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Characteristics and Production Costs of U.S. Wheat Farms

Mir B. Ali [1]

In this report… The average cost of producing a bushel of wheat was $3.97 for producers surveyed in 1998, ranging from about $1.25 to more than $6 per bushel. The cost of producing wheat generally declined as farm size increased. Regional differences in production practices and growing conditions were major influences on production costs and yields among wheat producers. Producers in the Prairie Gateway, a major wheat region, produced wheat at an average cost of $3.63 per bushel, the lowest cost among regions. Most high-cost farms and very large farms were in the Southeast region; these farms tended to be more diversified than farms in other regions, so wheat contributed a smaller share to their total farm income.

Keywords: Wheat, costs of production, cost variation, input use, production practices, farm characteristics, Agricultural Resource Management Study.

[1]Agricultural Economist, Resource Economics Division, Economic Research Service, USDA

Overview

Wheat is the principal cereal grain crop used for food consumption in the United States and most of the world. In terms of value of production and planted acreage, wheat is typically the Nation's fourth largest field crop. Only corn, hay, and soybeans are more important. Wheat is also a leading U.S. export crop, with exports accounting for almost half of total wheat production. U.S. wheat farmers are facing many challenges despite a strong domestic market demand for wheat products. Many wheat farmers are not able to cover all of their production costs, even after Government payments are added to their income.

Wheat land area has dropped from the early 1980s because of declining returns relative to other crops and alternative options under Government programs. The price of wheat has dropped sharply since the 1996 peak and averaged $2.78 per bushel during the past 4 crop years (1997/98 through 2000/01). The elimination of planting restrictions under the 1996 Farm Act facilitated expansion of soybeans, corn, and other crops in wheat areas. Also, loss of wheat acreage to row crops was due to strong genetic improvements in corn and soybean varieties that could be planted farther west and north (areas with drier conditions or shorter growing seasons).

U.S. wheat can be grown under many different topographic and soil situations and is adaptable to extreme weather conditions. Wheat production generally occurs in diversified farming operations. About a third of farms with wheat also raise livestock. U.S. farmers planted wheat on 65.8 million acres in 1998, 6.4 percent below 1997 acreage levels, and produced 2.55 billion bushels, up 2.8 percent from the 1997 level (USDA, NASS, 2000). Because of favorable weather, 1998 winter wheat yields surged to a record 46.9 bushels per harvested acre, 5 percent above the previous record yield in 1997. Wheat grown in the United States is either "winter wheat," or "spring wheat" depending on the season it is planted (see box "Six Basic Classes of Wheat" for details). Winter wheat varieties are sown in the fall and usually become established before going dormant when cold weather arrives. In the spring, they resume growth and grow rapidly until summer harvest. Winter wheat production accounts for over three-fourths of the total U.S. wheat crop. Virtually all hard red winter (HRW) wheat States planted less wheat in 1998, with Oklahoma's wheat area going unchanged. The 1998 wheat area in Kansas was down 700,000 acres from 1997, its lowest level since 1988.

Spring wheat varieties are planted in the spring, when the ground is workable, and grow continuously until harvest in late summer or fall. The 1998 spring wheat crop acreage also declined--down 18 percent from its 1997 acreage. However, yield improvement almost offset the sizable reduction in harvested acreage, and production dropped by only 4 percent to 529 million bushels in 1998. All spring wheat States reported less planted wheat in 1998 with the exception of Washington. North Dakota farmers planted spring wheat on 6.7 million acres in 1998, about 24 percent below the 1997 acreage. Farm price relationships among the various classes of wheat favored the shifting of some other spring wheat area into durum production. Acreage seeded to durum totaled 3.8 million acres in 1998, up 15 percent from 1997 and the largest level since 1982. Between 1997 and 1998, durum yield rose 10 bushels to 37.8 bushels per harvested acre, the second highest yield ever and only 2 bushels below the record high yields in 1992. As a result, 1998 durum production soared to 141 million bushels, a level exceeded only in 1981 (183 million bushels) and 1982 (146 million bushels).

This report compares selected farm characteristics and production costs among wheat producers. Producers were grouped according to their cost level for wheat production, production region, enterprise size, and farm typology (see glossary). Data are from the 1998 Agricultural Resource Management

Study (ARMS) of U.S. wheat farms, the only available source of such comprehensive nationwide micro-level farm information. Reponses represented 194,846 farms producing 2.2 billion bushels of wheat on 57.2 million acres (87 percent of total U.S. wheat acreage) (USDA, NASS, 2000).

Six Basic Classes of Wheat

There are many varieties of wheat, all of which can be grouped into six basic classes: hard red winter (HRW), soft red winter (SRW), hard white (HW), soft white (SW), hard red spring (HRS), and durum wheat. Each class of wheat is not only recognized by the time of year it is planted, but also by the hardness, color, and the shape of the wheat kernel. Each class has its own characteristics, especially as related to milling and baking or other food use.

