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U.S. Wheat Production Practices, Costs, and Yields: Variations Across Regions

Gary Vocke and Mir Ali





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Abstract

USDA's 2009 Agricultural Resource Management Survey (ARMS) provides the most recent data on U.S. wheat production costs. The wide variation in wheat production costs across the United States captured by the survey reflects the differences in cropping practices, yields, and costs of land, labor, and capital assets. The North Central and Northern Plains regions have the lowest and highest per bushel costs, respectively. The two cost items that accounted for much of the regional differences in total production costs were machinery and fertilizer. The survey found that 97 percent of the country's farms could have covered all their operating costs with the 2009/10 season average price of \$4.87 per bushel if they had been able to attain the yields they expected at planting (as reported in the survey). However, only 79 percent would have been able to cover their operating costs with the yields they actually harvested. The relatively high percentage of farmers who were apparently not covering these costs is attributed, in part, to a large number of farmers in the Southern Plains whose crops were adversely affected by severe weather.

Keywords: wheat, prices, inputs, cost of production, Agricultural Resource Management Survey, ARMS, operating costs, ownership costs

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U.S. Wheat Production Practices, Costs, and Yields: Variations Across Regions

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What Is the Issue?

Wheat, produced in nearly every part of the United States, is the third largest U.S. crop in terms of both value and acreage, behind corn and soybeans. Unlike most other crops, however, wheat has distinct varieties that are produced in different regions or over different seasons. The result is wide variation in the costs of wheat production across growing areas, inherent in the diversity of inputs and production practices. These costs can affect the competitiveness of wheat with other crops in each region and the profitability of planting wheat. This study explores the variation in wheat production costs across U.S. regions, based on data from the 2009 Agricultural Resource Management Survey (ARMS).

What Did the Study Find?

The wide variation of wheat production costs across the country reflected differences in yields, cropping practices, and costs of land, labor, and capital assets. Regional climatic differences across the United States accounted for much of the variation in the class of wheat grown, each with its own production practices and associated costs. Northern wheat producers, for example, chose spring wheat varieties that were harvested in the fall because winter wheat—planted in the fall for summer harvest—would be killed by the cold during its winter dormancy. Growers in areas with abundant rainfall were able to boost their yield potential by applying high rates of fertilizer. At the other extreme, some regions had areas so dry that costly irrigation was needed to produce a wheat crop.

Wheat Yields and Production Costs: Expected Versus Actual

National Overview

In 2009, the expected national average of combined operating and ownership costs was \$4.00 per bushel of wheat versus an actual average of \$4.75. The expected average U.S. yield was 47.7 bushels per acre, while the actual average yield was 40.2 bushels. The 2009 season average price (SAP, estimated annually by the USDA National Agricultural Statistics Service) was \$4.87 per bushel.

An analysis using **expected yields** (based on survey responses) and the 2009 SAP finds that 97 percent of U.S. farms would have covered their operating costs if they had met their expected yields and received the SAP of \$4.87 per bushel, 77 percent would have covered both operating and ownership costs, and 34 percent would have covered their total costs.

Fewer U.S. farmers covered their operating costs when the analysis considers **actual or realized yields**. If farmers, on average, had received the \$4.87 SAP for the bushels they harvested in 2009, 79 percent of them would have covered their operating costs, 53 percent would have covered their

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operating and ownership costs, and 18 percent would have covered their total costs. Actual yields and costs are typically lower than expected ones, but this may have been especially evident in 2009 because of adverse weather. In particular, an April freeze and severe drought in the Southern Plains region led to the abandonment of many wheat fields and sharply reduced output, resulting in high production costs per bushel for the region. Local statistics such as these are reflected, in turn, in national average yields and costs.

Regional Comparisons

In all five regions analyzed, the average yield of bushels per acre was fewer than expected and average production costs were higher. The discrepancies and the factors underlying them varied by region.

North Central – Although the region’s actual yield of 59.8 bushels per acre was well above the national average and the highest among the regions, it fell short of the expected 69.2 bushels. North Central had the lowest overall production costs among regions but the highest operating costs, driven by large input expenditures. Farmers in the region applied the most fertilizer, which acted in combination with the region’s generous rainfall to promote high yields. Overall production costs were low because the high yields spread ownership costs over many harvested bushels of wheat.

Southern Plains – The region had the largest discrepancies between expected and actual production costs (\$3.80 versus \$8.76) and yields per acre (37.5 bushels expected versus 16.3 realized). As noted, the Southern Plains were hit by a double weather disaster in 2009, an April freeze and severe drought, which sharply reduced the wheat harvest.

Central Plains – The actual yield of the Central Plains—43.2 bushels per acre—was close to the expected yield of 47.6 bushels and to the national average, although actual production costs of \$4.39 per bushel exceeded the \$3.98 expectation. In 2009, the region’s yield was almost three times higher than in the neighboring Southern Plains because of the freeze and drought in the south. Central Plains wheat yields are higher than Southern Plains yields even in a year of more normal weather because temperatures are not as high on the Central Plains and the risk of drought is less.

Northern Plains – The Northern Plains had the highest expected production cost per bushel among the regions. Three-fourths of producers grew lower yielding spring wheat varieties. The region had relatively high expenses for fertilizer, as well as for herbicides and fungicides. The harvested yield (43.7 bushels) came close to the projected yield (45.5 bushels).

Northwest – Although the Northwest region’s actual yield of 59.5 bushels per acre fell short of its 67.0-bushel expectation, it was nearly tied with North Central for the highest yield, despite having lower rainfall. The Northwest’s expected yields are high, in part, because it has the most irrigation, covering more than 20 percent of wheat acreage. With its relatively high yields, its actual production costs of \$4.42 per bushel were below the national average despite the irrigation expense. About half the crop is soft wheat, which is given only low applications of nitrogen fertilizer to ensure the low protein levels for which it is grown.

How Was the Study Conducted?

The farm-level data for this paper were derived from USDA’s annual Agricultural Resource Management Survey (ARMS) for 2009. The ARMS, based on a representative sampling of all U.S. farms, provides information on a broad range of issues about agricultural resource use, production practices, farm costs, and financial conditions and economic well-being of America’s farm households. The ARMS collects data every 4-8 years for each commodity. The authors based their annual production cost estimates on data from the 2009 survey of the U.S. wheat sector. They arranged these estimates from the lowest production costs to the highest to form cumulative distributions. Two sets of cumulative farm distributions were calculated, one using expected yields and the other using actual yields. To provide some explanation for the discrepancies between expected and realized output and prices, the authors supplemented their regional data analyses with expert knowledge of regional conditions and wheat production practices.

U.S. Wheat Production Practices, Costs, and Yields: Variations Across Regions

Gary Vocke and Mir Ali

Introduction

This analysis of costs and returns for U.S. wheat producers is based on data collected in the winter of 2009-10 in USDA's Agricultural Resource Management Survey (ARMS) of wheat farms, which included production costs for the wheat crop harvested in 2009.

The analysis of survey data uses both expected, or normal, yields and realized, or actual, yields. Expected yields reflect long-term trends based on normal conditions and are the yields that farmers use in planning input use, such as the quantity of fertilizer to apply. Realized yields are the crops that were actually harvested. This yield distinction is important because in 2009 an April freeze and a severe drought affected wheat production in the Southern Plains, especially in Texas. Yields were sharply reduced and in many cases were so low that fields were not harvested. These losses, due to both lower yields and abandoned acres, resulted in very high per bushel costs for the wheat harvested in the Southern Plains.

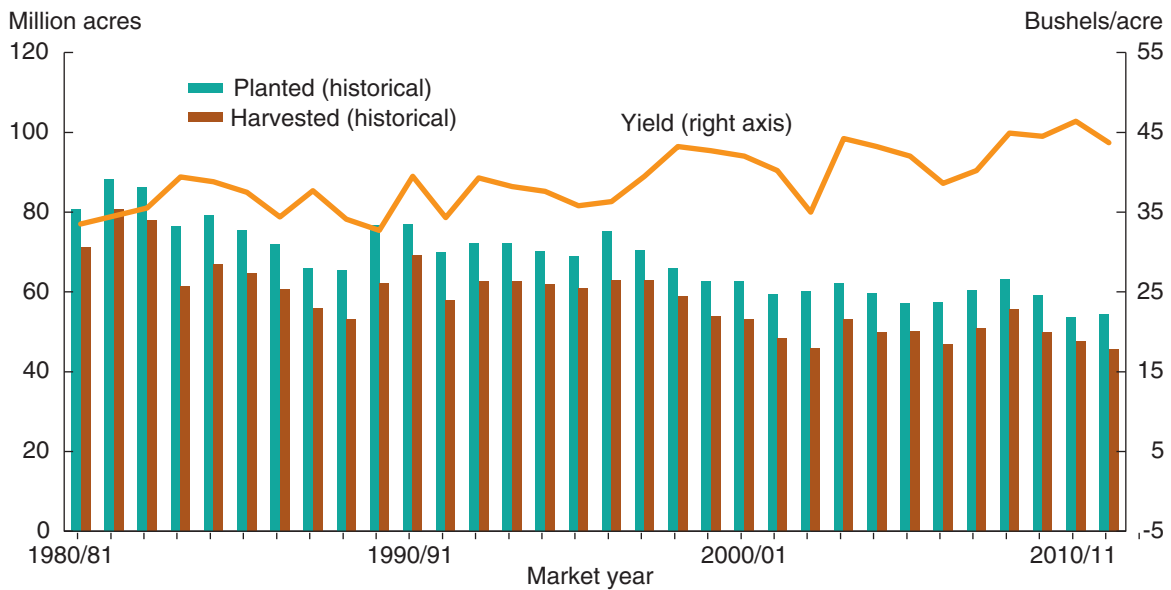
Trends in the U.S. Wheat Sector: Effects on Planted Area

Despite a decrease in wheat acreage, the United States is still a major wheat-producing country, with output exceeded only by China, the European Union (EU-27), and India. In the United States, wheat ranks third among field crops in both planted acreage and value of production, behind corn and soybeans. U.S. wheat area has varied widely during the past half-century, peaking in the early 1980s. Several factors have influenced the downward trend in wheat planting.

