol	15 b	9 a	^ 10	# 11
Unknown or other[1]	55	58 c	45 b	55
Planted corn acres per farm	320 c	306 c	219 ab	288
Ratio of harvested to planted acres	100 c	100 c	96 ab	99
Yield per planted acre (bu):				
Expected	180 c	175 c	160 ab	174
Actual	182 bc	164 ac	111 ab	159
Corn harvest-month price ($ per bu)	4.28 bc	4.33 ac	4.46 ab	4.33
Operating and ownership costs ($ per bu):				
Expected	1.76 bc	2.28 ac	2.69 ab	2.20
Actual	1.74 bc	2.43 ac	3.88 ab	2.40
Cost and return per planted corn acre ($):				
Gross production value	781 bc	711 ac	500 ab	690
Operating costs :	237 bc	304 ac	327 ab	289
Seed	80	83	81	82
Fertilizer	84 bc	120 a	130 a	112
Chemicals	21 bc	29 a	27 a	26
Custom operations	12 bc	17 a	^ 21 a	16
Fuel, lube, and electricity	18 bc	27 ac	33 ab	26
Repairs	19 bc	24 ac	30 ab	24
Purchased irrigation water	0	0	0	0
Interest on operating capital	0	0	0	0
Hired labor	2 bc	3 a	4 a	3
Ownership costs:	81 bc	95 ac	104 ab	93
Capital recovery of machinery and equipment	74 bc	86 ac	94 ab	84
Taxes and insurance	7 bc	9 ac	10 ab	8
Economic costs:	174 c	169 c	156 ab	168
Opportunity cost of land	137 bc	129 ac	110 ab	127
Opportunity cost of unpaid labor	19 bc	23 ac	26 ab	23
General farm overhead	18	18	20	18
Operating and ownership costs	318 bc	398 ac	431 ab	382
Total costs	492 bc	567 a	587 a	550
Production value less:				
Operating costs	544 bc	408 ac	173 ab	401
Operating and ownership costs	463 bc	313 ac	69 ab	308
Total costs	289 bc	144 ac	-88 ab	140

Note: Letters a, b, and c indicate that the estimates are significantly different from the indicated group at the 90-percent level or higher using the *t*-statistic. Coefficient of variation (CV) = (Standard error/estimate) x 100. ^ indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is above 50. bu=bushels. [1]Many producers do not know how their grain will be used.

Source: USDA, Economic Research Service (ERS) cost of production accounts and USDA's 2010 Agricultural Resource Management Survey, jointly conducted by ERS and USDA, National Agricultural Statistics Service.

Figure 3
Percent of corn cost groups represented by each region, 2010



[1]Note: The "Southeast" corn production region combines the ERS farm resource regions of Eastern Uplands, Southern Seaboard, and Fruitful Rim because of limited samples in these regions.
Source: USDA, Economic Research Service (ERS) cost-of-production accounts and USDA's 2010 corn versions of the Agricultural Resource Management Survey, jointly conducted by ERS and USDA, National Agricultural Statistics Service.

The average operating and ownership costs per acre were higher in the mid- and high-cost groups while economic costs per acre were lower. Operating costs averaged $237 per acre in 2010 for low-cost producers versus $327 per acre for high-cost producers. This difference was largely due to the range in fertilizer cost per acre, with costs averaging $84 per acre for low-cost producers versus $130 per acre for high-cost producers. This difference resulted partly from differences in the amounts of fertilizer applied. High-cost producers applied an average of 150 pounds of nitrogen per acre versus 131 pounds by low-cost producers (table 2). Fewer low-cost producers applied fertilizer and manure than did high-cost producers. In addition, a much higher share of low-cost than high-cost corn producers planted soybeans in their fields during the previous season (66 percent versus 44 percent). In much of the Heartland, soybeans enrich the soil so that less nitrogen needs to be added for the succeeding corn crop.

On average, low-cost corn producers used fewer inputs per planted corn acre while achieving higher yields. Data in table 2 show small, but often statistically significant differences between low-cost producers and their mid- and high-cost counterparts in their per-acre use of fuel and electricity, fertilizer, chemicals, and labor. These differences contributed to lower production costs per acre for low-cost producers.

Ownership costs, which mainly consist of the costs for capital recovery of machinery and equipment, averaged $81 per acre for low-cost producers versus $104 per acre for high-cost producers in 2010. Low-cost producers planted an average of 320 acres of corn per farm while high-cost producers planted an average of 219 acres per farm in 2010. Because low-cost producers planted more corn acres per farm, they spread the fixed machinery costs over more planted corn acres. In addition, these producers reduced their capital recovery and fuel costs per acre by making fewer trips over fields, 4.3 on average, compared with 5.2 for high-cost producers (see Glossary, “Trips over field”).

Table 2

Production practices and input use on 2010 corn acreage, by cost groups

Item	Low (a)	Mid (b)	High (c)	Total
Crop rotation (% of acres):				
Corn	25 c	25 c	38 ab	28
Soybeans	66 c	64 c	44 ab	61
Idle or Conservation Reserve Program	7	5	6	6
Irrigation:				
Irrigated (% of acres)	^ 5	8	9	7
Farms irrigating (%)	# 7 c	10 c	21 ab	11
Energy used per acre:				
Gasoline (gallons)	1.8 c	1.9	2.1 a	1.9
Diesel (gallons)	3.5 bc	5.7 a	6.3 a	5.2
Liquid petroleum gas (gallons)	1.4 b	2.1 ac	1.4 b	1.7
Natural gas (1,000 cubic feet)	^ 1.0 b	^ 0.2 a	# 0.4	^ 0.2
Electricity (kilowatt hours)	^ 14.6 c	26.7 c	63.9 ab	30.4
Seed used:				
Number of seeds per acre	30,988	30,988	32,119	31,204
Cost for 1,000 seeds ($)	2.58	2.67 c	2.51 b	2.61
Seed variety (% of acres)				
Herbicide resistant	18 c	15 c	25 ab	18
Bt	8 bc	19 a	19 a	16
Both herbicide resistant and Bt	62 c	55 c	45 ab	55
Fertilizer and manure use:				
Nitrogen (pounds per acre)	131 bc	145 a	150 a	142
Phosphorous (pounds per acre)	40 bc	55 a	51 a	50
Potassium (pounds per acre)	50	58	60	56
Lime (tons per acre)	0.2	0.2	0.2	0.2
Nitrogen (% of farms)	94 bc	98 a	98 a	97
Phosphorous (% of farms)	72 bc	90 a	89 a	85
Potassium (% of farms)	62 bc	77 a	76 a	73
Lime (% of farms)	46	50	52	49
Chemical use:				
Herbicides (% of acres)	93 b	97 ac	93 b	95
Insecticides (% of acres)	^ 6 bc	11 a	18 a	11
Herbicides (treatments per acre)	2.5	2.7	2.7	2.7
Insecticides (treatments per acre)	^ 0.0 bc	0.1 a	0.2 a	0.1
Trips over field (number)	4.3 bc	4.8 ac	5.2 ab	4.8
Labor hours per acre:	1.0 bc	1.2 ac	1.5 ab	1.2
Paid	0.1 bc	0.2 ac	0.3 ab	0.2
Unpaid	0.9 bc	1.0 ac	1.2 ab	1.0
Farms with paid labor (%)	41	45 c	38 b	42
Machinery maximum width (feet):				
Planter	26 c	24 c	20 ab	24
Harvester	17 c	16 c	15 ab	16

Note: Letters a, b, and c indicate that the estimates are significantly different from the indicated group at the 90-percent level or higher using the *t*-statistic. Coefficient of variation (CV) = (Standard error/estimate) x 100.
^ indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is above 50.
Source: USDA's 2010 Agricultural Resource Management Survey, jointly conducted by USDA, Economic Research Service and National Agricultural Statistics Service.

Economic costs per acre were higher for low-cost producers than for mid- and high-cost producers. This difference was due to the opportunity costs of land, which are based on the cash rent paid for land. Cash rents for land generally reflect the net income one expects to receive from the use of land. The expected net income is heavily influenced by the land's history of productivity. Low-cost producers' expected corn yields averaged 180 bushels per acre, and their opportunity costs of land averaged $137 per acre. In contrast, high-cost producers had expected corn yields of 160 bushels per acre and opportunity costs of $110 per acre for land in 2010 (table 1).

High-cost producers' whole-farm characteristics differed significantly from low- and mid-cost producers for items such as the types of commodities produced, share of farms receiving Government payments, and the average household and farm incomes (which were lower for high-cost than for low- and mid-cost producers) (table 3). High-cost producers were less likely to raise soybeans and more likely to raise wheat or cattle and to operate dairy enterprises. They were also less likely to have graduated from high school and less likely to receive Government payments.

Table 3

Characteristics of corn farms and operators in 2010, by cost groups

	Low (a)	Mid (b)	High (c)	Total
Total operated acres per farm:	711 b	865 a	790	808
Owned and operated	314	367	367	354
Cash-rented	362	401 c	314 b	368
Share-rented	83	116	121	109
Cropland	614 b	714 a	625	667
Number of commodities per farm	3.3 bc	3.5 ac	3.9 ab	3.6
Percent of farms producing:				
Some corn under contract	43 c	43 c	24 ab	38
Soybean	79 c	82 c	60 ab	76
Wheat	16 bc	26 a	27 a	24
Hay	16	17	17	17
Cattle	38 c	42 c	57 ab	45
Dairy	6 c	7 c	11 ab	8
Hogs	^ 8	5	^ 6	6
Operator occupation (percent):				
Farming	83	84 c	78 b	82
Nonfarm work	16	15	20	16
Operator paid for off-farm work (percent)	35	37	34	36
Principal operator age (mean):	57	55 c	57 b	56
Less than 50 years (percent)	29	31	26	29
65 or more (percent)	26	23 c	30 b	25
Principal operator education (percent):				
High school	95 c	93 c	83 ab	91
Completed college	21	21	19	21
Sole or family proprietor (percent)	88	85	85	86
Farms sharing farm income (percent)	10 bc	17 a	18 a	15
Government payments per farm ($):	10,429	11,299	11,563	11,157
Direct and counter-cyclical	8,667	9,808	10,295	9,658
Conservation	^ 1,721	1,408	1,147	1,416
Farms with Government payments (percent):	84 c	82 c	70 ab	79
Direct and counter-cyclical	80 c	76 c	64 ab	74
Conservation	32 c	28 c	20 ab	27
Household income per family ($1,000):	127.8 c	128.3 c	91.4 ab	118.5
Farm income	78.8 c	82.2 c	42.8 ab	71.0
Off-farm income:	49.0	46.1	48.7	47.5
Earned income from business or job	35.2	35.4	34.3	35.0
Percent with off farm business or job	63	70	63	66
Average value per farm ($1,000):				
Farm assets	1,932	2,116 c	1,780 b	1,983
Farm debt	222	238	204	225
Farm equity	1,711	1,877 c	1,576 b	1,758
Debt/asset ratio (percent)	11	11	11	11

Note: Letters a, b, and c indicate that the estimates are significantly different from the indicated group at the 90-percent level or higher using the *t*-statistic. Coefficient of variation (CV) = (Standard error/estimate) x 100.
^ indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is above 50.
Source: USDA's 2010 Agricultural Resource Management Survey, jointly conducted by USDA, Economic Research Service and National Agricultural Statistics Service.