Hard red winter wheat-- the largest class of wheat used mostly for bread and all-purpose flour; fall seeded; medium to high in protein; may have either a hard or soft endosperm; used to produce bread flour; produced in the Great Plains, a large interior area extending from the Mississippi River west to the Rocky Mountains, and from the Dakotas and Montana to Texas; good milling and baking characteristics; used to produce bread, rolls, and, to a lesser extent, sweet goods and all-purpose flour.

Soft red winter wheat-- fall seeded; low to medium in protein content with a soft endosperm; used in making cakes, pastries, flat breads, and crackers; grown in the eastern third of the United States, east of the Mississippi River; high yield; no subclasses.

Hard white wheat-- the newest white class of wheat to be grown in the United States; closely related to red wheats (except for color genes), this wheat has a milder, sweeter flavor, equal fiber, and similar milling and baking properties; used in yeast breads, hard rolls, bulgur, tortillas, and oriental noodles; no subclasses.

Soft white wheat-- used in much the same way as soft red winter (for bakery products other than bread); grown mainly in the Pacific Northwest and to a lesser extent in California, Michigan, Wisconsin, and New York; of low protein, but high yield; produces flour for baking cakes, crackers, cookies, pastries, quick breads, muffins, and snack foods; subclasses are soft white, white club, and western white wheats.

Hard red spring wheat-- contains the highest percentage of protein, making it an excellent bread wheat with superior milling and baking characteristics; chiefly grown in Montana, the Dakotas, and Minnesota; spring seeded; may have either a hard or soft endosperm; subclasses are dark northern spring, northern spring, and red spring wheats.

Durum wheat-- the hardest of all U.S. wheats; spring seeded; very hard; a high-protein wheat used in pasta products (macaroni, spaghetti, and other noodles); grown in the same northern area as hard red spring wheat--mainly in North Dakota; subclasses are hard amber durum, amber durum, and durum wheats.

Production Costs Varied Across the United States

Wheat production costs vary widely across the country because of regional differences in cropping practices, yields, and costs of land, labor, and capital.

This variation can be shown by ranking the wheat farms from lowest to highest costs per bushel to form a cumulative distribution of farms and production in 1998 (fig. 1). The cumulative distribution reveals that:

- 50 percent of farms in the survey incurred operating costs (including hired labor) of $1.40 per bushel or less and 75 percent of the farms incurred costs of $2.00 per bushel or less;
- 50 percent of farms in the survey incurred operating and ownership costs of $2.50 per bushel or less and 75 percent of the farms incurred costs of $3.65 per bushel or less;
- 50 percent of farms in the survey incurred total costs of $4.10 per bushel or less and 75 percent of the farms incurred total costs of $6.00 or less.

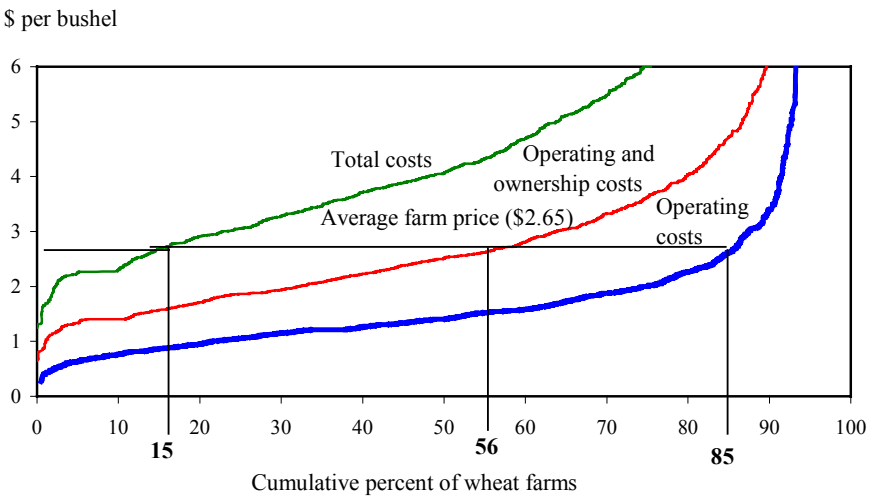
The operating costs of producing U.S. wheat in 1998 averaged $60 per planted acre; the operating plus ownership costs averaged $107 per acre; and the total costs averaged $166 per acre. However, these averages represent only a single point on the distribution of production costs and provide only limited information about the economic performance of U.S. wheat farms.