Policy Changes

Wheat area dropped off in the mid-1980s, primarily due to large Acreage Reduction Program (ARP) levels implemented when Government-owned stocks were very large (fig. 1).¹ Wheat planting recovered in the late 1980s through mid-1990s as stocks declined and prices rose. The 1996 Farm Act eliminated ARP and introduced full planting flexibility, enabling farmers to switch to alternative crops without penalties. Planting flexibility increased competition for area among corn, oilseeds, and wheat, putting downward pressure on wheat planting, which was less profitable than planting other crops. Enrollment in the Conservation Reserve Program (CRP), which encourages farmers to convert highly erodible cropland to environmentally beneficial uses, is concentrated in regions where wheat production predominates.

Figure 1
U.S. wheat area and yield



Source: USDA National Agricultural Statistics Service. *Quick Stats*.

¹See the ERS Farm & Commodity Policy Glossary at <http://www.ers.usda.gov/topics/farm-economy/farm-commodity-policy/glossary.aspx> for background information on the ARP and the CRP.

Changes in Production Practices and Technology

Wheat land has been switched to other uses as a result of changing technologies. For example, in western Kansas, the historical wheat/fallow rotation has commonly been replaced by a rotation of wheat/grain sorghum/fallow in which wheat is planted 1 year out of 3 instead of every other year. The increased use of water-conserving reduced-till and no-till farming has facilitated the planting of crops such as corn and soybeans, resulting in higher yields and profitability of these crops.

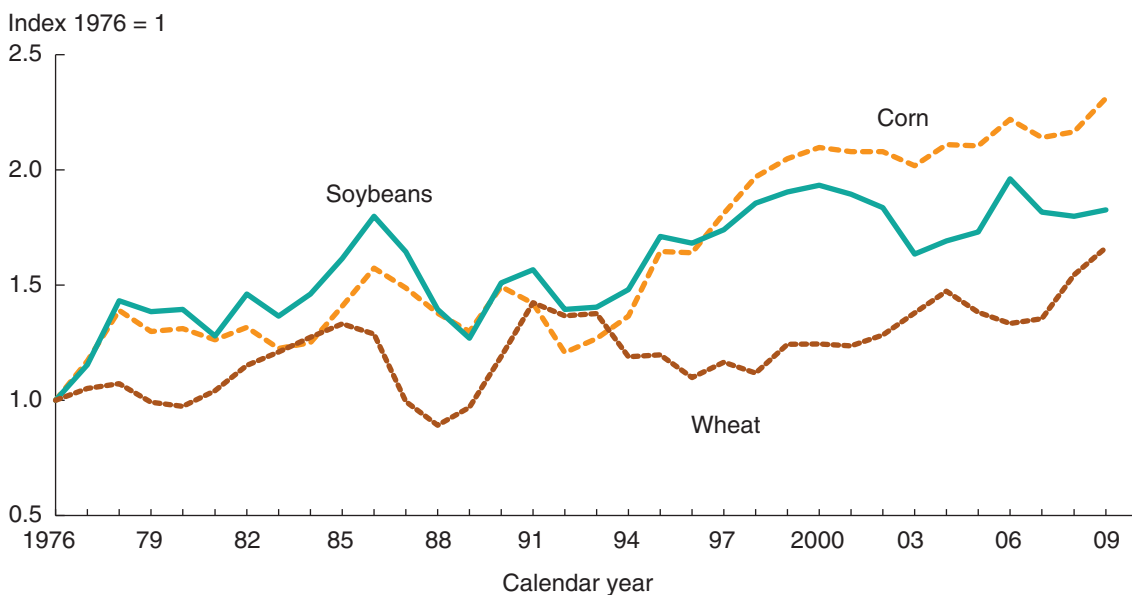
Wheat acreage on the Plains has been further lost to corn and soybeans because of genetic modifications in those crops. New varieties of corn and soybeans can be planted farther west and north in areas with drier conditions or shorter growing seasons. Further, weed control is far easier with herbicide-resistant varieties of corn and soybeans. The pace of genetic modification has been slower for wheat, resulting in little growth in wheat yields, which can make wheat a less attractive cropping option for farmers (fig. 2).

The trend of planting corn and soybeans on acreage traditionally planted to wheat can be illustrated by data for Kansas and North Dakota, two of the country's largest wheat-producing States. In the early 1980s, wheat accounted for 80-90 percent of the total area of wheat, corn, and soybeans planted in Kansas and North Dakota. In recent years, wheat's share has dropped to 50-52 percent of the total (fig. 3).

Wheat Disease

Concerns about wheat disease in the Northern Plains, particularly scab (head blight) in North Dakota and Minnesota, have influenced planting decisions since the 1990s. The increased incidence of this disease may stem in part from larger corn plantings and reduced tillage in traditional wheat areas in the Northern Plains, practices that support hosts for disease organisms.

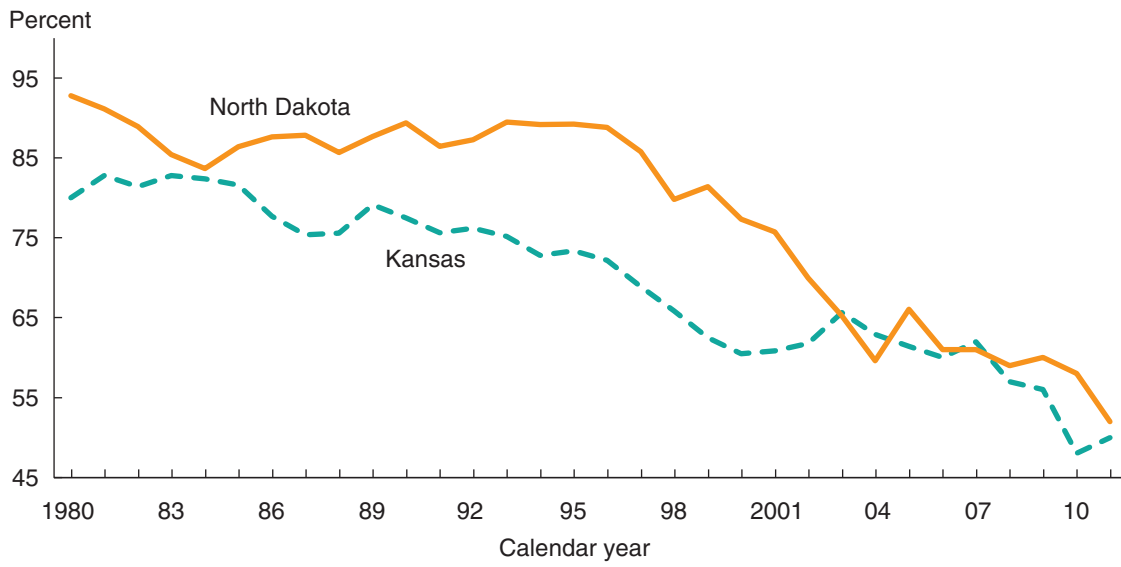
Figure 2
Indices of North Dakota crop yields (3-year averages)



Source: ERS calculations using data from USDA, National Agricultural Statistics Service, *Quick Stats*.

Figure 3

Wheat plantings as share of planted area of wheat, corn, and soybeans in Kansas and North Dakota



Source: ERS calculations using data from USDA, National Agricultural Statistics Service, *Quick Stats*.

Geographic and Climatic Patterns of U.S. Wheat Production

The interaction of climate with wheat classes results in regional differences in wheat production practices in the United States. These differences provide insight into regional variations in production costs per acre and per bushel.