The Heartland Continues To Dominate Corn Production

In 2010, the average operating and ownership cost of producing corn ranged from a low of $2.30 per bushel in the Heartland to a high of $3.27 per bushel in the Southeast (table 4 and Glossary on "Corn production regions"). Also, in 2010, differences in the average yield per planted acre—rather than differences in the costs per acre—were the principle reason for the spread in these costs. Heartland producers obtained the highest corn yields, 167 bushels per planted acre, as compared to 114 bushels per acre for Southeast producers, while the operating and ownership costs varied from $372 to $384 per acre among the regions.

As a result of higher yields than those of other regions, Heartland and Northern Crescent producers had significantly higher gross and net values of corn production per acre. These two regions accounted for 78 percent of the corn farms and 79 percent of corn production, with the Heartland accounting for 69 percent of the corn production. Net returns were the lowest in the Southeast despite higher prices that offset some of the effects from their lower yields.

Although the total operating and ownership cost per planted corn acre did not vary substantially among the regions in 2010, some of the cost components did (fig. 4). Differences in cost components per acre among the regions related to the variations in input use and production practices. The Heartland producers had the highest seed costs per acre, as a result of higher seed prices, and the greatest number of seeds planted per acre. Heartland and Northern Great Plains corn producers paid higher prices for corn seed, an average of $2.68 and $2.62 per 1,000 seeds, respectively, partly due to their greater use of Bt and herbicide-tolerant seed (table 5). Fertilizer costs per acre were higher in the Heartland and Northern Crescent, partly resulting from higher application rates of potassium than in Northern Great Plains and Prairie Gateway. Although Southeast producers applied similar amounts of potassium per acre as the Heartland and Northern Crescent producers, Southeast producers had lower fertilizer costs partly because they applied less nitrogen per acre. Fuel costs per acre were highest in the Prairie Gateway because these producers irrigated higher shares of their corn acres (43 percent). Irrigation raises several cost components, including those for fuel, capital recovery, and land.

The number of labor hours expended per corn acre has been trending downward. The average labor hours spent per acre varied between a low of 1.0 hours in the Heartland and a high of 1.9 hours in the Southeast for 2010, compared with a low of 1.5 hours in the Heartland and a high of 2.9 hours in the Southeast in 2001 (Foreman, 2006). The number of trips over a corn field declined slightly, while the maximum width of planters and harvesters used in corn fields increased between 2001 and 2010. Both factors contributed to fewer labor hours used per acre in 2010.

The data suggest a relationship between the number of corn acres on a farm and the average labor hours spent per corn acre. On average, Northern Crescent and Southeast corn producers planted less than 200 acres of corn per farm and had more labor hours per acre, 1.6 hours for Northern Crescent producers and 1.9 hours for Southeast producers. In contrast, Heartland, Northern Great Plains, and Prairie Gateway producers planted over 300 corn acres per farm in 2010 and averaged 1.3 labor hours or less per acre. These producers used significantly wider planters and harvesters, allowing them to cover more acres per hour.

Not only did Northern Crescent and Southeast corn producers plant less corn acres than did producers in other regions, but they also operated fewer total farm acres. Northern Crescent corn producers oper-

Table 4

Costs and returns per planted acre for corn in 2010, by region

Item	Heartland (a)	Northern Crescent (b)	Northern Great Plains (c)	Prairie Gateway (d)	Southeast (e)
Percent of corn farms	59	19	5	12	6
Percent of corn acres	66	10	6	15	3
Percent of corn production	69	10	5	14	2
Percent of corn acres planted for:					
Food	^ 7 e	# 5	^ 6	^ 7 e	^ 3 ad
Feed	20 bde	46 ace	^ 24 bde	38 ace	77 abcd
Ethanol	13 e	^ 9 e	^ 14 e	# 7 e	0 abcd
Unknown or other[1]	60 bde	40 ace	56 be	48 ae	20 abcd
Planted corn acres per farm	324 be	155 acd	356 be	373 be	134 acd
Ratio of harvested to planted acres	100 bc	97 ad	98 a	99 b	99
Yield per planted acre (bu):					
Expected	183 bcde	161 ae	156 ae	154 ae	139 abcd
Actual	167 bcde	156 acde	144 abe	142 abe	114 abcd
Corn harvest-month price ($ per bu)	4.33 bce	4.44 acde	3.99 abde	4.34 bce	4.76 abcd
Operating and ownership costs ($ per bu):					
Expected	2.10 bcde	2.34 ade	2.39 ae	2.49 abe	2.68 abcd
Actual	2.30 bce	2.43 de	2.58 ae	2.70 abe	3.27 abcd
Cost and return per planted corn acre ($):					
Gross production value	722 cde	696 cde	577 abd	619 abce	546 abd
Operating costs:	295 e	295 e	267 e	273 e	281 abcd
Seed	88 bcde	75 ade	80 ade	63 abc	63 abc
Fertilizer	118 cd	122 cd	95 abe	85 abe	116 cd
Chemicals	27 c	26 c	18 abde	26 c	29 c
Custom operations	15	20	^ 16	19	14
Fuel, lube, and electricity	22 cde	24 d	27 ad	42 abce	26 ad
Repairs	22 cde	24 d	27 a	32 abe	25 ad
Purchased irrigation water	0 c	0 c	^ 1 ab	0	0
Interest on operating capital	0	0	0	0	0
Hired labor	3 e	4 e	3 e	3 e	6 abcd
Ownership costs:	89 cd	83 cde	105 abe	111 abe	93 bcd
Capital recovery of machinery and equipment	81 bcd	74 acd	96 abe	101 abe	83 cd
Taxes and insurance	8 bde	9 a	9	10 a	11 a
Economic costs:	188 bcde	137 a	120 a	128 a	129 a
Opportunity cost of land	150 bcde	83 a	75 a	86 a	76 a
Opportunity cost of unpaid labor	20 bde	30 ad	27	24 abe	32 ad
General farm overhead	17 b	24 acd	18 b	17 b	21
Operating and ownership costs	384	378	372	384	374
Total costs	572 bcde	514 ad	492 a	512 ab	503 a
Production value less:					
Operating costs	427 cde	401 cde	309 abd	347 abce	266 abd
Operating and ownership costs	338 cde	318 cde	205 ab	235 ab	172 ab
Total costs	150 cde	182 cde	81 ab	108 abe	# 43 abd

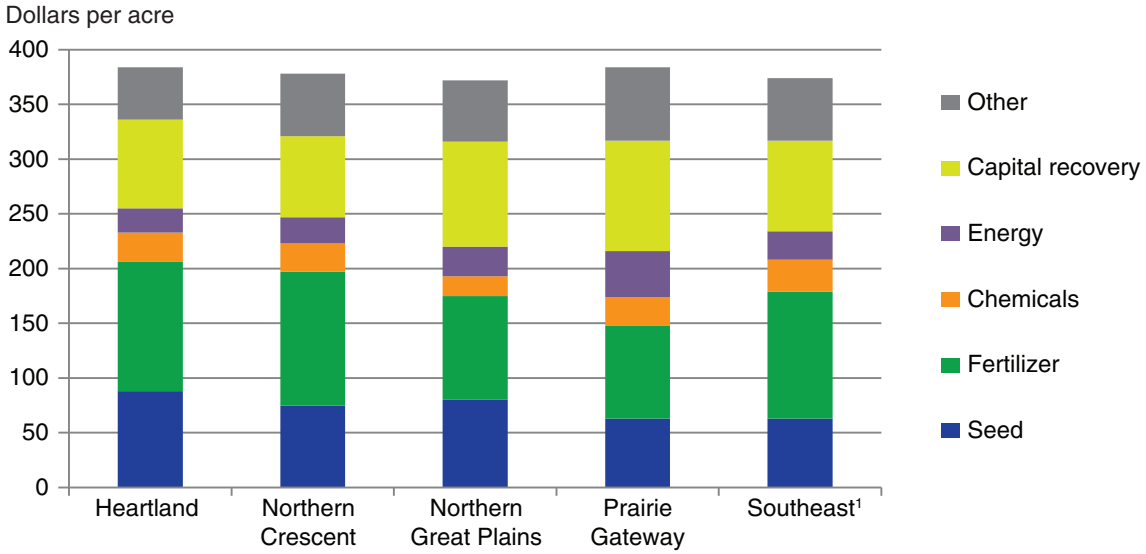
Note: Letters a, b, c, d, and e indicate that the estimates are significantly different from the indicated group at the 90-percent level or higher using using the *t*-statistic. Coefficient of variation (CV) = (Standard error/estimate) x 100. ^ indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is above 50. bu = bushel.

[1]Many producers do not know how their grain will be used.

Source: USDA, Economic Research Service (ERS) cost of production accounts and USDA's 2010 Agricultural Resource Management Survey, jointly conducted by ERS and USDA, National Agricultural Statistics Service.