While planted area has dropped in recent years, this distribution analysis helps to explain why U.S. farmers have continued to plant wheat despite the low prices of recent years. For example, the average farm-level wheat price in the 1998/99 marketing year was $2.65. When the opportunity costs of land, farmers' labor, and other farm overhead expenses are included, only 15 percent of farmers produced wheat at or below $2.65 per bushel. The low proportion of farms covering all their costs raises concerns about the long-term sustainability of many

Figure 1

Cumulative distribution of wheat farms at different cost levels, 1998

The 1998 average farm price covered operating costs on more than 80 percent of farms, while it covered operating plus ownership costs on just half of the wheat farms.



Source: 1998 USDA Agricultural Resource Management Study.

wheat producers. Their resources may be able to earn a higher return in other uses.

The relationship between prices and production costs has important implications for farmers' decisions to plant a crop each year. Planting decisions are usually based on whether the grower expects that the price plus Government payments received for the crop will cover operating costs, including such costs as seed, fertilizer, chemicals, fuel, custom operations, repairs, hired labor, and interest on operating inputs. Longer term decisions, such as whether to continue to raise the crop, will be based on expectations that prices over several years will cover both operating and ownership costs. Ownership costs are mainly the costs of maintaining the capital stock used in production, including costs associated with asset depreciation and interest (capital recovery), taxes, and insurance. Opportunity costs for land and the labor provided by the operators are not likely to influence planting decisions in the short term, but may ultimately affect farmers' decisions about whether to switch to other crops or pursue off-farm work.

The lack of profitability in raising wheat is causing high-cost wheat growers to consider alternatives. U.S. 2001 wheat planted area was down 15.5 million acres, or 21 percent, from the recent high in 1996. At the national level, a large number of crops are competing with wheat, including soybeans, cotton, sorghum, and barley.

The farm-level season-average price received for all wheat averaged $2.65 per bushel in 1998, compared with more than $4.00 per bushel in the mid-1990s. The fact that 85 percent of farms produced wheat at an operating cost of $2.65 per bushel or less in 1998 helps to explain why U.S. farmers have continued to plant wheat despite the low prices of recent years. However, for just over half of U.S. wheat farmers, the price of $2.65 does not cover both operating and ownership costs. Farmers cannot grow wheat for more than a few years if they cannot cover ownership costs and thus replace capital stock as it deteriorates. When the opportunity costs of land, farmers' labor, and other farm overhead expenses are included, only 15 percent of farmers produced wheat at or below $2.65 per bushel in 1998 (see box "ERS Costs of Production and Returns Accounts" for details). If wheat prices continue to decline, producers may look for alternative crops that are offering higher returns than wheat, such as corn, soybeans, and sorghum, in areas where they can be grown. Some farmers may leave their land fallow, especially in the drier areas.

Although Government program payments are not included in ERS cost and return accounts, wheat growers who participated in the program received an additional average $0.19 per bushel through loan deficiency payments and marketing loan gains for the 1998 wheat crop. Also, many wheat producers received production flexibility contract payments and emergency assistance. Note that farmers did not have to produce wheat to be eligible for these payments. The average flexibility contact payment rate was $0.663 per bushel in 1998. These payments together likely enabled about 75 percent of producers to cover their operating and ownership costs in 1998 (for more discussion, refer to USDA, ERS, 2001a and 2001b). To analyze the contribution of Government payments in a more accurate manner, one needs to construct cumulative distribution of production costs minus actual Government payments per unit. Limited information on the Government payments in the 1998 survey of wheat farms did not allow such analysis.

Some wheat producers received income from secondary products, such as grazing and wheat straw. While these additional revenues varied widely among wheat growers, these revenues also helped offset production costs.

ERS Costs of Production and Returns Accounts

ERS cost-of-production accounts include estimates of both cash and noncash costs (sometimes called economic, or opportunity, costs). Cash costs are incurred when factors of production are purchased or rented. Noncash costs are incurred when factors are owned. For example, a farmer who fully owns the land used to produce a commodity (e.g. wheat) has no cost for land rental or loans to pay for purchasing land. Yet, an economic cost arises. By owning the land and using it to grow wheat, the farmer forgoes income from other uses of the land, such as renting it to another producer. If a farmer uses savings to pay for operating inputs, such as fertilizer, chemicals, and fuel, and thus pays no interest on operating loans, the farmer still incurs an economic cost because the savings could have earned a return in another use. Likewise, the farmer has an opportunity cost of his/her labor used in the production of the commodity because it could have been used on another farm or in off-farm employment. The opportunity cost of farm operators' unpaid labor was imputed using off-farm wage equations for U.S. farm operators based on production region, size of farm, and farm type (El-Osta and Ahearn, 1996). Owned farm inputs are not without costs because they are limited and have alternative uses. Noncash costs in the ERS accounts are estimated using methods recommended by the American Agricultural Association Task Force on Commodity Costs and Returns (1998).

Returns above total costs in ERS accounts are consistently negative for several commodities over many years. Reasons for negative returns are:

Impact of Government program. Because Government payments are excluded from the accounts, the estimated gross value of production is less than what farmers actually receive for being engaged in the enterprise.