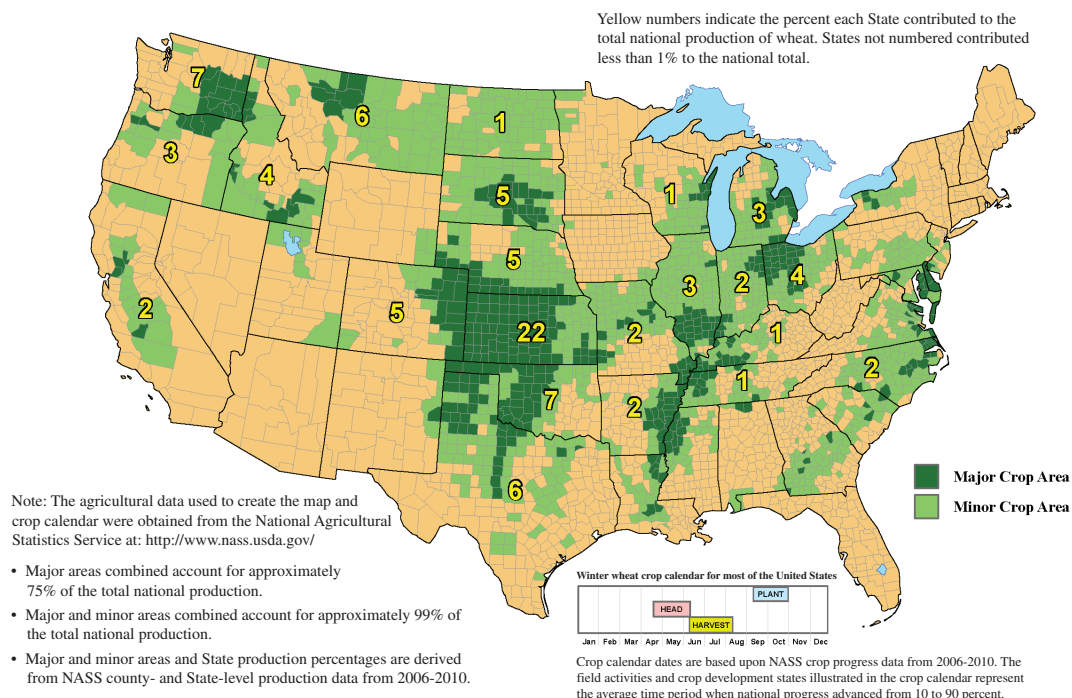
Winter Versus Spring Wheat

Wheat varieties grown in the United States are classified as “winter wheat” or “spring wheat,” depending on the season in which they are planted. Wintertime temperature lows are a key determinant of whether winter or spring wheat is grown in a particular location. Winter wheat varieties are sown in the fall and usually become established before going into dormancy when winter cold arrives. The following spring, winter wheat plants resume growth until summertime harvest (fig. 4). Winter wheat represents 70-80 percent of total U.S. wheat production. Winter wheat has a higher yield potential than spring because of its longer growing season. Spring wheat is planted in the spring and harvested in late summer or fall of the same year (fig. 5). It is grown largely in the Northern Plains, where cold wintertime temperatures would kill winter wheat in dormancy.

Effects of Climate on Wheat Production Practices and Yields

In the Plains, wheat yield potential is lower than in the eastern half of the United States, not just because the Plains cultivate lower yielding spring wheat, but also because the area has less than optimal moisture and higher growing-season temperatures. Extreme heat causes wheat crops to mature faster, reducing yield potential. The stress of high temperatures and/or lack of moisture

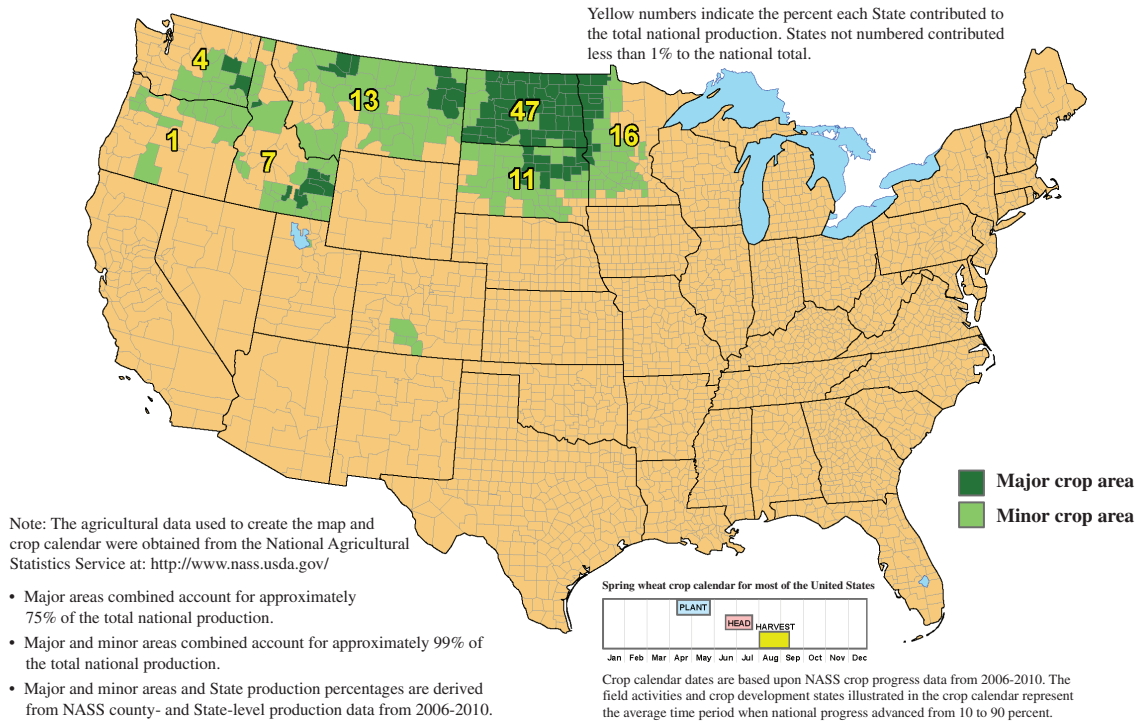
Figure 4
U.S. winter wheat areas



Source: USDA, World Agricultural Outlook Board, Agricultural Weather Assessments.

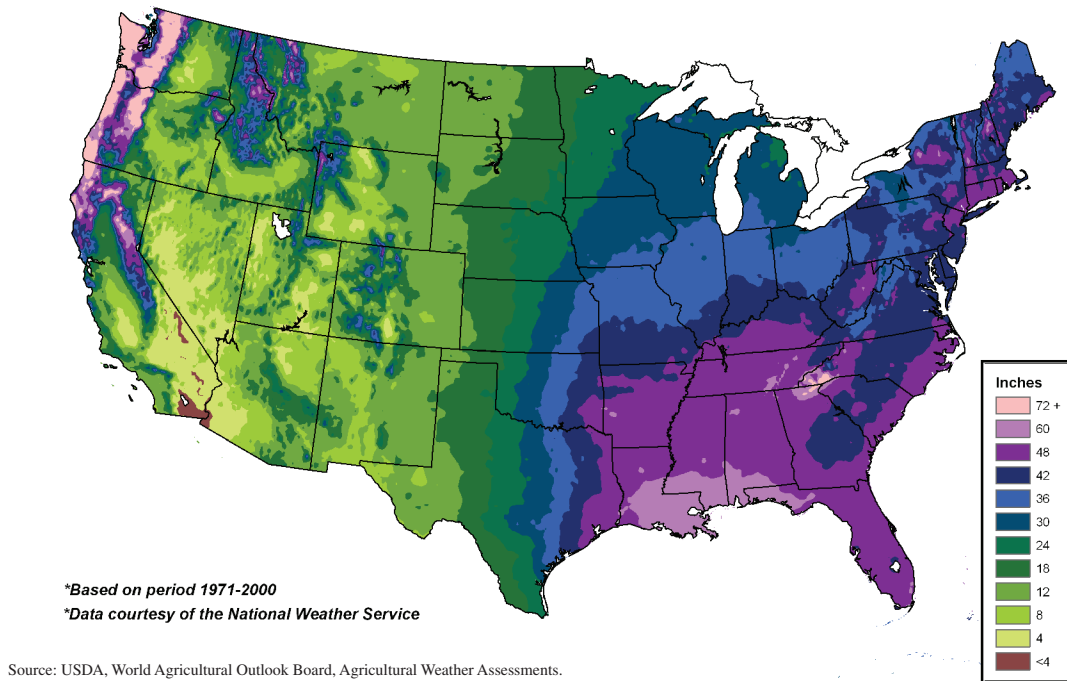
results in smaller wheat kernels with a higher protein content than would occur with more favorable weather. Dryland farmers in the Pacific Northwest obtain higher yields than farmers in the Central and Southern Plains, in part because of the Northwest's cooler summertime temperatures. For optimum wheat growth and yield, milder temperatures are better.

Figure 5
U.S. spring wheat areas



Source: USDA, World Agricultural Outlook Board, Agricultural Weather Assessments.

Figure 6
U.S. rainfall distribution



Rainfall has a considerable impact on potential yields and production practices. In the eastern half of the country, rainfall is typically more than adequate to produce a wheat crop. With this relatively high rainfall comes a higher yield potential than in the Plains, provided adequate fertilizer is applied. In some arid areas in the West, rainfall is inadequate to produce a crop, necessitating irrigation if wheat is to be grown. Though costly, irrigation, along with adequate fertilizer application, sharply increases yields.

Table 1 presents the highest yields achieved over the past 5 years for selected States. These data provide an indication of the yield potential under favorable weather conditions. Yields are higher in the more humid Midwest than in the semiarid West. In States where both winter and spring wheat are grown, winter wheat has the higher yield.

Higher yields generally mean that machinery expenses can be spread over more bushels, reducing machinery costs per bushel. Machinery expenses are a key variable in regional differences in per bushel production costs. Fertilizer expenses are another key variable: farmers in the eastern half of the country use more fertilizer than Plains farmers and realize higher yields. Conversely, yield potential is less in the Plains, so fertilizer requirements are lower.