Figure 4

Major components of operating and ownership costs per acre for corn producers by region, 2010



[1]Note: The "Southeast" corn production region combines the ERS farm resource regions of Eastern Uplands, Southern Seaboard, and Fruitful Rim because of limited samples in these regions.
Source: USDA, Economic Research Service (ERS) cost of production accounts and USDA's 2010 Agricultural Resource Management Survey, jointly conducted by ERS and USDA, National Agricultural Statistics Service.

ated an average of 440 acres per farm in 2010, while Southeast corn producers averaged 566 acres per farm (table 6). In contrast, Heartland producers averaged 704 acres per farm; Northern Great Plains producers averaged 2,117 acres per farm; and Prairie Gateway producers averaged 1,619 acres per farm. Table 6 data also show that Northern Crescent and Southeast corn producers had lower farm incomes along with fewer acres per farm than corn producers in other regions.

The distribution of planted corn acres and production among the regions was nearly the same in 2010 and 2001, despite a 17-percent increase in planted corn acres and a 31-percent increase in corn production at the national level between these 2 years (Foreman, 2006). This finding indicates that growth rates for corn acres and production were similar among the regions (fig. 5).

In 2001, corn producers' household income averaged $51,000, below the U.S. average household income of $58,200. In contrast, in 2010, corn producers' average household incomes ranged from a low of $67,700 thousand to a high of $172,300 among the regions, compared with $67,500 for all U.S. households (see Glossary for "farm household income" and ERS, 2013c). Higher farm commodity prices and increased total acreage per farm contributed to higher-than-average household incomes for corn producers in 2010. Northern Crescent and Southeast corn producers had lower average household incomes in 2010 than corn producers in other regions. Variations in the average total household income per family came mainly from variations in average farm income.

Table 5

Production practices and input use on 2010 corn acreage, by region

Item	Heartland (a)	Northern Crescent (b)	Northern Great Plains (c)	Prairie Gateway (d)	Southeast (e)
Crop rotation (percent of acres):					
Corn	26 cd	32 c	^ 13 abde	36 ac	31 c
Soybeans	70 bcde	51 ade	54 ade	35 abc	33 abc
Idle or Conservation Reserve Program	^ 2 bd	10 ade	^ 8 de	18 abce	# 1 bcd
Irrigation:					
Irrigated (percent of acres)	^ 5 bcde	# 0.0 acde	^ 19 abd	43 abce	11 abd
Farms irrigating (percent)	^ 4 bcd	# 0.1 acde	24 abe	28 abe	^ 7 bcd
Energy used per acre:					
Gasoline (gallons)	1.9 e	2.0 e	2.1 e	1.9 e	1.6 abcd
Diesel (gallons)	4.4 cde	4.1 de	3.8 ade	^ 9.7 abc	6.4 abc
Liquid petroleum gas (gallons)	2.0 de	2.4 de	2.4 de	na	^ 0.7 abcd
Natural gas (1,000 cubic feet)	^ 0.0 bcd	^ 0.1 acde	0.0 abde	^ 1.0 abce	# 0.0 bcd
Electricity (kilowatt hours)	12.3 bcde	4.2 acde	^ 70.6 ab	105.9 ab	^ 57.2 ab
Seed used:					
Number of seeds per acre	32,696 bcde	31,441 ade	30,564 ade	25,727 abc	26,241 abc
Cost for 1,000 seeds ($)	2.68 bde	2.39 ac	2.62 b	2.46 a	2.39 a
Seed variety (percent of acres)					
Herbicide resistant	14 bde	28 ae	^ 19 e	23 ae	45 abcd
Bt	15 d	^ 15	^ 18	23 ae	^ 12 d
Both herbicide resistant and Bt	60 bde	44 ace	60 bde	44 ace	26 abcd
Fertilizer and manure use:					
Nitrogen (pounds per acre)	147 be	124 a	143	137	127 a
Phosphorous (pounds per acre)	57 bcde	41 ad	42 ad	30 abce	39 ad
Potassium (pounds per acre)	68 cde	76 cde	^ 13 abe	11 abe	53 abcd
Lime (tons per acre)	0.3 cd	0.3 cd	0.0 abde	0.1 abce	0.3 cd
Nitrogen (percent of farms)	98 d	98 d	97 d	92 abce	99 d
Phosphorous (percent of farms)	85 bde	92 acd	84 bde	72 abce	93 acd
Potassium (percent of farms)	77 bcde	93 acd	37 abde	27 abce	92 acd
Lime (percent of farms)	57 cd	55 cd	3 abde	14 abce	62 cd
Chemical use:					
Herbicides (percent of acres)	96	91	96	94	98
Insecticides (percent of acres)	13 cd	# 3 e	# 5 a	^ 6 a	^ 13 b
Herbicides (treatments per acre)	2.6 cd	2.0 cd	2.1 abde	3.3 abce	2.5 cd
Insecticides (treatments per acre)	0.1 bcd	# 0.1 a	# 0.0 ae	^ 0.1 a	^ 0.2 c
Trips over field (number)	4.6 be	5.4 acd	4.5 be	4.3 be	5.4 acd
Labor hours per acre:	1.0 bde	1.6 acd	1.3 be	1.3 abe	1.9 acd
Paid	0.2 e	0.3 e	0.2 e	0.2 e	0.6 abcd
Unpaid	0.9 bde	1.4 ad	1.1	1.0 abe	1.3 ad
Farms with paid labor (percent)	38 bcd	48 ade	52 ae	57 abe	35 bcd
Machinery maximum width (feet):					
Planter	26 bce	17 acd	29 abde	25 bce	17 acd
Harvester	17 bcde	13 acd	19 abe	18 abe	13 acd

Note: Letters a, b, c, d, and e indicate that the estimates are significantly different from the indicated group at the 90-percent level or higher using using the *t*-statistic. Coefficient of variation (CV) = (Standard error/estimate) x 100. ^ indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is above 50. na = not available due to statistical or confidentiality concerns.
Source: USDA's 2010 Agricultural Resource Management Survey, jointly conducted by USDA, Economic Research Service and National Agricultural Statistics Service.

Table 6

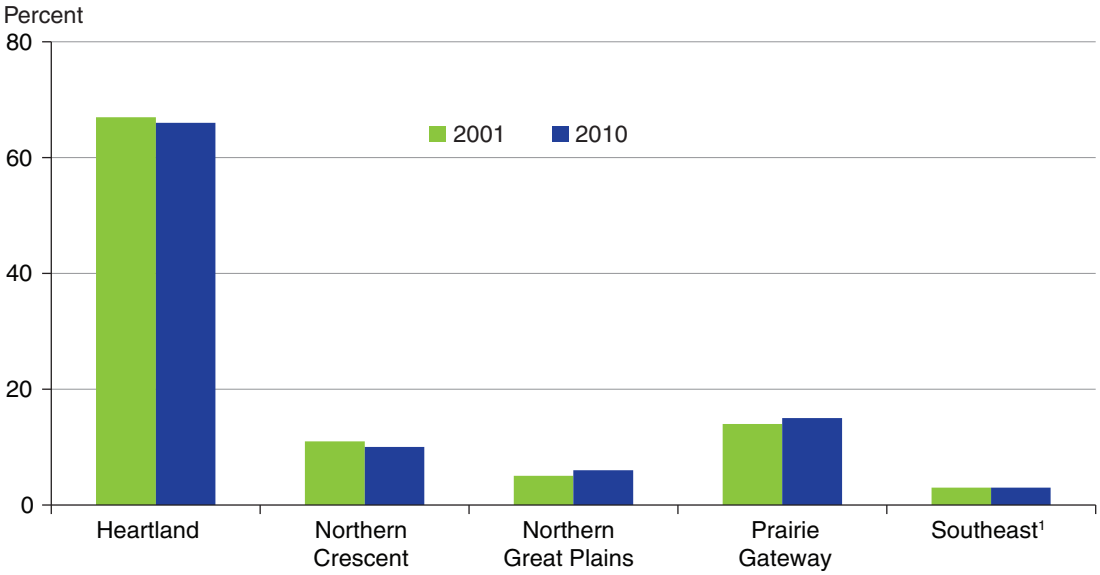
Characteristics of corn farms and operators in 2010, by region

Item	Heartland (a)	Northern Crescent (b)	Northern Great Plains (c)	Prairie Gateway (d)	Southeast (e)
Total operated acres per farm:	704 bcde	440 acd	2,117 abde	1,619 abce	566 acd
Owned and operated	299 bcd	232 acd	1,110 abde	627 abce	235 cd
Cash-rented	333 bcd	198 acd	922 abe	675 abe	297 cd
Share-rented	101 bde	^ 10 acde	^ 140 bde	361 abce	^ 38 abcd
Cropland	636 bcde	364 acd	1,492 abe	1,173 abe	426 acd
Number of commodities per farm	3.1 bcde	4.8 ade	4.5 ade	3.4 abc	3.5 abc
Percent of farms producing:					
Some corn under contract	43 be	30 ace	43 be	38 e	10 abcd
Soybean	87 bcde	66 ae	71 ade	6 ac	47 abc
Wheat	15 bcd	30 acde	61 abde	54 abce	18 bcd
Hay	12 b	28 acd	^ 12 b	18 b	^ 23
Cattle	38 bce	60 ad	66 ade	45 bc	50 ac
Dairy	3 b	29 acde	# 3 b	^ 2 b	^ 5 b
Hogs	9 bcde	^ 5 acd	na	na	^ 3 acd
Operator occupation (percent):					
Farming	80 cd	86 cd	93 abe	94 abe	75 cd
Nonfarm work	19 cd	14 cd	# 5 abe	^ 6 abe	23 cd
Operator paid for off-farm work (percent)	39 cd	35	26 a	26 a	34
Principal operator age (mean):	56	56	54	58	58
Less than 50 years (percent)	30	25	34	31	24
65 or more (percent)	25	22	^ 19 d	32 c	31
Principal operator education (percent):					
High school	94 b	84 ac	96 b	91	87
Completed college	20 d	18 d	^ 15 d	32 abce	15 d
Sole or family proprietor (percent)	86	84	86	86	8
Farms sharing farm income (percent)	13	19	^ 11	18	3
Government payments per farm ($):	11,823 bcde	4,183 acde	19,624 abe	19,022 abe	7,066 abcd
Direct and counter-cyclical	10,376 bcde	3,297 acde	16,351 abe	16,630 abe	6,004 abcd
Conservation	1,409 bc	^ 829 acd	^ 2,845 ab	2,110 b	# 1,059
Farms with Government payments (percent)	86 bce	62 acd	97 abde	84 bce	55 acd
Direct and counter-cyclical	80 bce	55 acd	91 abe	82 be	44 acd
Conservation	30 bce	18 ac	44 abde	25 ce	^ 15 acd
Household income per family ($1,000):	131.1 be	67.7 acd	172.3 be	133.8 be	90.1 acd
Farm income	83.3 be	21.4 acd	124.0 be	92.9 be	^ 32.7 acd
Off-farm income:	47.9	46.4	^ 48.2	40.8	57.3
Earned income from business or job	36.4 c	32.3	25.3 a	^ 30.0	^ 45.5
Percent with off-farm business or job	68 e	69	69	59	58 a
Average value per farm ($1,000):					
Farm assets	2,146 bcde	1,567 ace	3,189 abde	1,811 ace	1,266 abcd
Farm debt	247 bce	186 ace	410 abde	208 ce	59 abcd
Farm equity	1,899 bcde	1,381 ac	2,779 abde	1,603 ace	1,207 acd
Debt/asset ratio (percent)	12 e	12 e	13 e	11 e	5 abcd