Exclusion of marketing costs and returns. Accounts include only costs associated with crop production and end at the point when the commodity is hauled from the field to storage or directly to market. Production is then valued at the harvest period price. However, farmers often delay sales and store grain with the expectation that the price in later months will exceed the harvest period price plus any costs associated with storing the crop.

Noncash costs. Accounting methods and measurement procedures used for noncash costs affect costs and return estimates. For example, opportunity costs are used to value capital, land, and unpaid labor. Because of various farm financial arrangements and the unique nature of many farm production inputs, opportunity cost estimates may not represent exactly individual farmers' true opportunity costs.

Regional Factors Influenced Wheat Production Costs

Differences in production practices, acreage, and growing conditions contributed to regional cost and yield differences.

The national data show that, on average for 1998, wheat returns were enough to cover all operating costs, but not adequate to cover total costs. Disaggregating the national data to a regional level allows inspection of the variation in costs and returns across the country. For this report, several of the ERS Farm Resource Regions were combined because of either their minor share of U.S. wheat production or limited sample size. The Northern Crescent and the Heartland were combined to form the North Central while the Eastern Uplands, Southern Seaboard, and Mississippi Portal regions were combined into the Southeast (fig. 2). The most important region in terms of wheat production was the Prairie Gateway, followed by the Northern Great Plains (table 1). These two regions accounted for 70 percent of total U.S. wheat production. Notably, these two regions had the lowest gross returns per acre in the country because of low yields.

Per-acre gross returns were higher in the North Central than in the Plains because of both higher yields and substantial income from the wheat straw. Gross returns per acre were highest in the two far-West regions where irrigation produced the highest yields in the country. The Southeast region accounted for the least wheat, less than 5 percent of the total U.S. wheat crop. Of all wheat farms surveyed in 1998, about 40 percent were in the Prairie Gateway. Nearly 30 percent of wheat farms were in the North Central region. Less than 10 percent of wheat farms were in each of the Basin and Range, the Fruitful Rim, and the Southeast regions.

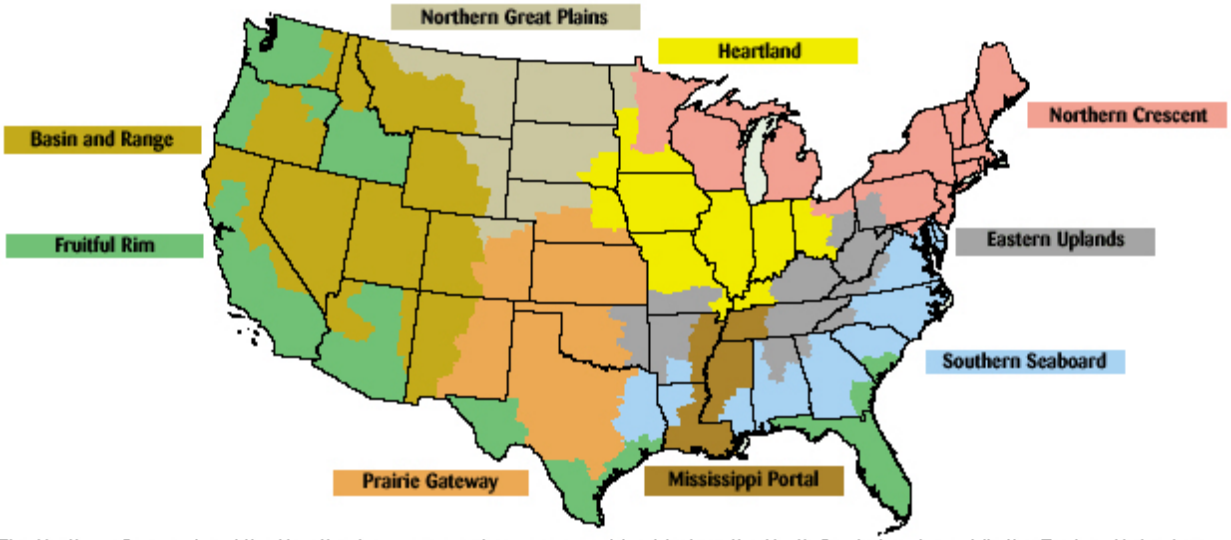
In no region were average returns enough to cover all costs, indicating that the relatively low prices of 1998 were below long-term sustainable levels. The largest shortfalls from covering total costs were in the two far-West regions, with losses ranging from $87 to $118 per acre due to irrigation-related expenses. Producers in the two Plains regions had the smallest shortfalls in the country, but these losses were still a very substantial $36-$47 per acre.