Table 1
Highest wheat yields from 2007 to 2011 for selected States¹

	Winter wheat yields	Spring wheat yields
	<i>bu/acre</i>	<i>bu/acre</i>
Midwest States		
Illinois	67	
Michigan	75	
Missouri	61	
Ohio	72	
Plains States		
Colorado	45	
Kansas	48	
Montana	48	38
Nebraska	48	
North Dakota		46
Oklahoma	39	
South Dakota	55	45
Texas	37	
Pacific Northwest States		
Idaho	91	84
Oregon	77	
Washington	75	62

¹Includes both irrigated and nonirrigated acres.
bu. = bushel.

Source: USDA, National Agricultural Statistics Service, *Quick Stats*.

Nitrogen Fertilizer Requirements Vary by Class of Wheat

Five principal classes of wheat are grown in the United States (see box, “U.S. Wheat Classes”). The key difference among them for this discussion is protein content. Hard red winter (HRW), hard red spring (HRS), and durum wheat are used to make products that require high-protein flour. Soft red winter and soft white wheat are used to make products that require low-protein flour.

These flour-protein requirements have implications for wheat producers, as protein production in wheat requires nitrogen. Producers of HRW, HRS, and durum wheat must make sure to apply enough nitrogen fertilizer to produce grain with adequate protein content for the products made from these wheat classes. Soft-wheat producers have the opposite concern; they need to limit nitrogen fertilizer applications to ensure a low-protein crop. This is particularly true for soft white wheat produced for export to Asia. In the Pacific Northwest, where both soft white spring and HRS wheat

U.S. Wheat Classes

Wheat is the principal food grain produced in the United States. Production of wheat classes tends to be region-specific (see National Association of Wheat Growers, 2012). The terms “hard” and “soft” refer to the texture of the starchy endosperm of the wheat kernel that is ground to produce wheat flour. Each class has a somewhat different end use. The five major classes of U.S. wheat are:

- **Hard red winter (HRW) wheat** accounts for about 40 percent of total production and is grown primarily in the Great Plains (Texas north through Montana). HRW is a high-protein wheat that is principally used to make bread flour.
- **Hard red spring (HRS) wheat** accounts for about 25 percent of production and grown primarily in the Northern Plains (North Dakota, Montana, Minnesota, and South Dakota). HRS wheat is valued for high protein levels that make it suitable for specialty breads, pasta, and blending with lower protein HRW wheat for loaf bread.
- **Soft red winter (SRW) wheat** accounts for 15 to 20 percent of total production, is grown primarily in States along the Mississippi River and in the eastern States. SRW flour is used for cakes, cookies, crackers, and other wheat products made from low-protein flour.
- **Soft white wheat**, which accounts for 10 to 15 percent of total production, is grown in Washington, Oregon, Idaho, Michigan, and New York. Its flour is used for cakes, cookies, crackers, and other wheat products made from low-protein flour.
- **Durum wheat**, accounting for 3 to 5 percent of total production, is grown primarily in North Dakota and Montana and is used to produce pasta.

These different classes of wheat are used to make different products, based in part on their protein content. The protein in wheat flour turns into gluten when the flour is made into dough, and the proteins absorb water and are pulled and stretched in the kneading process. As the proteins are worked, they become long, flexible strands. The yeast added to the dough produces gases, mostly carbon dioxide, which is trapped by these strands, causing the dough to expand or rise. Leavened bread products require more flour than products like cookies and crackers.

are produced, the nitrogen fertilizer application will be about 40 percent higher for the HRS crop to attain the same yield (Mahler and Guy, 2007).

In addition, in areas of the Pacific Northwest where both HRW and HRS wheat are grown, nitrogen fertilizer application rates are more than 20 percent higher for HRS to get the same yield as HRW because of the shorter growing season for HRS (Stark, Mahler, and Tindall, 2004). During the growing season, microorganisms convert organic sources of nitrogen to inorganic nitrogen that can be utilized by the wheat plant. With spring wheat’s shorter growing season, there is less total organic matter conversion to inorganic nitrogen. To compensate for the reduced conversion, a higher nitrogen fertilizer application rate must be used for spring wheat.

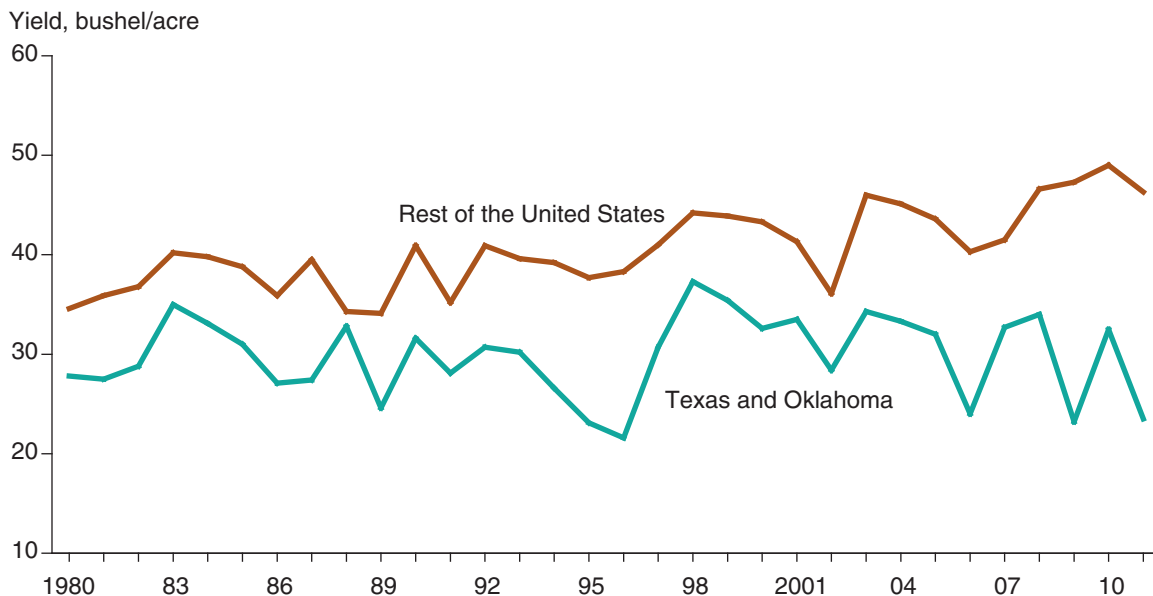
The Risk of Adverse Weather in Any One Year

Detrimental weather conditions, such as low rainfall or a late-spring freeze, can reduce wheat yields and raise realized per bushel production costs above expected levels. In extreme cases, yield potential may be reduced so much that it is not economical to harvest the crop. Weather risk is perhaps highest in the Southern Plains because of the frequency of drought.

Figures 7 and 8 show that wheat yields and harvest-to-planted ratios in the Southern Plains States of Texas and Oklahoma are lower and more variable than in the rest of the country. The rate of abandonment is typically higher in these States than elsewhere in the country because part of the crop is used as pasture when grazing is more profitable than harvesting the grain. The use as pasture increases as adverse weather reduces wheat yields. The graphs also show the impact of adverse weather on yields and rates of acreage abandonment in Texas and Oklahoma in 2009, the year of the ARMS used in this study. Wheat producers in these two Southern Plains States were severely impacted in 2009 by a spring freeze and drought.

Figure 7

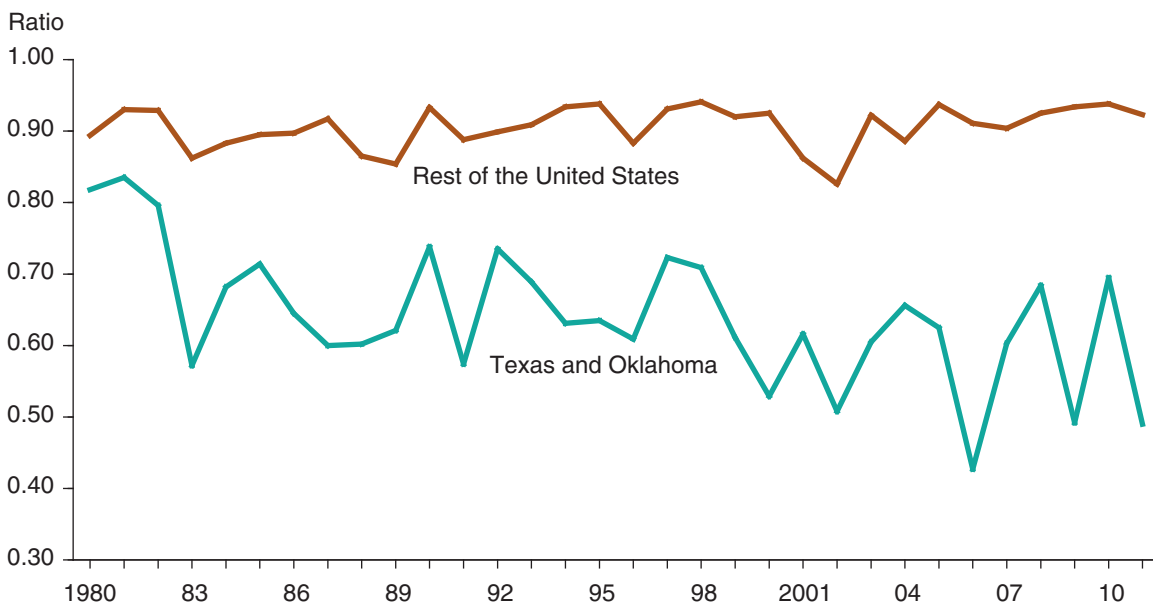
Wheat yields for Texas and Oklahoma and the rest of the United States



Source: USDA, Economic Research Service.