Note: Letters a, b, c, d, and e indicate that the estimates are significantly different from the indicated group at the 90-percent level or higher using using the *t*-statistic. Coefficient of variation (CV) = (Standard error/estimate) x 100. ^ indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is above 50. na = not available due to statistical or confidentiality concerns.
Source: USDA, Economic Research Service (ERS) cost of production accounts and USDA's 2010 Agricultural Resource Management Survey, jointly conducted by ERS and USDA, National Agricultural Statistics Service.

Figure 5

Distribution of planted corn acres by region in 2001 and 2010



[1]Note: The "Southeast" corn production region combines the ERS farm resource regions of Eastern Uplands, Southern Seaboard, and Fruitful Rim because of limited samples in these regions.
Source: USDA, Economic Research Service (ERS) cost of production accounts and USDA's 2001 and 2010 corn versions of the Agricultural Resource Management Survey, jointly conducted by ERS and USDA, National Agricultural Statistics Service.

Costs Varied Little by Farm Enterprise Size

A farm enterprise is the group of activities related to the production of an agricultural commodity (see glossary on "Farm enterprise size"). For this report, the size of the corn enterprise is defined by the number of corn acres planted per farm with the intent to harvest the crop for grain. Production costs per acre, production practices, input use, and farm characteristics vary by enterprise size with the sharpest differences visible between those planting less than 250 acres of corn and those planting 1,000 or more acres of corn.

Most corn producers operated relatively small corn enterprises, while at the other extreme a small percentage of corn producers operated very large corn enterprises. Table 7 shows that 67 percent of corn producers planted less than 250 acres of corn, while 5 percent planted 1,000 or more acres in 2010. In contrast, corn production is more uniform across the enterprise size classes, with 20 percent of the corn produced by those planting fewer than 250 acres and 28 percent produced by those planting 1,000 or more acres of corn.

In 2010, producers planting less than 250 acres planted 21 percent of U.S. corn acres (versus 29 percent for the same producer group in 2001). At the other extreme, producers planting 1,000 or more corn acres accounted for 23 percent of planted acres in 2001 versus 28 percent in 2010. Producers planting 1,000 or more corn acres may have accounted for a large share of the 12 million-acre increase in planted corn acres that occurred in that 10-year span.

In 2010, the operating and ownership costs to produce corn ranged from an average of $2.34 to $2.46 per bushel among farms in the enterprise size categories, but for the most part, the differences were not statistically significant. With harvest-month prices averaging $4.29 to $4.37 per bushel among the enterprise size groups, most corn producers in each size group were more than able to cover their production costs in 2010.

While the total operating and ownership cost per bushel of corn in 2010 varied little among the enterprise size groups, the yields and costs per acre for farms with the smallest corn enterprises varied significantly from those for all other corn farms. Producers with fewer than 250 corn acres had the lowest expected (see glossary on "Expected yields") and actual corn yields per planted acre. Their expected yields averaged 164 bushels per planted acre versus a minimum average of 174 bushels for producers in all other categories. Following the same pattern, actual yields averaged 149 bushels per planted acre for those with smallest corn enterprises versus a minimum average yield of 161 bushels for producers planting 250 or more corn acres.

At $364 per acre, the operating and ownership costs were lowest for producers planting less than 250 corn acres versus a range of $377 to $397 per acre for producers with more planted corn acres.[2] The average cost per acre was higher for each sequential farm enterprise size category although the differences were not always statistically significant (fig. 6). Differences in production practices, land quality, and other factors among farms in each size group may have contributed to differences in the per-acre costs.

[2]When corn producers were divided into cost groups based on their operating and ownership cost per bushel, it was found that low-cost producers planted more corn acres per farm, on average, than high-cost producers. However, it does not necessarily follow that the reverse situation holds true. The average production costs per bushel for producers with 1,000 or more corn acres were not statistically different than for producers with less than 250 corn acres in 2010 (see tables 1 and 7).

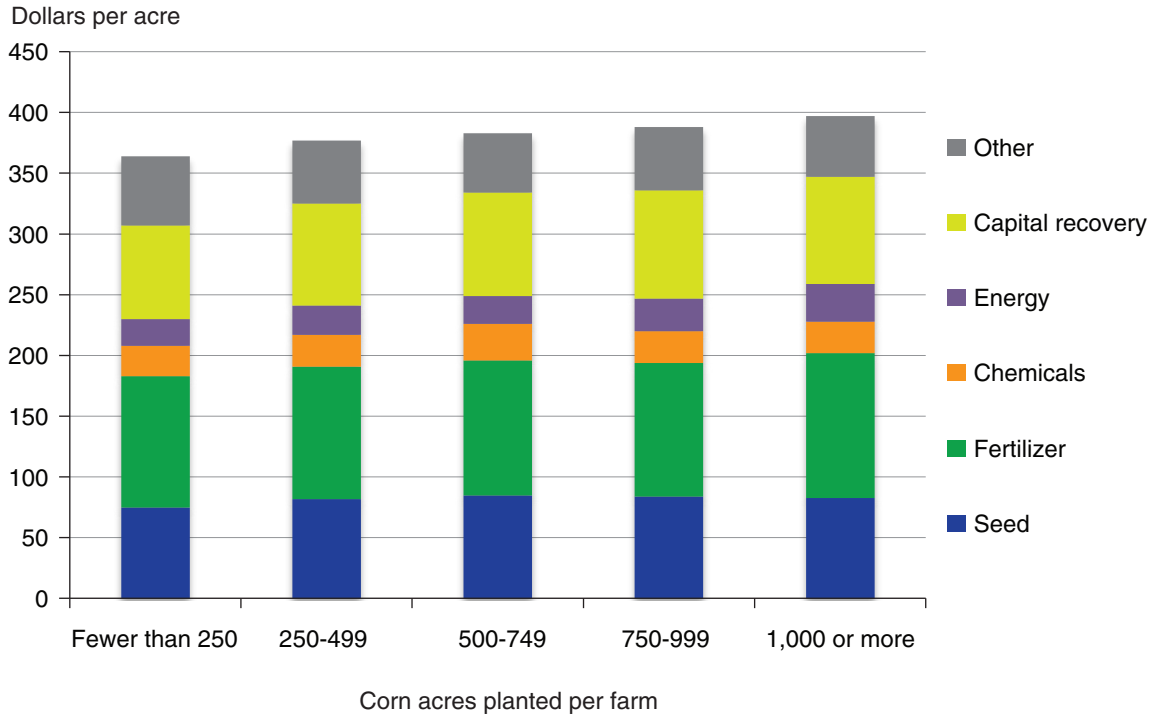
Table 7

Costs and returns per planted acre for corn in 2010, by enterprise size

Item	Fewer than 250 acres (a)	250-499 acres (b)	500-749 acres (c)	750-999 acres (d)	1,000 or more acres (e)
Percent of corn farms	67	17	8	4	5
Percent of corn acres	21	22	16	12	28
Percent of corn production	20	23	17	13	28
Percent of corn acres planted for:					
Food	6	^ 4 e	^ 5	^ 5	^ 12 b
Feed	36 bcd	23 a	23 a	22 a	20
Ethanol	6 de	^ 10	^ 13	^ 16 a	12 a
Unknown or other[1]	53 b	64 ae	59 e	57	46 bc
Planted corn acres per farm	91 bcde	372 acde	616 abde	875 abce	1,758 abcd
Ratio of harvested to planted acres	98 bcde	99 a	100 a	100 a	100 a
Yield per planted acre (bu):					
Expected	164 bcde	174 a	175 a	178 a	178 a
Actual	149 bcde	162 a	164 a	161 a	161 a
Corn harvest-month price ($ per bu)	4.37 bc	4.29 ade	4.32 a	4.34 b	4.35 b
Operating and ownership costs ($ per bu):					
Expected	2.21	2.17	2.19	2.18	2.23
Actual	2.44 b	2.34 a	2.34	2.41	2.46
Cost and return per planted corn acre ($):					
Gross production value	654 bcde	693 a	707 a	698 a	702 a
Operating costs:	276 ce	285 e	291 a	292	302 ab
Seed	75 bcde	82 a	85 a	84 a	83 a
Fertilizer	108 e	109 e	111	110	119 ab
Chemicals	25 c	26 c	30 abe	26	26 c
Custom operations	20 bce	16 a	15 a	17	14 a
Fuel, lube, and electricity	22 de	24 e	23 e	27 a	31 abc
Repairs	24	25	23	23	24
Purchased irrigation water	0	na	na	na	na
Interest on operating capital	0	0	0	0	0
Hired labor	1 bcde	2 acde	3 abe	3 abe	5 abcd
Ownership costs:	88 de	92	92	96 a	96 a
Capital recovery of machinery and equipment	77 bcde	84 a	85 a	89 a	88 a
Taxes and insurance	11 bcde	8 a	8 a	8 a	8 a
Economic costs:	166	168	172	179 e	162 d
Opportunity cost of land	111 bcde	126 a	133 a	140 a	132 a
Opportunity cost of unpaid labor	31 bcde	23 ae	23 ae	21 ae	15 abcd
General farm overhead	23 bcde	19 ae	16 a	18 a	15 ab
Operating and ownership costs	364 bcde	377 ae	383 a	388 a	397 ab
Total costs	530 cde	545	555 a	567 a	559 a
Production value less:					
Operating costs	378 bc	409 a	416 a	406	400
Operating and ownership costs	291 bc	316 a	323 a	310	304
Total costs	124 c	148	152 a	131	142

Note: Letters a, b, c, d, and e indicate that the estimates are significantly different from the indicated group at the 90-percent level or higher using the *t*-statistic. Coefficient of variation (CV) = (Standard error/estimate) x 100. ^ indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is above 50. na = not available due to statistical or confidentiality concerns.
bu = bushel. [1]Many producers do not know how their grain will be used.
Source: USDA, Economic Research Service (ERS) cost of production accounts and USDA's 2010 Agricultural Resource Management Survey, jointly conducted by ERS and USDA, National Agricultural Statistics Service.