Farm size can influence unit production costs and farm income. Small farm size is generally associated with a low volume of production, increased per unit costs, and low net farm income. The average size, measured in acres, of all ARMS wheat farms surveyed in 1998 was 1,237 acres, of which 70 percent was cropland (table 1). Regionally, average farm size ranged from 546 acres in the North Central to 2,034 acres in the Basin and Range. Harvested cropland as a percentage of total operated acres was much larger in the North Central and Southeast regions, about 85 percent compared with some 45-55 percent in other regions. The Basin and Range and Prairie Gateway regions had the lowest percentage of cropland harvested, suggesting a large portion of land was used for pasture and grazing purposes. Nationwide, wheat farmers owned half the land they operated. The remaining acreage was rented about equally on a cash- and share-rent basis (with share-rent leasing generally share input costs). On average, 41 percent of the cropland was harvested for wheat. Wheat acreage as a percent of harvested cropland on wheat farms ranged from 16 percent in the North Central to about 50 percent in other regions. Among other crops harvested on farms growing wheat included corn, followed by soybeans, hay, and cotton.

Wheat farms tend to have multiple enterprises, with cattle and pasture also frequently produced. The value of wheat production averaged $31,900 per farm in 1998, about 18 percent of the total value of production on farms growing wheat (table 2). Wheat accounted for less than 10 percent of total value of production in the North

Figure 2
U.S. farm resource regions

In 1998, the Prairie Gateway had the largest share of ARMS wheat farms.



The Northern Crescent and the Heartland resource regions were combined to form the North Central region, while the Eastern Uplands, Southern Seaboard, and Mississippi Portal resource regions were combined to form the Southeast region.

Central and Southeast regions and 46 percent in the Basin and Range region.

A farm's production specialty, the commodity or group of commodities that represents the largest portion of its gross income, affects how farmers allocate their production resources (see glossary). In all regions except the Southeast, most wheat farms were specialized in cash grains. Southeast wheat farms were equally specialized in other crops, such as cotton and peanuts. Farms in the Prairie Gateway and Northern Great Plains regions had particularly large inventories of beef cattle to take advantage of extensive pasture, while farms in the North Central region, primarily in Illinois, had large inventories of hogs.

Geographical location largely governs the type of wheat that can be grown. Types of wheat identified in the survey were winter wheat and spring wheat (durum and other spring wheat). All wheat acres in the Prairie Gateway and Southeast regions were planted to winter wheat varieties. In the Northern Great Plains, spring wheat plantings dominated (81 percent spring wheat and 19 percent winter wheat). About 15 percent of the spring wheat acres in the Northern Great Plains were planted to durum wheat. Durum wheat was seldom planted in other regions.

Production Practices

Production practices varied across regions and factored importantly in cost differences. Fallowing to retain soil moisture for the subsequent year's wheat crop was more common in the Basin and Range than elsewhere in the country. Fallow wheat land produces no crops but its land cost is still included in the wheat farm's land cost. A deficiency of water from natural precipitation is the primary limitation on wheat production in this region. The North Central and Southeast regions, in contrast, are typical of an area that depends on natural precipitation but does not practice dryland fallowing because of abundant rainfall.

Double-cropping with wheat to increase total returns per acre was more common in the Southeast region than elsewhere in the country. Double-cropping, usually with short season soybeans, has several advantages. Farmers get the revenue from two crops each year and are able to spread the fixed costs of machinery over more cropped acres. Also, soybeans fix nitrogen, which benefits the wheat crop. Nearly a fourth of Southeast farmers double-cropped wheat with soybeans.

Grazing livestock on wheat acres or feeding wheat grain to livestock were common practices in the Prairie Gateway region. Wheat straw was an important secondary product in the North Central because of high straw value. Wheat straw is frequently used as bedding for livestock, particularly horses.

Wheat yields generally improve with irrigation. However, the high costs of irrigation make it prohibitive unless the returns from the additional yield are enough to cover the higher costs. Further, the income potential of irrigating a crop is dependent on the relative profitability of different cropping systems, with and without irrigation. Only 5 percent of ARMS wheat farms reported irrigation on wheat acreage. Among regions, the Fruitful Rim region (primarily in Washington and Oregon) had a large percentage of farms irrigating wheat (35 percent). Some irrigation was reported in the northern parts of the Basin and Range and the Prairie Gateway regions. The Fruitful Rim wheat growers had the highest costs per acre because of irrigation-related expenses.

Fertilizers were applied at higher rates in the Southeast, primarily due to double-cropping, and in the North Central region because a large wheat acreage was harvested for straw. Heavy fertilizer applications were also reported in the Fruitful Rim (table 3). Generally, wheat is one of the least chemical-intensive crops. However, regions that grow spring wheat used more herbicide treatments because of more intense weed pressure. Winter wheat, in contrast, has a head start on the springtime weeds because the crop is planted in the fall. More than 80 percent of the Northern Great Plains wheat farmers applied herbicides to their wheat crop, compared with only 40 percent of Prairie Gateway. North Central wheat growers used considerably fewer chemicals than growers did in other regions.