Figure 8

Wheat harvest-to-planted ratios for Texas and Oklahoma and the rest of the United States



Source: USDA, Economic Research Service.

Price Trends for Wheat and Production Inputs

This analysis of costs and returns for U.S. wheat producers is based on ARMS data collected in the winter of 2009/10 on the production costs for the wheat crop harvested in 2009. For context, price trends for wheat and production inputs from 1996 to 2011 are shown in figures 9 and 10.

Wheat Prices, 1996-2011

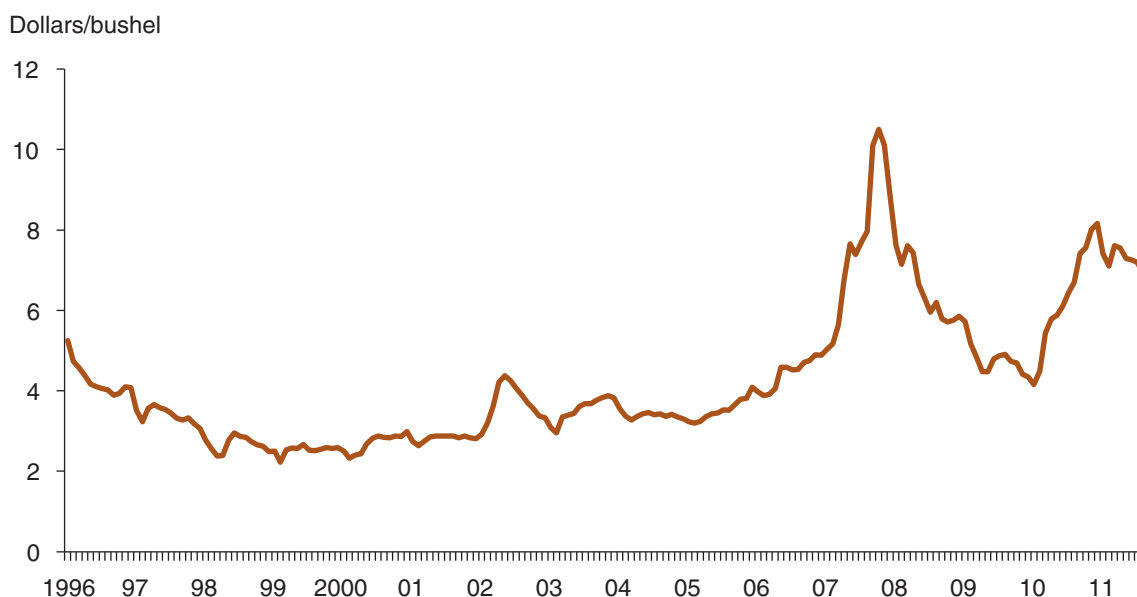
Monthly prices for the 2009/10 wheat marketing year (June 2009-May 2010) resulted in a national season-average price (SAP) of \$4.87 per bushel. This price is below the record \$6.78 per bushel set in 2008/09, but high by historical standards; the 10-year average SAP before the price increase in 2007 and 2008 was \$3.20 per bushel. Global production expanded sharply in response to the 2008/09 price spike and received a boost from more favorable weather, reducing the world's demand for U.S. wheat. As a result, U.S. wheat exports declined, ending stocks rose, and prices fell in 2009/10. (See box, "U.S. Wheat Prices in 2009," for details about prices received by farmers. For more details about this marketing year, see Vocke, 2010).

Input Costs, 1996-2011

Rapidly falling input prices partially offset the sharp decline in wheat prices from 2008/09 to 2009/10 (fig. 10). Fertilizer and fuel costs, accounting for between 25 and 50 percent of operating and ownership costs in the regions used in this analysis, have been particularly volatile, spiking in 2008 before declining to lows in 2009 and 2010. The decline was due in part to falling energy prices as the global financial crisis began in late 2007. As global economic growth resumed, energy prices began to rise again, increasing both fuel and fertilizer prices for farmers.

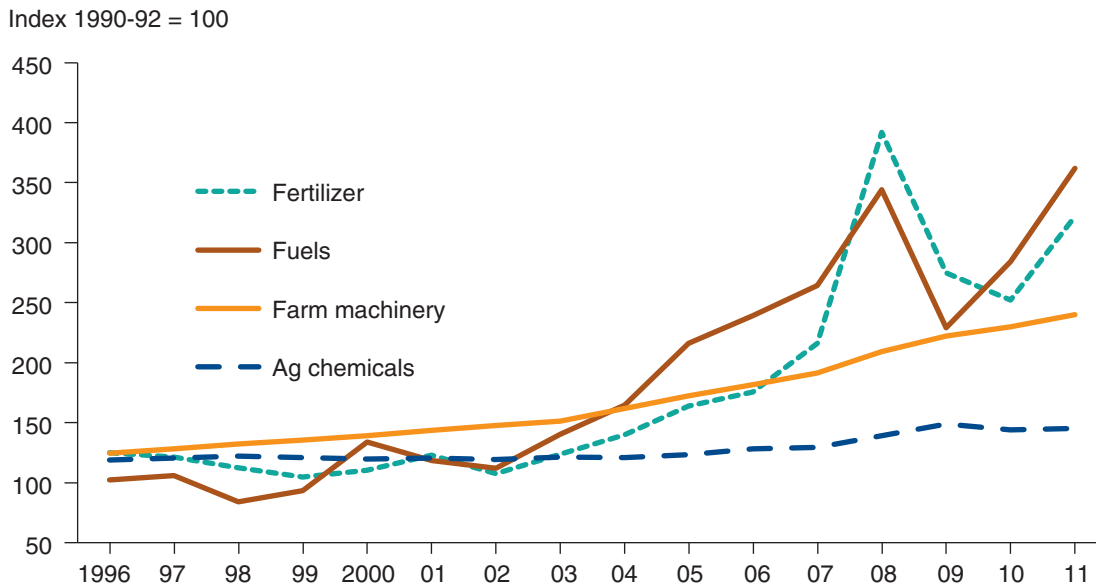
Figure 9

Average monthly wheat prices received by farmers, June 1996-December 2011



Source: USDA, National Agricultural Statistics Service, *Quick Stats*.

Figure 10
Prices-paid index for selected farm inputs



Source: USDA, National Agricultural Statistics Service, *Quick Stats*.

U.S. Wheat Prices in 2009

Prices received by individual farmers can vary because of wheat class differences, distance from principal markets, quality premiums or discounts, cash spot prices or forward contract prices, and the date marketed.

The timing of wheat sales is important because of price variability during the marketing year. Average all-wheat monthly prices for 2009/10 began with \$5.72 per bushel in June 2009. The monthly price dropped to a fall low of \$4.47 in October and rose to a winter high of \$4.90 in January 2010 before dropping to a May low of \$4.33. Each marketing year has a unique seasonal pattern that is often difficult to forecast, making the timing of sales to get the highest price problematic.

The price spreads between the wheat classes vary year to year. The Season-Average Price (SAPs) for the five classes of wheat for 2009/10 were: hard red winter, \$4.84; hard red spring, \$5.26; soft red winter, \$4.35; white, \$4.52; and durum, \$5.47. The principal growing areas of each class of wheat are discussed in box 1, “U.S. Wheat Classes.” Most of the regions in this report have more than one class of wheat, making comparison of regional cost with the SAP of an individual class SAP invalid. The focus of the regional analysis is on the differences in input use that lead to production cost differences.

Energy prices are related to fertilizer prices, both directly through the price for the natural gas used to produce ammonia and indirectly through transportation costs. Ammonia is the main source of nitrogen in various fertilizers, so a change in the price of ammonia often affects the price of all nitrogen-compound fertilizers. Fertilizer prices are also affected by the rapidly rising demand for fertilizer in developing countries like China, India, and Brazil. Finally, the fall in the value of the

U.S. dollar in recent years has raised the price of imported energy and fertilizer for U.S. farmers. **Machinery prices**, which range from 25 to 40 percent of operating/ownership costs, have shown strong annual growth in recent years. The price of **agricultural chemicals** has increased, but at a much slower pace than the other input prices.

The 2009 Agricultural Resource Management Survey of the U.S. Wheat Sector

This section uses the concepts of operating, ownership, and opportunity costs (see box, “Enterprise Costs of Production”) to analyze the regional variability of the cost of growing wheat in the United States. The analysis includes both expected and realized yields. Farmers use expected yields in planning input use, for example, the quantity of fertilizer to apply. Realized yields can be higher or lower than expected if, for example, the weather was better or worse than predicted.

USDA’s 2009 ARMS provides the most recent data on U.S. wheat production costs.² The wide variation of wheat production costs across the country captured by the survey reflects the differences in cropping practices and yields, as well as cost differences in land, labor, and capital assets. The 2009 ARMS data also capture the effects of adverse weather events on realized wheat yields in the Southern Plains, along with their consequent effects on harvested acres and per bushel costs in the region.