Figure 6
Operating and ownership costs for 2010 corn by enterprise size



Source: USDA, Economic Research Service (ERS) cost of production accounts and USDA's 2010 corn versions of the Agricultural Resource Management Survey, jointly conducted by ERS and USDA, National Agricultural Statistics Service.

In 2010, per-acre costs for seed, hired labor, and capital recovery for machinery and equipment were significantly lower for those planting less than 250 acres than for producers in each of the remaining groups. Producers with the smallest corn enterprises were least likely to purchase more expensive seed with stacked traits. Data from table 8 show 45 percent of the producers with the smallest enterprises planted Bt or herbicide-tolerant corn seed, compared with a range of 49 to 62 percent of producers in the groups planting more than 250 corn acres. In addition, producers with the smallest enterprises planted less seed per acre. These producers, with an average of 91 corn acres, were also the least likely to hire labor, while producers of the largest corn enterprises, with an average of 1,758 acres of corn, often hired labor. Capital recovery costs averaged $77 per acre for producers with the smallest corn enterprises versus an average of $84 to $89 per acre for producers with larger enterprises.

A number of production practices differ between producers with the largest and smallest corn enterprises and may explain the cost differences observed between these groups. Table 8 shows that 43 percent of producers with the largest corn enterprises planted corn for 2 consecutive years versus 20 percent of producers with the smallest corn enterprises. Forty-eight percent of operators with the largest corn enterprises rotated their corn field with soybeans versus 65 percent of those with small enterprises. Crop rotation is a practice that can break plant disease, pests, and weed cycles, thereby lowering the need for chemical treatments (USDA, ERS, 2013d, and glossary on “crop rotation”). Producers receive an additional benefit from rotating corn with soybeans because soybeans promote the development of organic nitrogen in the soil, lowering the amount of supplemental nitrogen that needs to be applied to corn. The continuous planting of corn can result in higher chemical, fertilizer,

Table 8

Production practices and input use on 2010 corn acreage, by enterprise size

Item	Fewer than 250 acres (a)	250-499 acres (b)	500-749 acres (c)	750-999 acres (d)	1,000 or more acres (e)
Crop rotation (percent of acres):					
Corn	20 e	19 e	28 e	22 a	43 abcd
Soybeans	65 e	67 e	63 e	68 a	48 abcd
Idle or Conservation Reserve Program	8 de	^ 6	^ 6	^ 4 a	^ 4 a
Irrigation:					
Irrigated (percent of acres)	^ 6 bcd	10 a	^ 12 a	^ 14 a	^ 11
Farms irrigating (percent)	7 b	12 a	^ 11	^ 11	^ 15
Energy used per acre:					
Gasoline (gallons)	1.8	1.9	2.0	1.8	2.0
Diesel (gallons)	4.2 e	4.5 e	4.3 e	4.9	7.1 abc
Liquid petroleum gas (gallons)	1.4 e	1.3 ce	1.9 b	2.0	2.2 ab
Natural gas (1,000 cubic feet)	# 0.1	^ 0.1	# 0.1	# 0.4	# 0.2
Electricity (kilowatt hours)	29.3	32.0	^ 23.1	^ 52.0	^ 24.6
Seed used:					
Number of seeds per acre	30,110 cde	30,840	30,990 a	32,227 a	31,993 a
Cost for 1,000 seeds ($)	2.48 bcd	2.67 a	2.74 ae	2.62 a	2.59 c
Seed variety (percent of acres):					
Herbicide resistant	27 bce	15 ad	12 ad	28 bce	^ 12 ad
Bt	15	17	^ 18	^ 13	^ 17
Both herbicide resistant and Bt	45 bce	56 a	60 a	49 e	62 ad
Fertilizer and manure use:					
Nitrogen (pounds per acre)	126 cde	135 e	143 a	148 a	157 ab
Phosphorous (pounds per acre)	46 e	44 de	52	55 b	55 ab
Potassium (pounds per acre)	54 e	50 e	50 e	61	65 abc
Lime (tons per acre)	0.3 ce	0.2	0.2 a	0.2	0.2 a
Nitrogen (percent of farms)	97 d	96 d	96 d	100 abce	98 d
Phosphorous (percent of farms)	84	87	88	87	87
Potassium (percent of farms)	75 c	72 c	62 ab	69	69
Lime (percent of farms)	50	49	44	54	49
Chemical use:					
Herbicides (percent of acres)	93 de	94 e	92 de	98 ac	98 abc
Insecticides (percent of acres)	6 ce	9	12 a	^ 14	15 a
Herbicides (treatments per acre)	2.4 e	2.6	2.6	2.7	2.9 a
Insecticides (treatments per acre)	0.1 e	^ 0.1	^ 0.1	^ 0.1	0.1 a
Trips over field (number)	4.7 e	4.6 de	4.9 e	5.0 be	5.4 abcd
Labor hours per acre:	1.5 bcde	1.2 ae	1.3 ae	1.1 a	1.0 abc
Paid	0.1 bcde	0.1 acde	0.2 ab	0.2 abe	0.3 abd
Unpaid	1.5 bcde	1.0 ae	1.0 ae	0.9 ae	0.7 abcd
Farms with paid labor (percent)	35 bcde	45 acde	69 ab	63 ab	71 ab
Machinery maximum width (feet):					
Planter	20 bcde	29 acde	33 abde	38 abce	42 abcd
Harvester	14 bcde	18 acde	20 abe	20 abe	24 abce

Note: Letters a, b, c, d, and e indicate that the estimates are significantly different from the indicated group at the 90-percent level or higher using the *t*-statistic. Coefficient of variation (CV) = (Standard error/estimate) x 100. ^ indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is above 50.

Source: USDA's 2010 Agricultural Resource Management Survey, jointly conducted by USDA, Economic Research Service and National Agricultural Statistics Service.

and capital recovery costs per acre because more trips across a field are needed to apply chemicals and fertilizers. Producers with the largest corn enterprises made more trips across a field, applied more fertilizer per acre, and treated a higher percentage of their corn acres with herbicides and insecticides than did producers with the smallest corn enterprises.

Fewer labor hours were spent per planted corn acre on the largest corn enterprises than on the smallest corn enterprises, even though more trips were taken across corn fields on the largest corn enterprises. On average, 1.0 labor hour per acre was spent on farms with the largest corn enterprises versus 1.5 labor hours per acre on farms with the smallest corn enterprises in 2010 with differences in machinery sizes likely accounting for most of the variation. The maximum width of planters and harvesters used on small corn enterprises averaged 20 feet and 14 feet, respectively, versus 42 feet and 24 feet on the largest corn enterprises.

Characteristics of corn farms and their operators differ with the size of their corn enterprises. Producers with largest corn enterprises tended to operate farms with more total acres than producers with small corn enterprises (table 9). The percentage of each farm's total operated acres planted with corn averaged 51 percent for farms with the largest corn enterprises versus 24 percent for farms with the smallest corn enterprises. A high degree of reliance on a single commodity can increase vulnerability to commodity policy modifications, adverse growing conditions, or unexpected changes in market conditions. Producers with the largest corn enterprises produced an average of 3.2 commodities versus 3.7 commodities for those with the smallest corn enterprises. Greater commodity diversification can reduce risks. In addition, producers with the largest corn enterprises had higher average ratios of debt-to-farm assets. Higher ratios indicate a higher risk of loan defaults if income levels drop.

Producers with the largest corn enterprises had several characteristics that help blunt risks from their high reliance on corn. In 2010, these operators were, on average, 51 years old versus operators with the smallest enterprises, who averaged 57 years old. Thus, operators with the largest corn enterprises have more time to recover from adverse conditions. Farms with the largest corn enterprises also were more likely to have multiple operators or partners, so the financial risks were frequently spread. Operators with the largest corn enterprises were twice as likely to use a contract for corn production than were operators with the smallest corn enterprises. Most corn contracts are marketing contracts to sell corn. Marketing contracts reduce price risk by establishing a selling price before the commodity is produced.