The use of custom work influences wheat production costs by reducing the costs of operating and owning machines and providing labor, while increasing the costs of custom operations. The decision to custom hire some field operations depends on several factors, such as the size of the farm and its complement of machines, availability of capital and labor, importance of timely operations, and weather-related factors. Nearly 60 percent of U.S. wheat farms used custom operations, with custom fertilizer or chemical applications being the most common, followed by custom harvesting and hauling. The percentage of farms reporting custom operations ranged from about 80 percent in the Fruitful Rim to 40 percent in the Basin and Range. Forty-five to 60 percent of wheat farms used custom operations in the Northern Great Plains and Prairie Gateway. Custom harvesting and hauling were most common in the Southeast and the Prairie Gateway. The Fruitful Rim wheat farms also reported more custom fertilizer and chemical application than other regions.

Conventional tillage, primarily with chisel and disk, was the most common practice for U.S. wheat farmers. Only a third of the surveyed wheat farms used conservation tillage (table 3). Among regions, conservation tillage was more common in the North Central and Northern Great Plains (45 percent), followed by the Basin and Range region (35 percent). The type of conservation tillage practice varied by region. A no-till system was more common in the North Central region, while a mulch-till system was more common in the Northern Great Plains and Basin and Range.

The field operations chosen by a farmer have a major impact on farm costs. The frequency of field operations varied by region (table 4). Wheat growers in the North Central and Southeast regions made fewer trips over their fields than growers in other regions, primarily because of fewer tillage operations. Harvesting costs were higher in the Northern Great Plains than in other regions because the wheat crop there is first cut and windrowed to ensure uniform drying before actual combining. In other regions, harvesting consists of combining alone.

Production Costs

Costs of producing wheat varied by region due to differences in production practices, input use, and irrigation. Operating costs ranged from $50 per acre in the Prairie Gateway to $115 in the Fruitful Rim region (table 5). Fertilizer, chemicals, and fuel accounted for 50-60 percent of the operating costs across all regions. Input costs varied widely among regions, reflecting differences in acreage covered and application rates.

Total production costs ranged from $143 per acre in the Prairie Gateway to $291 in the Fruitful Rim region. This wide range illustrates the differences in capital recovery, labor, and land costs, which were a result of production practices such as tillage, irrigation, summer fallow, and double-cropping.

Regionally, weather conditions adversely affected wheat yields, especially in the Southeast, which was experiencing drought (table 5). Wheat yields ranged from 36 bushels per acre in the Northern Great Plains to 69 bushels in the Fruitful Rim. The Fruitful Rim and Basin and Range had the highest yields due to irrigation. However, among dryland regions, the North Central reported the highest wheat yields because of heavy fertilizer applications and better growing conditions. On average, national wheat yields in 1998 were slightly higher than growers expected at planting time. Yields in the Prairie Gateway and Basin and Range were 2-4 bushels above growers' expectations, while those of the Northern Great Plains and Southeast regions were 2-6 bushels below expected yields.

On a per-bushel basis, production costs varied greatly among regions due primarily to differences in yields. Operating costs ranged from $1.26 to $2.03, while total costs ranged from $3.63 to $4.54 per bushel. The Prairie Gateway had the lowest per-bushel costs among regions. The Southeast, on the other hand, had the highest production costs per bushel. To account for differences between 1998 and a typical year, costs were also compared on per-unit of expected yield. The expected yield represents the yield normally attained in the past. When expected yields were used, the Fruitful Rim had the highest per-bushel costs. There, relatively high per-acre costs due to irrigation were not offset by greater yields. The Prairie Gateway had the lowest costs per unit of expected yield, indicating this region has a clear cost advantage among all wheat producing regions. Specific costs varied widely across regions, reflecting differences in production practices and growing conditions.

Table 1—Land use on wheat farms, 1998

Item	Prairie Gateway	Northern Great Plains	Fruitful Rim	Basin and Range	North Central[1]	Southeast[2]	All ARMS farms
				Percent			
ARMS share							
Wheat farms	38	20	5	*	28	7	100
Wheat acres	41	38	6	5	8	*	100
Wheat production	39	31	10	8	9	*	100
				Acres			
Size							
Operated acres	1,346	2,002	1,383	2,034	546	718	1,237
Cropland	831	1,314	1,054	1,317	455	578	833
Harvested cropland	604	1,043	761	903	466	625	672
				Percent of acres			
Land tenure							
Owned	43	54	47	50	46	43	47
Cash-rent	30	31	31	19	28	47	30
Share-rent	30	18	24	32	29	11	25
Crops harvested							
Corn	17	7	*	*	31	14	15
Wheat	49	49	42	56	16	19	41
Soybeans	6	8	0	0	44	33	15
Hay	9	12	14	10	7	6	10
Cotton	*	0	5	0	0	14	*
Sorghum	11	*	0	0	*	*	*
Barley/oats	*	8	10	19	*	*	*
Others	*	16	24	15	*	8	9

* = 0.1 to less than 5 percent.