Enterprise Costs of Production

Enterprise costs are the value of resources used in the production of wheat, classified into three categories for this analysis:

Operating costs are the short-run costs incurred in planting, growing, and harvesting the wheat crop. They include items such as seed, fertilizer, and chemicals, custom operations, fuel, electricity, purchased water, baling straw, and hired labor. The farmer expects that the returns from the crop will at least cover these expenses, or else it would not be worthwhile to plant the crop.

Ownership costs include repairs, the annualized cost of maintaining the capital investment (depreciation and interest) in farm machinery, equipment, and facilities, and property taxes and insurance. Ownership costs do not need to be covered in one crop cycle but will have to be covered in the medium-term for the farm to remain profitable.

Opportunity costs reflect the loss of potential gains from alternative opportunities when one alternative is chosen. They can include unpaid labor for the time spent by a farmer in the production of a commodity, the rental rate of the land (should the farmer have chosen to rent the land to another producer), and the enterprise share of general farm overhead. General farm overhead includes the expenses for items such as farm supplies, marketing containers, hand tools, power equipment, maintenance and repair of farm buildings, farm utilities, and general business expenses that cannot be directly attributed to a single farm enterprise. Costs of general farm overhead items are allocated to each commodity produced on the farm based on its relative contribution to total farm operating margin (i.e., value of production less operating costs). In the long run, if the opportunity cost for these resources, such as labor and land, is not covered, then those resources will be moved to other activities that provide a higher return.

²Seventeen wheat-producing States were included in the survey. Respondents to the 2009 ARMS of wheat used in this analysis (2,330 farms) represented 140,694 farms, or 49.9 million acres of the 59.1 million acres planted in 2009.

National Overview of Production Costs

The variation in producer costs across the United States can be shown by arranging wheat farms or production from the lowest to the highest cost to form cumulative distributions of farms or production.³ Figures 11a and 11b have cumulative distributions based on farms, with figure 11a using expected yields and figure 11b using realized yields. Figure 12a and figure 12b have distributions based on production, with figure 12a using expected yields and figure 12b using realized yields. The steeper slopes of the distribution lines in the “b” graphs indicate that realized yields were smaller than expected yields, meaning that fewer farmers were able to cover their costs.

The cumulative distributions are evaluated using the national SAP for wheat of \$4.87 per bushel for the 2009/10 marketing year. The national SAP is used for the comparison with costs because actual prices received are not collected by the survey, which is completed before all the grain has been marketed. Only part of the wheat is marketed at harvest. Much is stored in anticipation of a price rise after a harvest-time low. Some grain is never marketed but is used as feed by the farmer. Sometimes farmers will hold their wheat a year or more, to get better prices or to shift revenue between tax years.

The cost/price comparisons shown in the four graphs are summarized in table 2. The column for figure 11a in table 2 shows that if expected yields were achieved, 97 percent of the farms would have covered their operating costs if they had received the SAP of \$4.87; 77 percent of the farms would have covered both their operating and ownership costs; and 34 percent would have covered their total costs. For comparison, the column for fig. 11b, with realized yields, shows that 79 percent of the farms would have covered their operating costs if they had received the SAP of \$4.87; 53 percent would have covered their operating and ownership costs; and only 18 percent would have covered their total costs.

The two right-hand columns in table 2 summarize figures 12a and 12b, which depict the percentage of total U.S. wheat production costs that would have been recovered by the SAP of \$4.87 per bushel with expected and realized yields. For fig. 12a, the operating costs on 98 percent of the national

Table 2

Percent of farms and production covering costs with SAP of \$4.87 per bushel

	Farms distribution		Production distribution	
	Expected yields (fig. 11a)	Realized yields (fig. 11b)	Expected yields (fig. 12a)	Realized yields (fig. 12b)
Percent covering operating costs	97	79	98	93
Percent covering operating and ownership costs	77	53	78	67
Percent covering total costs	34	18	37	33

Source: USDA, Economic Research Service using data from USDA's Agricultural Resource Management Survey, 2009 wheat.

³Associated with each of the 2,330 sampled farms is a group of similar farms. For the farm distribution, the number of farms in each group is divided by the total number of farms represented by the survey to get the group's percentage share of the total. These percentage shares are ranked by the per bushel costs found for the group's sampled farm to create the cumulative distribution of farms. For the production distribution, the total wheat production of each group is divided by the total wheat production covered by the survey to get the group's percentage share of the total. Each group's percentage share is ranked by per bushel costs found for the group's sampled farm to create the cumulative distribution of production.

Figure 11a
Cumulative distribution of wheat farms by cost levels using expected yield, 2009

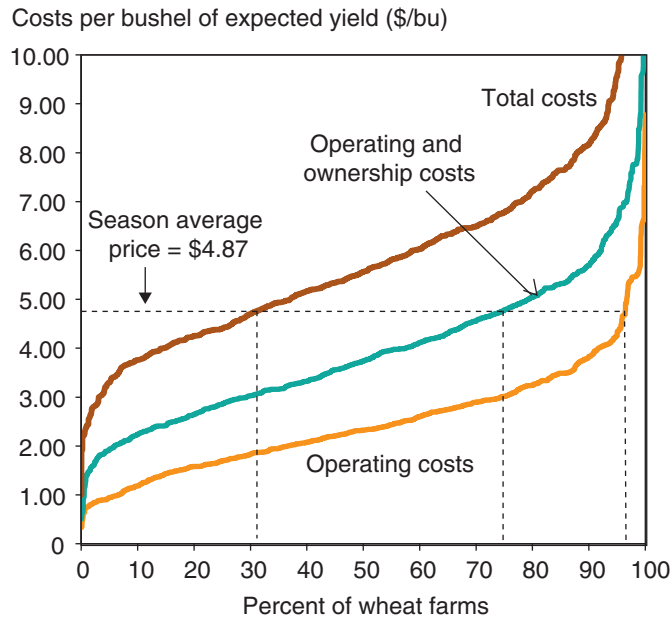
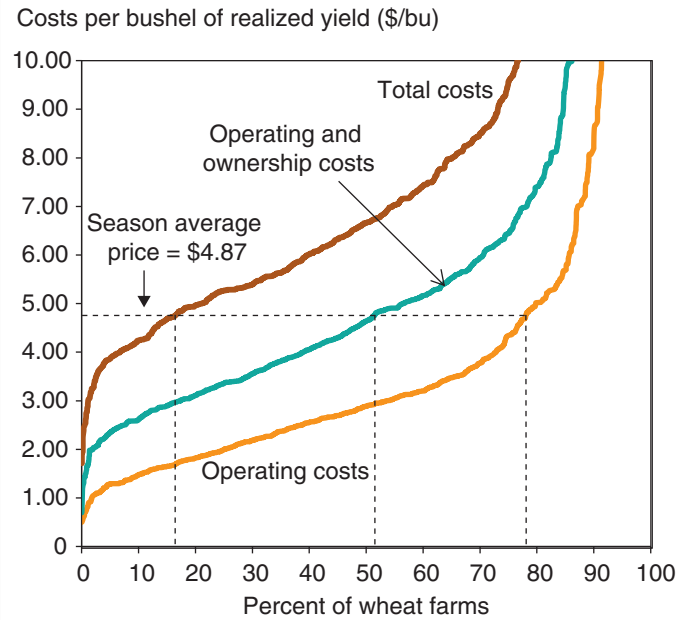


Figure 11b
Cumulative distribution of wheat farms by cost levels using realized yield, 2009



Sources: USDA, Economic Research Service using data from USDA's Agricultural Resource Management Survey, 2009 wheat.

Figure 12a
Cumulative distribution of expected wheat production by cost levels, 2009

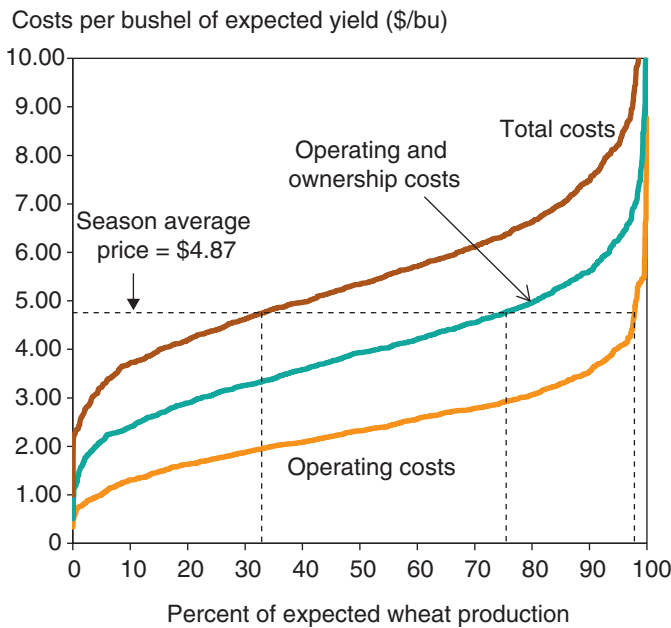
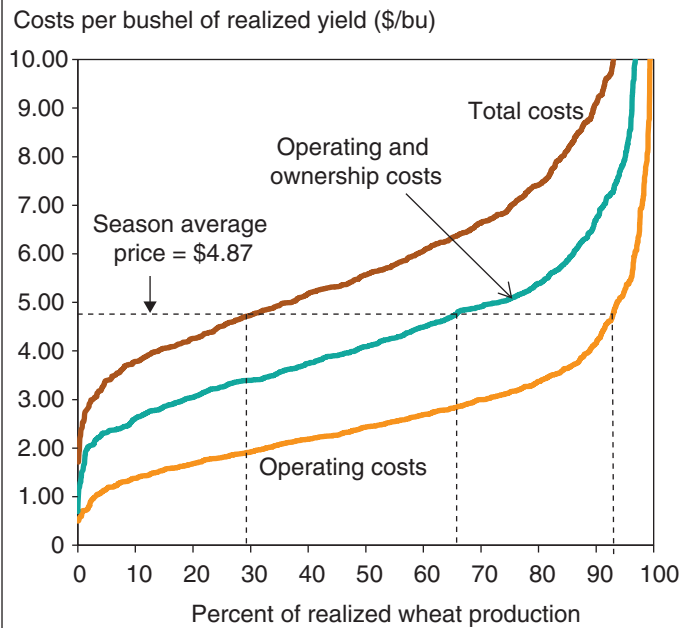


Figure 12b
Cumulative distribution of realized wheat production by cost levels, 2009



Sources: USDA, Economic Research Service using data from USDA's Agricultural Resource Management Survey, 2009 wheat.

expected wheat production would have been covered if it had been sold for the SAP of \$4.87 per bushel; 78 percent of the wheat produced would have covered both operating and ownership costs; and 37 percent would have covered all its costs.