Table 9

Production practices and input use on 2010 corn acreage, by enterprise size

Item	Fewer than 250 acres (a)	250-499 acres (b)	500-749 acres (c)	750-999 acres (d)	1,000 or more acres (e)
Total operated acres per farm:	373 bcde	1,149 acde	1,448 abde	1,899 abce	3,425 abcd
Owned and operated	237 bcde	519 ae	494 ae	530 ae	986 abcd
Cash-rented	122 bcde	493 acde	731 abde	1,002 abce	2,050 abcd
Share-rented	41 bcde	151 ade	236 ae	^ 379 ab	443 abc
Cropland	281 bcde	919 acde	1,310 abde	1,748 abce	2,951 abcd
Number of commodities per farm	3.7 cde	3.5	3.3 a	3.2 a	3.2 a
Percent of farms producing:					
Some corn under contract	27 bcde	55 a	62 a	66 a	62 a
Soybean	69 bcde	89 a	93 ae	88 a	83 ac
Wheat	22 b	30 a	22	25	28
Hay	19 be	12 a	^ 14	^ 17 e	^ 6 ad
Cattle	49 de	43 de	40 e	29 ab	29 abc
Dairy	10 bcde	^ 4 ae	^ 3 a	# 2 a	# 1 ab
Hogs	6 d	^ 4 d	^ 4 d	^ 16 abc	^ 14
Operator occupation (percent):					
Farming	74 bcde	98 ac	100 ab	98 a	99 a
Nonfarm work	24 bcde	^ 2 ace	0 ab	na	0 ab
Operator paid for off-farm work (percent)	43 bcde	23 ae	26 ae	22 a	^ 12 abc
Principal operator age (mean):	57 bcde	54 a	53 a	55 a	51 a
Less than 50 years (percent)	27 e	31	36	33	41 a
65 or more (percent)	30 bcde	17 a	13 a	^ 15 a	17 a
Principal operator education (percent):					
High school	88 bcde	98 ade	98 a	100 abe	93 abd
Completed college	19 d	20 d	23 d	39 abc	28
Sole or family proprietor (percent)	91 bcde	84 ade	75 ae	63 ab	55 abc
Farms sharing farm income (percent)	11 cde	^16 de	^ 21 ae	^ 33 ab	38 abc
Government payments per farm ($):	4,793 bcde	13,906 acde	22,447 abde	32,372 abce	49,408 abcd
Direct and counter-cyclical	3,855 bcde	12,816 acde	19,272 abde	27,761 abce	44,506 abcd
Conservation	857 cde	1,087 cde	^ 2,958 ab	4,334 ab	4,902 ab
Farms with Government payments (percent):	73 bcde	90 a	91 a	94 a	93 a
Direct and counter-cyclical	67 bcde	87 a	87 a	92 a	92 a
Conservation	21 bcde	34 a	44 a	40 a	43 a
Household income per family ($1,000):	81.1 bcde	151.1 ae	203.4 a	207.3 a	300.5 ab
Farm income	30.7 bcde	108.5 ace	165.1 ab	^ 169.0 a	254.2 ab
Off-farm income	50.4 cd	42.6	38.3 a	38.3 a	^ 46.3
Earned income from business or job	36.9 c	34.3	23.9 a	27.5	^ 35.7
Percent with off farm business or job	67 e	69 e	69 e	65 e	50 abcd
Average value per farm ($1,000):					
Farm assets	^ 1,222 bcde	2,587 acde	3,284 abde	4,354 abce	5,910 abcd
Farm debt	^ 87 bcde	314 acde	451 abde	692 abce	989 abcd
Farm equity	^ 1,135 bcde	2,273 acde	2,832 abde	3,662 abce	4,921 abcd
Debt/asset ratio (percent)	7 bcde	12 ade	14 a	16 ab	17 ab

Note: Letters a, b, c, d, and e indicate that the estimates are significantly different from the indicated group at the 90-percent level or higher using the *t*-statistic. Coefficient of variation (CV) = (Standard error/estimate) x 100. ^ indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is above 50. na = not available due to statistical or confidentiality concerns.

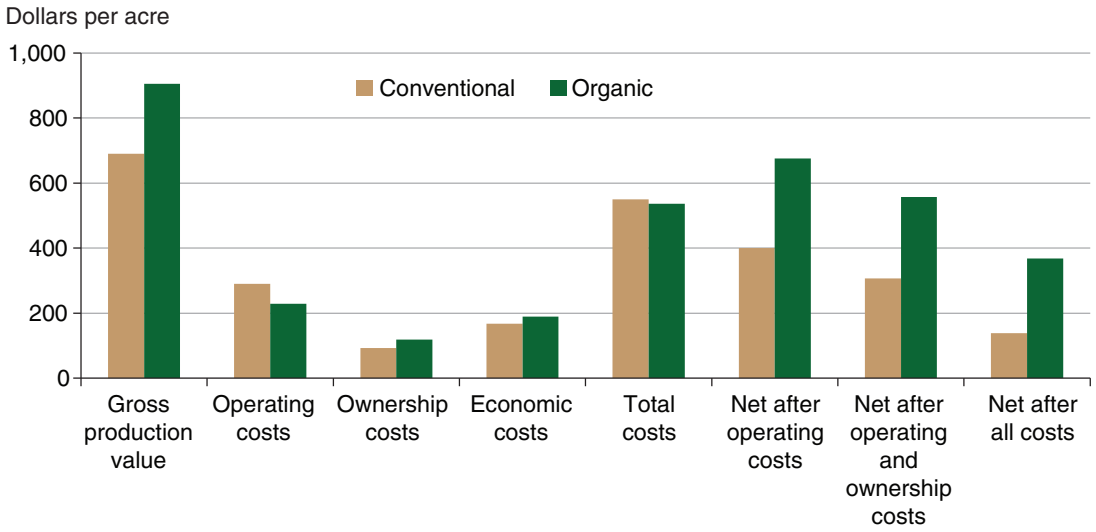
Source: USDA's 2010 Agricultural Resource Management Survey, jointly conducted by USDA, Economic Research Service and National Agricultural Statistics Service.

Returns From Organic Corn Exceed Those for Conventional Corn

Although organic corn production was only a fraction of the total corn market, the national average net returns per acre from organic corn production surpassed those for conventional corn production, regardless of the cost measure used. In 2010, net returns—after subtracting the sum of operating and ownership costs from the gross value of corn production—averaged $555 per acre for organic corn and $307 per acre for conventional corn (fig. 7). The gross value of production for organic corn averaged $904 per acre in 2010 and $689 per acre for conventional corn. Operating costs per acre were lower for organic corn than conventional corn, while ownership costs and economic costs per acre were higher for organic corn in 2010. The total operating and ownership costs per acre did not significantly differ for conventional and organic corn because higher ownership costs per acre for organic corn offset a portion of their lower operating costs per acre in 2010.[3]

The higher gross value of production per acre for organic corn resulted from higher harvest-month prices, which more than offset lower average yields per planted acre. In 2010, organic corn prices averaged $7.46 a bushel versus $4.33 per bushel for conventional corn (table 10). Yields per planted acre averaged 121 bushels for organic corn and 159 bushels for conventional corn.

Figure 7
Conventional and organic corn production value, costs, and returns per planted acre in 2010



Source: USDA, Economic Research Service (ERS) cost of production accounts and USDA's 2010 Agricultural Resource Management Survey, jointly conducted by ERS and USDA, National Agricultural Statistics Service.

[3]The cost and return account for organic corn excludes the costs of transitioning land from conventional to organic production. This transition period lasts for 3 consecutive years, during which producers are banned from using substances not approved for organic production but are not allowed to sell certified organic corn. In addition, producers who wish to sell $5,000 or more of organic produce annually must undergo an approval process to become certified organic growers. See ERS Web site for further information: http://www.ers.usda.gov/topics/natural-resources-environment/organic-agriculture/organic-certification.aspx.

Table 10

Costs and returns per planted acre for conventional and organic corn in 2010

Item	Conventional (a)	Organic		
		Total (b)	Heartland (c)	Northern Crescent (d)
Pecent of corn farms	99.0	1.0	0.5	0.5
Percent of corn acres	99.8	0.2	0.1	0.1
Percent of corn production	99.8	0.2	0.1	0.1
Percent of corn acres planted for:				
Food	7	^ 15	# 6	^ 9
Feed	27 b	77 a	81	88
Ethanol	11 b	0 a	0	0
Unknown or other[1]	55 b	^ 8 a	# 13	# 4
Planted corn acres per farm	290 b	73 a	^ 78	55
Ratio of harvested to planted acres	99	99	100	98
Yield per planted acre (bu):				
Expected	174 b	135 a	138 d	127 c
Actual	159 b	121 a	120	113
Corn harvest-month price ($ per bu)	4.33 b	7.46 a	7.13	7.16
Operating and ownership costs ($ per bu):				
Expected	2.20	2.58	2.09 d	2.75 c
Actual	2.40 b	2.87 a	2.42 d	3.01 c
Cost and return per planted corn acre ($):				
Gross production value	689 b	904 a	856	811
Operating costs:	290 b	229 a	174	239
Seed	82 b	61 a	67 d	57 c
Fertilizer	112 b	# 73 a	# 39 d	90 c
Chemicals	26 b	0 a	0	0
Custom operations	16	17	# 8	^ 14
Fuel, lube, and electricity	26 b	41 a	29 d	38 c
Repairs	24 b	33 a	28	34
Purchased irrigation water	0	0	0	0
Interest on operating capital	0	0	0	0
Hired labor	3	^ 4	# 2 d	6 c
Ownership costs:	93 b	119 a	116	111
Capital recovery of machinery and equipment	84 b	106 a	102	97
Taxes and insurance	8 b	13 a	^ 13	14
Economic costs:	168 b	189 a	205	170
Opportunity cost of land	127 b	110 a	123 d	84 c
Opportunity cost of unpaid labor	22 b	49 a	51	50
General farm overhead	18 b	30 a	^ 31	36
Operating and ownership costs	382	348	290	351
Total costs	550	537	494	521
Production value less:				
Operating costs	400 b	674 a	682 d	572 c
Operating and ownership costs	307 b	555 a	566 d	460 c
Total costs	139 b	366 a	361	290

Note: Letters a and b indicate whether conventional and organic corn estimates are significantly different while c and d indicate whether Heartland and Northern Crescent organic corn estimates are significantly different at the 90-percent level or higher using the *t*-statistic. Coefficient of variation (CV) = (Standard error/estimate) x 100. ^ indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is above 50. bu = bushel. [1]Many producers do not know how their grain will be used.

Source: USDA, Economic Research Service (ERS) cost of production accounts and USDA's 2010 Agricultural Resource Management Survey, jointly conducted by ERS and USDA, National Agricultural Statistics Service.

Operating costs per acre for organic corn were lower as a result of the inputs required for organic production. Most synthetics and some natural, but toxic substances are banned from use in organic production (U.S. Environmental Protection Agency, Organic Farming). Organic seed must be used, and the seed cannot be genetically engineered. Chemical fertilizers, chemical insecticides, and chemical herbicides are banned, though fertilizers from manure and compost are allowed.

Organic seed is more expensive than conventional corn seed that is not genetically modified, but it is far less expensive than genetically modified corn seed that is widely used in conventional corn production (table 11). Organic corn producers used fewer pounds of nitrogen, phosphorous, potassium, and lime per planted acre than did conventional corn producers, and virtually no producers applied chemicals to their organic corn acres. As a result, the average seed, fertilizer and manure, and chemical costs per acre were lower for organic corn production. Manure and compost were the primary nutrient sources for organic corn production because commercial fertilizers are banned in organic farming.