[1]North Central = Northern Crescent and Heartland resource regions.

[2]Southeast = Eastern Uplands, Southern Seaboard, and Mississippi Portal resource regions.

Source: 1998 USDA Agricultural Resource Management Study.

Table 2—Characteristics of wheat farms, by region, 1998

Item	Prairie Gateway	Northern Great Plains	Fruitful Rim	Basin and Range	North Central[1]	Southeast[2]	All ARMS farms
Size (acres)							
Operated	1,346	2,002	1,383	2,034	546	718	1,237
Planted wheat	327	523	388	507	81	128	294
Harvested wheat	293	514	320	505	74	121	273
Wheat tenure (percent of acres)							
Owned	47	44	39	35	48	53	45
Cash-rented	13	31	19	16	33	37	22
Share-rented	39	25	42	49	19	10	33
Previous crop (percent of farms)							
Wheat	65	33	15	28	7	37	40
Corn	*	*	6	*	12	29	6
Soybeans	5	6	0	0	76	25	18
Production specialty (percent of farms)							
Cash grains	62	73	47	77	84	37	68
Other crops	10	0	18	*	0	36	7
Livestock	29	26	30	19	16	19	24
Livestock (percent of farms)							
Hogs	*	5	6	5	17	9	8
Beef cattle	66	45	24	39	54	41	54
Dairy	*	7	6	*	7	8	5
Other livestock	21	25	16	26	8	15	18
Production practices							
Winter wheat (percent of acres)	100	19	80	80	86	100	67
Spring wheat (percent of acres)	0	81	20	20	14	0	33
Irrigated (percent of acres)	6	*	35	8	0	*	5
Fallow (percent of farms)	22	39	39	58	*	*	25
Double-cropping (percent of farms)	*	0	*	0	*	25	*
Straw (percent of farms)	6	9	22	11	33	16	13
Grazing (percent of farms)	24	*	*	*	*	*	9
Farm finances (dollars/farm)							
Wheat production value	31,261	55,929	58,760	86,914	8,909	13,961	31,900
Farm production value	142,681	183,927	434,053	190,793	130,961	290,044	173,681
Net cash income	30,590	36,367	37,940	34,836	19,213	46,809	30,168
Government payments	18,011	22,145	23,357	34,879	11,079	13,730	17,402
Assets	631,294	828,026	1,367,874	966,295	697,166	725,071	742,316
Debt	116,292	128,784	263,733	123,824	69,733	72,657	110,921
Debt-to-asset ratio (percent)	18.4	15.6	19.3	12.8	10.0	10.0	14.9
Favorable (percent of farms)	63	64	53	58	66	61	63
Wheat crop insurance (percent of farms)	56	88	68	68	51	23	60
Farm operator characteristics (percent of							
Farming as major occupation	80	88	80	89	68	70	78
Under 50 years of age	33	46	55	41	46	60	42
Completed college	22	18	44	30	11	26	20

* = 0.1 to less than 5 percent. Total may not add due to rounding or omission of possible categories.
[1]North Central = Northern Crescent and Heartland resource regions.
[2]Southeast = Eastern Uplands, Southern Seaboard, and Mississippi Portal resource regions.
Source: 1998 USDA Agricultural Resource Management Study.

Table 3—Input use of wheat production, by region, 1998

Item	Prairie Gateway	Northern Great Plains	Fruitful Rim	Basin and Range	North Central[1]	Southeast[2]	All ARMS farms
Field size (acres)	72	72	97	79	30	24	63
Seed							
Rate per acre, one time (bushels/acre)	1.2	1.5	1.5	1.4	2.1	2.0	1.4
Homegrown seed (percent of seed)	68	70	19	33	41	34	60
Fertilizer use (percent of farms)							
Any fertilizer	91	87	96	92	97	99	91
Nitrogen	90	85	94	92	95	96	90
Phosphorus	66	73	41	72	83	75	71
Potassium	15	13	14	24	76	84	29
Fertilizer application rate (pounds/acre)							
Nitrogen	52	54	92	76	91	94	61
Phosphorus	20	21	12	16	48	35	22
Potassium	*	*	*	*	55	61	8
Chemical use (percent of farms)							
Any chemicals	39	84	90	95	33	56	58
Herbicides	37	84	90	95	33	50	57
Insecticides	*	7	9	10	*	17	6
Tillage system (percent of farms)							
Conventional with moldboard plow	6	5	13	19	*	*	6
Conventional without moldboard plow	74	50	76	46	49	74	62
Mulch tillage	17	36	11	28	11	15	22
No-till	*	9	*	6	36	8	10
Soil surface covered (percent)	18	30	13	20	32	21	25
Tillage/planting (field passes)	4.77	3.54	4.11	4.29	2.35	3.08	3.82
All field operations (field passes)	6.83	7.29	6.99	8.03	4.34	4.83	6.83
Custom operations (percent of farms)							
Any custom operation	60	46	82	42	66	71	57
Fertilizer/chemical	37	27	64	31	54	26	36
Harvest/hauling	27	11	24	6	16	32	20
Fuel use (gallons/acre)							
Diesel	4.9	3.6	6.1	5.7	2.9	4.4	4.4
Gasoline	0.8	1.0	1.2	1.8	1.7	2.1	1.0