For figure 12b, with realized yields, the operating costs on 93 percent of national production would have been covered if it had been sold for the SAP; 67 percent of the wheat produced would have covered both operating and ownership costs; and 33 percent would have covered all the costs of the national production. (The percentages for 11b are lower than for 12b because abandoned, nonproductive acres are included in the sample.)

Regional Variation in Production Costs for Expected Yields

Our analysis of the variation in regional production costs uses expected rather than actual yields. Most farmers budget their input expenditures, for example, the quantity of fertilizer to apply, based on their expected yield for the growing season. Expected yields avoid the complications of unusually favorable or unfavorable weather events. Table 3 shows the wide variation in regional yields, both expected and actual, in 2009. There is greater regional variation in actual yields than in expected yields.

At the national level, the total of operating and ownership costs was \$4.00 per bushel, using expected or normal yields. Of this total, operating costs were 60 percent and ownership costs were 40 percent. Fertilizer expenditures and capital recovery for machinery were the two largest cost items.

The following regional analyses elaborate on the data in table 3.

North Central Region. This region represents 9 percent of wheat-planted area in the United States. Wheat production practices there are geared to achieving the benefits of crop rotation and to producing straw for livestock bedding in addition to grain output. The North Central region reports the lowest per bushel total operating and ownership costs, \$3.47, despite having the highest regional operating cost. The operating cost—\$2.56 per bushel versus an average of \$2.41 per bushel for all farms in the ARMS—is driven by per acre fertilizer and seed expenditures that are more than double the all-farm average. Fertilizer costs are much higher here than elsewhere because abundant moisture allows for a high-yield potential. To take full advantage of this potential, farmers apply more fertilizer than in other regions.

Seed costs are high compared with other regions because North Central farmers purchase wheat seed from a dealer every year instead of using wheat saved from the previous year. Most of the region's farmers are small wheat producers whose individual wheat seedings are too small to justify the storage and cleaning facilities needed for "farmer-saved" seed wheat. The larger wheat producers elsewhere in the country have enough acreage to make saving wheat seed economically worthwhile.

The North Central's higher operating costs are offset by very low ownership costs per bushel of expected yield, \$0.91. Because the high yields spread the ownership costs over many more bushels of harvested wheat, these costs are the lowest among all the regions.

Northern Plains. The largest wheat growing region in the United States, the Northern Plains accounts for 41 percent of all land planted to wheat. The Northern Plains has high production costs per bushel, with the highest ownership costs and the second highest operating costs. These high costs are due in part to low yields. The average expected yield from the survey for this region is the next to lowest among the regions, with only the Southern Plains yield lower. About 75 percent of Northern Plains wheat is of lower yielding, spring wheat varieties. Compared with the North Central region, moisture supplies are lower, reducing yield potential.

Fertilizer and chemical inputs account for the largest share of operating cost expenditures in this region. Fertilizer expenditures by Northern Plains producers are about equal to the national average but higher than the Central and Southern Plains, which grow only winter wheat. As noted, the shorter growing season of spring wheat requires a higher nitrogen fertilizer application rate.

Table 3

Wheat production costs by region, 2009¹

Item	Northwest ²	Northern Plains ²	Central Plains ²	Southern Plains ²	North Central ²	All ARMS farms
<i>Dollars per planted acre</i>						
Operating costs						
Seed	17.98	14.39	10.07	11.68	30.17	13.99
Fertilizer	50.32	41.73	40.03	29.19	104.89	43.36
Chemicals	21.15	20.72	8.91	8.02	7.40	14.16
Custom operations	10.76	7.75	10.78	10.00	9.78	9.41
Fuel, lube, and electricity	21.79	8.87	13.40	13.84	8.63	12.22
Repairs	28.50	18.16	21.46	15.53	13.36	19.09
Other variable costs	4.26	0.22	0.13	0.03	0.58	0.53
Interest on operating capital	0.22	0.16	0.15	0.13	0.25	0.16
Hired labor	6.97	1.37	1.21	1.96	1.83	1.97
Ownership costs						
Capital recovery (machinery)	92.69	74.93	77.80	47.60	55.76	70.33
Taxes and insurance	8.14	5.94	5.53	4.45	7.34	5.80
Other costs						
Opportunity costs of unpaid labor	19.13	13.54	17.01	17.22	16.09	15.87
Opportunity cost of land	83.74	40.49	40.76	33.90	92.22	46.20
General farm overhead	14.47	9.42	10.53	7.84	14.60	10.15
Total operating costs	161.96	113.37	106.15	90.38	176.89	114.89
Total ownership costs	100.83	80.87	83.33	52.06	63.10	76.13
Total operating and ownership costs	262.79	194.24	189.48	142.44	239.99	191.02
Total other costs	117.34	63.46	68.31	58.95	122.91	72.22
Total costs	380.13	257.70	257.79	201.39	362.90	263.24
<i>Bushels per planted acre</i>						
Actual yield	59.5	43.7	43.2	16.3	59.8	40.2
Expected yield	67.0	45.5	47.6	37.5	69.2	47.7
<i>Dollars per bushel</i>						
Costs per bushel of actual yield						
Operating costs	2.72	2.59	2.46	5.56	2.96	2.86
Ownership costs	1.70	1.86	1.93	3.20	1.05	1.89
Operating and ownership costs	4.42	4.45	4.39	8.76	4.01	4.75
Other costs	1.97	1.45	1.58	3.63	2.06	1.80
Total costs	6.39	5.90	5.97	12.39	6.07	6.55
Costs per bushel of expected yield						
Operating costs	2.42	2.49	2.23	2.41	2.56	2.41
Ownership costs	1.50	1.78	1.75	1.39	0.91	1.59
Operating and ownership costs	3.92	4.27	3.98	3.80	3.47	4.00
Other costs	1.76	1.40	1.43	1.57	1.77	1.51
Total costs	5.68	5.67	5.41	5.37	5.24	5.51

—continued

Table 3

Wheat production costs by region, 2009¹—continued

Item	Northwest ²	Northern Plains ²	Central Plains ²	Southern Plains ²	North Central ²	All ARMS farms
<i>Percent of acres</i>						
Enterprise production practices						
Winter wheat	71.3	25.5	99.8	100.0	100.0	69.3
Spring wheat	28.7	74.5	0.2	0.0	0.0	30.7
Harvested	99.4	97.6	97.9	64.0	98.3	90.8
Irrigated	21.1	1.2	4.5	7.0	0.0	4.9

¹The data are an aggregation of irrigated and nonirrigated fields.

²Northwest—Washington, Oregon, and Idaho; Northern Plains—Montana, North Dakota, Minnesota, and South Dakota; Central Plains—Kansas, Colorado, and Nebraska; Southern Plains—Oklahoma and Texas; and North Central—Ohio, Michigan, Illinois, and Missouri.

Source: USDA, Economic Research Service using data from USDA's Agricultural Resource Management Survey, 2009 wheat.

The higher chemical expenditures for the Northern Plains region are associated in part with the more humid spring-wheat producing areas, where there is greater use of fungicides because of a higher incidence of disease. Spring wheat producers also have higher herbicide expenses because of multiple applications to control weeds; 20 to 40 percent of the spring wheat acreage is sprayed with an herbicide before planting. In general, both the Northern Plains and Northwest spring wheat producers have more severe weed problems than producers in other regions.

Southern Plains. Like the North Central region, the Southern Plains represents about 9 percent of wheat-planted area in the United States. The Southern Plains region's total expected operating and ownership costs per bushel are lower than the national average but still significantly above the North Central region's costs. The Southern Plains has the lowest expected yield among all the regions because of limited moisture supplies in its semiarid parts. In addition, high temperatures during the growing season accelerate the maturity of the crop, which limits yield potential.

With low expected yields, fertilizer expenditures per bushel are the second lowest among the regions, only about half of the North Central's expenditures. However, the region has the highest expenditures per bushel for custom operations and fuel, lube, and electricity, and total operating costs per bushel for Southern Plains producers are equal to the national average.