Average per-acre costs for fuel, repairs, capital recovery of machinery and equipment, and labor were higher for organic corn than for conventional corn in 2010. These higher per acre costs resulted from a greater number of trips across a field and smaller machinery used in organic corn production. Because synthetic chemicals are banned, organic producers employ mechanical weed control, thereby increasing their trips across a field. In 2010, organic corn producers averaged 8.1 trips across their corn fields versus 4.7 trips for conventional corn producers. A greater number of trips results in higher fuel and labor use per acre, and higher costs for repairs and capital recovery. On average, 2.8 hours of labor per corn acre was used on organic fields versus 1.2 hours per acre on conventional corn fields in 2010. Part of the labor-hour difference is due to the smaller widths of farm machinery used by organic producers since it takes longer to cover an acre with the smaller machines.

The surveyed organic corn growers were asked to list their reasons for raising organic corn. The primary reason cited by 43 percent of the growers was increased farm income, while 26 percent reported the protection of family and/or community health as their primary goal. Just over 20 percent cited the adoption of more environmentally friendly practices as their primary reason.

Organic corn growers raised an average of 5.2 agricultural commodities on their farms versus 3.6 for conventional corn growers (table 12). Commodity diversification reduces production risk and financial impacts from unexpected changes in market prices or yields. More organic corn growers grew hay, 41 percent, versus 16 percent of conventional corn growers.

Organic corn growers operated smaller farms, averaging 462 total acres per farm versus 811 acres per farm for conventional corn growers, in 2010. Organic corn growers also planted fewer acres of corn, 73 on average, versus 290 acres per farm for conventional corn growers.

The smaller farm operations of organic corn producers were reflected in the lower values of equity per farm and smaller farm incomes per farm family. On average, operators of organic farms averaged $1.2 million in farm equity, while operators of conventional corn farms averaged $1.8 million. Farm income per household averaged $25,300 for organic corn producers, versus $71,400 for conventional producers in 2010. In addition to having less farm income, families of organic corn producers received less off-farm income per family than conventional producers, even though these families were equally likely to have someone working off-farm.

Table 11

Production practices and input use on conventional and organic corn acreage in 2010

Item	Conventional (a)	Organic		
		Total (b)	Heartland (c)	Northern Crescent (d)
Crop rotation (percent of acres):				
Corn	28 b	^ 3 a	# 1 d	# 6 c
Soybeans	61	^ 36	# 53	^ 18
Idle or Conservation Reserve Program	6 b	^ 24 a	# 11 d	31 c
Irrigation:				
Irrigated (percent of acres)	7	# 4	# 1	na
Farms irrigating (percent)	11	# 15	# 1	na
Energy used per acre:				
Gasoline (gallons)	1.9	1.8	^ 1.7	2.0
Diesel (gallons)	5.2 b	7.5 a	6.3 d	7.4 c
Liquid petroleum gas (gallons)	1.7	1.8	1.5 d	2.7 c
Natural gas (1,000 cubic feet)	^ 0.2	# 0.5	0.0	0.0
Electricity (kilowatt hours)	30.5	^ 21.6	# 27.4	# 16.2
Seed used:				
Number of seeds per acre	31,206	30,180	31,391	29,851
Cost for 1,000 seeds (dollars)	2.62 b	2.01 a	2.12 d	1.90 c
Fertilizer and manure use:				
Nitrogen (pounds per acre)	142 b	^ 50 a	# 40	^ 51
Phosphorous (pounds per acre)	50 b	^ 20 a	# 15	^ 28
Potassium (pounds per acre)	56 b	^ 30 a	# 16 d	^ 51 c
Lime (tons per acre)	0.2 b	0.1 a	# 0.1	0.2
Nitrogen (percent of farms)	97 b	79 a	76	82
Phosphorous (percent of farms)	85	79	74	84
Potassium (percent of farms)	73	78	71	85
Lime (percent of farms)	49	48	37 d	58 c
Trips over field (number)	4.7 b	8.1 a	8.2	8.0
Labor hours per acre:	1.2 b	2.8 a	^ 2.9	2.9
Paid	0.2	^ 0.3	# 0.2 d	^ 0.4 c
Unpaid	1.0 b	2.5 a	^ 2.8 d	2.5 c
Farms with paid labor (percent)	42	39	^ 39	39
Machinery maximum width (feet):				
Planter	24 b	17 a	19	15
Harvester	16	14	^ 17	12

Note: Letters a and b indicate whether conventional and organic corn estimates are significantly different while c and d indicate whether Heartland and Northern Crescent organic corn estimates are significantly different at the 90-percent level or higher using the *t*-statistic. Coefficient of variation (CV) = (Standard error/estimate) x 100. ^ indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is above 50. na = not available due to statistical or confidentiality concerns.

Source: USDA's 2010 Agricultural Resource Management Survey, jointly conducted by USDA, Economic Research Service and National Agricultural Statistics Service.

Table 12

Characteristics of corn farms and operators in 2010 by conventional and organic corn

Item	Conventional (a)	Organic		
		Total (b)	Heartland (c)	Northern Crescent (d)
Total operated acres per farm:	811 b	462 a	431	375
Owned and operated	356 b	229 a	211	242
Cash-rented	370 b	189 a	188	^ 133
Share-rented	110 b	# 50 a	# 39	# 6
Cropland	670 b	352 a	342	280
Number of commodities per farm	3.6 b	5.2 a	5.5	5.1
Percent of farms producing:				
Some corn under contract	38 b	21 a	^ 21	^ 20
Soybean	76	73	85	63
Wheat	24	24	# 5 d	42 c
Hay	16 b	41 a	# 28	53
Cattle	45	57	71 d	43 c
Dairy	8	^ 20	^ 30	# 10
Hogs	6	^ 6	^ 11	^ 3
Operator occupation (percent):				
Farming	82 b	90 a	96	84
Nonfarm work	16 b	^ 9 a	# 4	^ 15
Operator paid for off-farm work (percent)	36	^ 34	^ 32	^ 37
Principal operator age (mean):	56 b	52 a	52	53
Less than 50 years (percent)	29	42	^ 52	^ 33
65 or more (percent)	25	^ 16	# 14	^ 18
Principal operator education (percent):				
High school	91	74	^ 62	86
Completed college	21	# 13	^ 9	^ 15
Sole or family proprietor (percent)	86	88	88	91
Farms sharing farm income (percent)	15	^ 17	# 10	* 23
Government payments per farm ($):	11,213 b	5,319 a	^ 6,650	^ 2,784
Direct and counter-cyclical	9,723 b	^ 2,995 a	^ 3,651	^ 1,705
Conservation	1,408	^ 2,245	^ 3,000	^ 917
Farms with Government payments (percent):	79 b	50 a	^ 49	50
Direct and counter-cyclical	74 b	40 a	^ 42	37
Conservation	27	27	^ 30	^ 24
Household income per family ($1,000):	119.0 b	59.1 a	^ 60	^ 55.8
Farm income	71.4 b	^ 25.3 a	^ 27.2	^ 20.8
Off-farm income:	47.6 b	33.9 a	^ 32.8	^ 35
Earned income from business or job	35.1	^ 25.1	^ 25.0	^ 24.8
Percent with off-farm business or job	66	64	^ 62	64
Average value per farm ($1,000):				
Farm assets	1,988 b	1,407 a	1,411	1,388
Farm debt	226	162	^ 140	^ 182
Farm equity	1,763 b	1,245 a	1,271	1,206
Debt/asset ratio (percent)	11	11	10	13

Note: Letters a and b indicate whether conventional and organic corn estimates are significantly different while c and d indicate whether Heartland and Northern Crescent organic corn estimates are significantly different at the 90-percent level or higher using the *t*-statistic. Coefficient of variation (CV) = (Standard error/estimate) x 100. ^ indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is above 50.

Source: USDA's 2010 Agricultural Resource Management Survey, jointly conducted by USDA, Economic Research Service and National Agricultural Statistics Service.

Although organic corn producers operated smaller farms, they were more likely to be full-time farmers and younger than conventional corn producers. In 2010, 90 percent of organic corn producers reported that their principal occupation was farming versus 82 percent of conventional corn producers. The average age for operators of organic corn farms was 52 years versus 56 years for operators of conventional corn farms.

Regional Organic Corn Production

Nearly all organic corn production occurs in two regions. Virtually half of all U.S. organic corn production occurs in the Heartland, which is well known for its low-cost conventional corn production, while the other half is produced in the Northern Crescent. Organic corn production may be more concentrated in Northern Crescent than conventional corn because of the concentration of organic milk production in this region. In 2005, the Northern Crescent produced nearly half of U.S. organic milk (McBride and Greene, 2009). Organic production tends to be concentrated in northern regions because of the cooler climate that reduces the pressure from pests (Rosenzweig et al., 2000). Warmer temperatures, especially those in the winter and at night, are conducive to the survival of crop pests. Pests are especially troublesome for organic producers since they are not permitted to use most chemicals.

Expected and actual organic corn yields per planted acre in 2010 were higher in the Heartland than in the Northern Crescent while organic corn prices were nearly identical in the two regions. The operating and ownership costs averaged $2.42 per bushel for organic corn in the Heartland versus $3.01 per bushel in Northern Crescent. The three cost measures per acre did not differ significantly for organic corn in the Heartland and the Northern Crescent. However, the net returns per acre were significantly higher in the Heartland for two of the three cost measures.

The average operating costs per acre for organic corn were lower in the Heartland than in the Northern Crescent, although the difference was not statistically significant. Fertilizer, fuel, and hired labor costs per acre were lower for Heartland than Northern Crescent producers while seed cost per acre was higher for Heartland producers in 2010. Heartland producers applied less potassium to their organic corn fields and used less diesel and liquid petroleum gas per acre than Northern Crescent producers did. Heartland producers used less paid labor hours and more unpaid labor per acre of organic corn than did Northern Crescent producers. Heartland organic corn producers were less likely than Northern Crescent producers to indicate that their main occupation was nonfarm work. Producers working off-farm have less time for farming and may hire labor to complete farm tasks. Heartland organic corn producers had higher costs per acre for land rental than Northern Crescent organic producers had. These higher land costs may reflect the higher expected corn yields obtained by Heartland corn producers.

Conclusions

The boost in corn prices between 2001 and 2010 significantly affected corn producers. Increased corn prices resulted in significantly higher return to corn production. In 2010, most U.S. producers, 92 percent, covered their operating and ownership costs per bushel for corn from harvest-month prices compared with 59 percent in 2001 (Foreman, 2006). Higher returns from corn production created the incentive to move additional land into corn production. More than 12 million U.S. corn acres were added between 2001 and 2010.

The operating and ownership cost to produce corn varied widely, ranging from an average of $1.74 per bushel for low-cost producers to $3.88 per bushel for high-cost producers while corn prices averaged $4.33 per bushel. Differences in yields and input use accounted for most of the cost differences, with low-cost producers achieving higher corn yields using lower levels of inputs.

Despite the increase in corn acreage from 2001 to 2010, the distribution of corn farms and production among the regions was quite similar in each year, suggesting that corn acreage was added at about the same rate in each region (Foreman, 2006). [4] The Heartland continues to be the major corn production region because producers in this region have the lowest average production costs per bushel. Heartland producers had the highest average yields in 2010. In contrast, Southeast producers had the lowest yields and the highest average operating and ownership costs per bushel. Variations in the average corn yields per planted acre accounted for the majority of regional variation in corn costs per bushel in 2010. In 2010, drought in pockets of the Southeast reduced yields and pushed some of the region's producers into the high-cost group.

The majority of corn production, 58 percent, took place on farms that planted 500 or more corn acres in 2010. These farms made up 17 percent of corn farms. In contrast, 67 percent of corn producers planted fewer than 250 acres of corn and produced 20 percent of the 2010 corn. One might expect the corn production costs to be lower for producers planting more corn acres because of factors contributing to economies of size, such as spreading fixed costs over more acres and discounts for large purchases. However, the 2010 ARMS data showed that farms with more planted corn acres tended to have higher costs per acre. This situation also occurred in 2001 and may be partially due to the greater use of irrigation on farms with more corn acres. In 2010, the fact that farms planting the most corn acres were less likely to rotate corn with soybeans and other crops tended to raise their corn production costs. Further, the addition of 12 million corn acres between 2001 and 2010 may have resulted in some less productive land being added to corn production, which would increase average corn production costs. Still, high corn prices in 2010 enabled returns above costs from corn production on land not previously planted with corn.

Net returns from organic corn production surpassed those from conventional corn production, largely because of organic corn's higher prices. Higher organic corn prices more than offset the lower yields per planted acre in 2010. Although the total operating and ownership costs per acre did not differ significantly between conventional and organic corn, the operating costs per acre were lower for organic corn because of the nature of inputs used, while ownership costs per acre were higher as a result of more intensive use of machinery. Organic production is concentrated in the Heartland and Northern Crescent, with the Heartland producers having lower operating and ownership costs per bushel.

[4]However, year-to-year changes in corn acreages can show significant variation as discussed for 2009 to 2010 in the Background section of this report.

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Glossary

Coefficient of variation (CV) is a statistical measure that allows one to examine the relative data variability about the mean for two estimates that may have significantly different means. The coefficient of variation is computed by dividing the standard deviation by the mean, and the result is often multiplied by 100 to report it as a percentage. Higher CV values indicate relatively greater variation of values around the mean.

Corn is a grass that requires nitrogen for growth because grasses cannot convert atmospheric nitrogen into organic nitrogen usable by the plant. Therefore, producers usually apply organic nitrogen to their grass crops. Often, increased amounts of nitrogen are added to a corn field if the field has not been rotated with legumes.

Corn enterprise refers to the activities related to the farm production of corn. In contrast, the farm operation usually refers to all farm-related activities on the farm. Often farms grow more than one commodity and, therefore, most farms have more than one enterprise.

Corn farms are those with at least 1 acre of corn planted with the intention of harvesting it for grain. Data on producers planting corn with the intention of harvesting it for silage or commercial seed were excluded from this report.

Corn production regions are defined by modifying ERS farm resource regions. Farm resource regions consist of county groupings with similar soils and climates that favor production of selected crops and livestock and lead to the use of similar production practices within a region. The Southeast region was created by combining farms in the Eastern Uplands, Southern Seaboard, and Fruitful Rim because of limited samples in these regions. Fruitful Rim producers were reclassified into the Southeast because the only Fruitful Rim producers included in the 2010 corn survey were located in either Georgia or Texas. Data on one corn producer located in the Basin and Range region of Colorado were categorized as "Prairie Gateway" due to the producer's proximity to this region. No corn producers were sampled in the Mississippi Portal.

Corn under contract refers to marketing or production contracts. Marketing contracts either specify the price or stipulate how the price will be determined before corn is harvested. Typically, the producer provides all production inputs and retains ownership until the corn is delivered. Production contracts are formal or informal arrangements to produce corn for processors, packers, canners, or integrators. Often, such contracts specify which inputs will be provided by the producer and which will be supplied by the contractor, and how the producer will be compensated.

Cost categories are based on the ranking of operating and ownership costs per bushel of corn raised for grain in 2010 on U.S. corn farms. The high-cost category included farms planting corn but not harvesting it. For these farms, the operating and ownership costs per bushel of corn were set to the cost per planted acre.

- Low-cost farms: lowest quartile (25 percent of the farms with the lowest costs per bushel).
- Mid-cost farms: second and third quartiles (the mid 50 percent of farms with neither the highest nor lowest costs per bushel).
- High-cost farms: highest quartile (25 percent of farms with the highest costs per bushel).

Crop rotation is the planting of different crops in a field during sequential growing seasons. Rotation increases soil fertility and reduces problems with weeds, pests, and pathogens. Corn is often rotated with soybeans because soybeans provide nitrogen in the soil for corn. Despite the benefits of crop rotation, corn is often planted in the same field for two consecutive growing seasons.

Debt-to-asset ratio measures the level of debt on farm assets. A higher proportion of debt relative to assets indicates more financial risk. The ratio is the value of the operator's farm debt divided by the value of farm assets, expressed either as a percentage or a fraction.

Economic costs are the sum of opportunity costs for land and unpaid labor and general farm overhead. The opportunity costs for land are based on cash rental rates per acre, and unpaid labor is valued at off-farm wage rates.

Ending stocks are the difference between the total supply and total disappearance. For corn, the total disappearance is the sum of corn used for food, alcohol, industrial items, seed, feed, residual and exports. Ethanol is a form of alcohol.

Expected yields are the yields farm operators reported that they expected to achieve when planting corn.

Farm enterprise size measures of the size of the corn operation on the farm. The unit of measure for size is the number of corn acres planted. Five sizes for the corn enterprise are used in this report: less than 250 acres, 250 to 499 acres, 500 to 749 acres, 750 to 999 acres, and 1,000 or more acres.

Farm household income is computed from ARMS data and is the sum of farm and off-farm income for the household of the principal farm operator. It excludes income earned by landlords and contractors. In addition, it excludes income generated by farms organized as nonfamily corporations or cooperatives and farms operated by hired managers. For farms with multiple operators or partners, the only income reported is that earned by the household of the principal farm operator. Farm income of farm households is defined as the net cash farm business income plus net income from farmland rental, and earnings of the operator household from farming activities, minus the sum of depreciation, gross farmland rental income, and farm business income received by other households. Off-farm income consists of wages, salaries, net income from nonfarm businesses, interest, dividends, transfer payments, Social Security retirement, pensions, other retirement plans, gifts, net cash income from another farm operation, net income from farmland rental, and other off-farm income sources.

General farm overhead costs are those costs that cannot be directly attributable to a specific enterprise. Some examples of these costs include general farm supplies, marketing containers, hand tools, power equipment, maintenance and repair of farm buildings, farm utilities, and general business expenses. General farm overhead costs are allocated to each commodity based on the relative contribution to total farm operating margin (i.e., value of production less operating costs).

Idled land was fallowed or in the Conservation Reserve Program during summer and fall of 2009. Land that has been idled during the previous growing season frequently needs additional work to prepare the field for planting corn.

Labor hours per acre are the hours worked by paid and unpaid workers on the corn enterprise, excluding the hours spent by workers performing custom field operations.

Lime is normally applied once every few years to a field to reduce acid in the soil since acidic soils often reduce plant growth. Amounts per acre shown in the tables in this report are the average prorated annual amount of lime applied to all planted corn acres. The annual prorated amount is computed by taking the amount of lime applied and dividing it by the number of years between lime applications for each farm reported in ARMS. The annual prorated amount of the lime is then summed across all farms and divided by the sum of planted corn acres.

Principal operator is the person who makes most of the daily decisions for the farm operation.

Returns are the gross production value minus the costs. In this publication, three levels of returns are shown, those after subtracting operating costs, those after the sum of operating and ownership costs are subtracted, and those after all costs are subtracted.

Sole or family proprietors have no legal partners or shareholders. Under the sole or family proprietor arrangement, the operator(s), usually husband and wife, are regarded as self-employed and personally liable for all the farm's obligations.

Soybeans are legumes. Legumes are plants with nodules on their roots formed by bacteria that convert atmospheric nitrogen to organic nitrogen that enrich the soil. Often, producers can reduce the amount of nitrogen they apply to crops planted after legumes. For our purposes, corn was considered to be rotated with soybeans if soybeans were planted in the spring or summer of 2009 and a second crop was not planted in the fall.

Statistically significant differences in estimates in this report indicate that there is a 90-percent chance that means from two different producer groups are actually different. The t-test is used to make this determination.

Trips over field is a measure that counts the number of trips made across the selected corn field. The number of trips excludes trips made by custom operators since the costs for labor, fuel, and machinery used in custom operations are included in the costs for custom operations. Tandem operations count as one trip over the field. Partial trips over a field are included. For example, if a producer sprays pesticide over the entire field and later sprays pesticide over half of the field, then the number of trips over the field would be recorded as 1.5 trips for pesticide applications.

Width of farm machinery measures the maximum width of farm machinery used on the corn field. The machinery used in custom operations is excluded from this calculation.