Ownership costs per bushel in the Southern Plains are the second lowest among the regions, after North Central. However, because of the low yields, the Southern Plains ownership costs are still 50 percent above North Central costs.

Central Plains. The Central Plains is the second largest wheat-growing region in the United States, representing 28 percent of all land planted to wheat. Its total per bushel operating and ownership costs are nearly equal to the national average. The ownership costs are slightly above the national average and the operating costs slightly below.

The expected Central Plains yield is nearly equal to the national average. It is significantly higher than the Southern Plains, despite parts of the region being semiarid. Temperatures during the growing season are typically not as high as on the Southern Plains, and the risk of drought is less.

Operating cost expenditures by input categories are each only slightly more or less than the national average.

Northwest. The Northwest region accounts for 13 percent of all wheat-planted land in the United States. Total per bushel operating and ownership costs there are lower than the national average because of higher yields, while operating costs are nearly the same as the national average.

The Northwest region's expected yield is the second highest, nearly as high as the North Central's, despite low rainfall. In part, this is because more than 20 percent of the region is irrigated, much more than in any other region. Wheat yields in the region are also boosted by relatively cooler temperatures during the growing season than in the Southern Plains, for example. Despite much higher yields in the Northwest than in the Northern Plains, fertilizer expenses are only slightly higher. About half of the Northwest's wheat crop is soft wheat. To keep protein levels low, less nitrogen fertilizer is applied than with a hard wheat crop. The Northern Plains does not grow soft wheat.

Because the Northwest produces spring wheat, chemical costs are higher, especially for herbicides. Both the Northwest and the Northern Plains regions have higher chemical costs per bushel than the Central, Southern Plains, and North Central regions where winter wheat is grown. Seed costs are second only to the North Central's high because of the Northwest's higher use of certified seed. Fuel, lube, and electricity expenditures in the Northwest are above the national average, partly because this region leads the others in irrigation, for which these inputs are required.

Impacts of Adverse Weather in the Southern Plains, 2009

The realized yields achieved in 2009 reflect the impact of regional weather conditions, especially of the spring freeze and the drought that occurred in the Southern Plains. On average, producers in the Southern Plains expect wheat yields of 37.5 bushels per planted acre; the actual yield on the Southern Plains averaged only 16.3 bushels. Because of these low yields, 36 percent of the planted acres in the region were not harvested. Had more acres been harvested, actual yield in comparison with expected yield would have been even lower.

We have classified each region's producers into one of two cost categories relative to the national level. Cost is defined here as cost per bushel, with yield (expected or realized) based on planted area. The cost categories are:

- Low cost: producers whose operating and ownership costs per bushel are in the lowest 25 percent of all producers.
- High cost: producers whose operating and ownership costs per bushel are in the highest 25 percent of all producers.

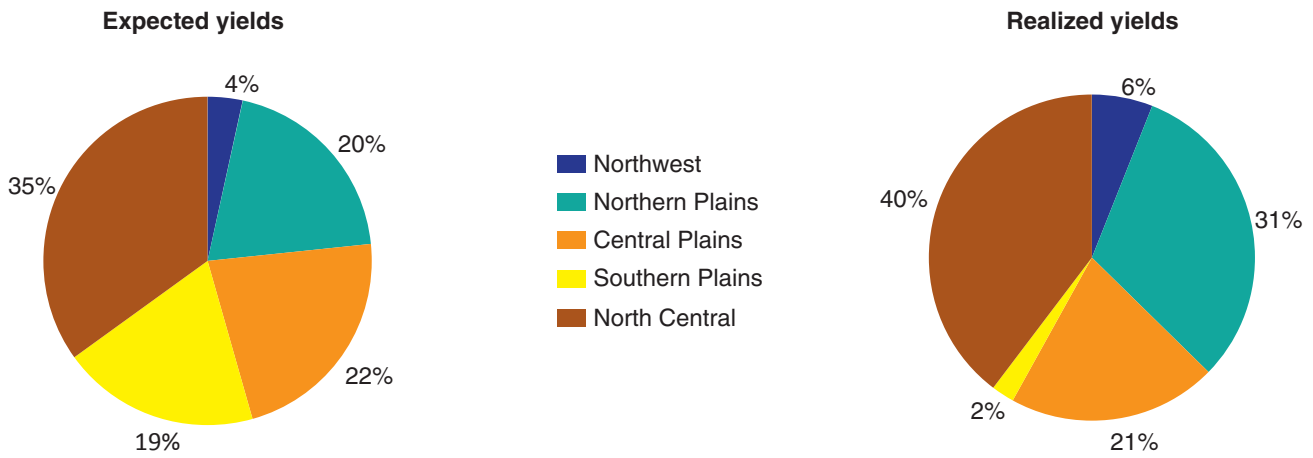
Figure 13 shows each region's share of low-cost producers with expected yields and realized yields.

Figure 14 shows each region's share of high-cost producers with expected and realized yields.

A comparison of the Southern Plains share in the two figures shows the impact of the adverse weather in the region in 2009. For the low-cost producers in figure 13, the Southern Plains share of low-cost producers with expected yields is 19 percent. With realized yields, the Southern Plains share of low-cost producers falls to 2 percent. The Southern Plains share of high-cost producers with expected yields is 14 percent. The region's share rises to 40 percent with realized yields.

Figure 13

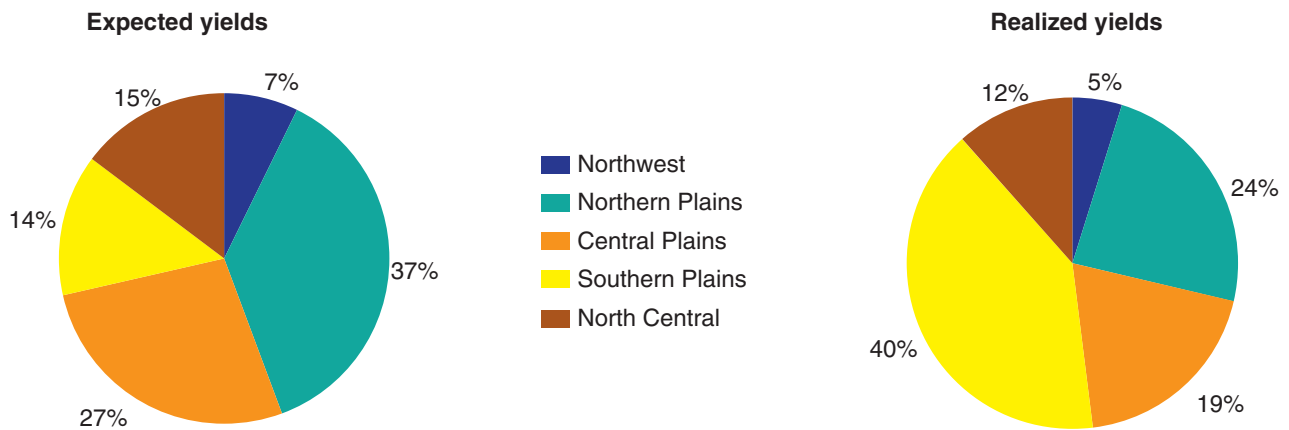
Distribution of low-cost producers based on expected and realized yields in 2009



Sources: USDA, Economic Research Service using data from USDA's Agricultural Resource Management Survey, 2009 wheat.

Figure 14

Distribution of high-cost producers based on expected and realized yields in 2009



Sources: USDA, Economic Research Service using data from USDA's Agricultural Resource Management Survey, 2009 wheat.

Conclusions

An analysis of the 2009 Agricultural Resource Management Survey (ARMS) data shows that most wheat producers would have covered all operating costs if yields were normal and they had received the 2009/10 season average price (SAP) of \$4.87 per bushel. The \$4.87 SAP covers about three-fourths of the sum of both operating and ownership costs and about a third of total costs. The comparison of these costs with the 2009 SAP is an aggregate analysis of U.S. wheat production costs. The price that individual wheat producers received in the 2009/10 marketing year depended upon many factors, including class of wheat grown, distance from principal markets, timing of sales during the marketing year, and any quality premiums or discounts received.

Regional climatic differences help explain the variation in costs across the country. The two largest cost items were fertilizer expenditures and capital recovery for machinery. These two cost items played important roles in making the wheat producers in the North Central region the lowest cost producers and the Northern Plains producers the highest cost producers. The relatively high yields in the humid North Central region allowed producers to spread their fixed machinery costs over many more bushels, so per bushel machinery costs were the lowest in the country. The spring wheat producers in the semiarid Northern Plains had relatively low yields, both because of moisture shortages and of the cold winters that force them to grow spring wheat varieties, which have high per bushel nitrogen fertilizer requirements. The low yields in the Northern Plains result in high machinery costs per bushel, which, added to the high nitrogen fertilizer requirement, makes Northern Plains wheat the most expensive to produce.

The 2009 ARMS also captured the devastating cost consequences of the spring freeze and drought in the Southern Plains. The low yields and abandoned fields sharply raised per bushel costs in that region. Despite the loss of production in the Southern Plains in 2009, the United States still produced 2.5 billion bushels of wheat, slightly above the average of 2.2 billion bushels for the most recent 5 years. Because wheat is grown in most regions of the country, it is unlikely that wheat producers everywhere in the country will be adversely affected by a single weather event.

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