* = 0.1 to less than 5 percent.

[1]North Central = Northern Crescent and Heartland resource regions.

[2]Southeast = EasternUplands, Southern Seaboard, and Mississippi Portal resource regions.

Source: 1998 USDA Agricultural Resource Management Study.

Table 4—Field operations in wheat production, by region, 1998

Item	Prairie Gateway	Northern Great Plains	Fruitful Rim	Basin and Range	North Central[1]	Southeast[2]	All ARMS farms
				Times-over			
All field operations[3]	6.83	7.29	6.99	8.03	4.34	4.83	6.83
Tillage							
Plowing	2.19	1.11	0.72	0.79	0.20	0.22	1.43
Disking	0.95	0.16	0.78	0.55	0.64	0.94	0.60
Cultivating	0.75	1.13	0.51	0.86	0.25	0.29	0.83
Harrowing	0.25	0.53	1.61	1.67	0.08	0.28	0.49
Other tillage[4]	0.07	0.02	0.16	0.14	0.03	0.09	0.06
Fertilizer/chemical applications	0.96	1.98	1.18	2.03	1.01	1.18	1.42
Seeding	0.99	0.94	0.95	0.99	0.98	0.96	0.97
Harvesting	0.64	1.23	0.89	0.95	0.88	0.74	0.91
Mowers/balers	0.01	0.03	0.09	0.03	0.15	0.08	0.03
Other implements	0.07	0.15	0.11	0.02	0.11	0.07	0.09

Total may not add due to rounding.

[1]North Central = Northern Crescent and Heartland resource regions.

[2]Southeast = Eastern Uplands, Southern Seaboard, and Mississippi Portal resource regions.

[3]Excludes custom operations.

[4]Includes bedders, shapers, and packers.

Source: 1998 USDA Agricultural Resource Management Study.

Table 5—Wheat production costs and returns per planted acre, by region, 1998

Item	Prairie Gateway	Northern Great Plains	Fruitful Rim	Basin and Range	North Central[1]	Southeast[2]	All ARMS farms
			Dollars per planted acre				
Gross value of production	107.15	102.53	173.65	159.23	144.29	121.50	115.07
Wheat grain	104.91	100.79	169.59	158.71	127.25	113.71	111.75
Wheat straw/grazing	2.24	1.74	4.06	0.52	17.04	7.79	3.32
Operating costs							
Seed	5.13	7.64	12.33	10.80	13.26	14.15	7.61
Fertilizer	14.27	14.78	30.97	29.83	37.55	38.40	18.61
Chemicals	3.30	10.61	14.49	16.13	3.70	4.50	7.36
Custom operations	8.07	4.04	13.73	4.36	6.84	12.87	6.77
Fuel, lube, and electricity	7.03	4.25	13.89	6.68	4.32	5.47	6.14
Repairs	8.84	8.10	14.41	13.19	7.08	9.65	9.00
Purchased irrigation water and baling	0.15	0.16	6.04	1.12	0.63	0.21	0.58
Interest on operating capital	1.12	1.19	2.54	1.97	1.76	2.04	1.34
Hired labor	1.77	1.45	6.56	5.02	1.22	4.16	2.12
Ownership costs							
Capital recovery (machinery and equipment)	40.66	41.23	63.31	64.10	38.39	45.40	43.34
Taxes and insurance	3.03	3.76	5.86	7.06	3.33	3.36	3.70
Other costs							
General farm overhead	5.67	6.32	10.12	11.46	7.27	6.06	6.59
Opportunity cost of land	28.18	35.09	76.64	49.50	63.60	38.26	37.52
Opportunity costs of unpaid labor	15.80	10.77	20.52	25.41	16.44	19.56	14.85
Total operating costs	49.68	52.22	114.96	89.10	76.36	91.44	59.53
Total operating and ownership costs	93.37	97.21	184.13	160.26	118.08	140.20	106.57
Total costs	143.02	149.39	291.41	246.63	205.39	204.08	165.53
Returns above							
Operating costs	57.47	102.53	173.65	159.23	144.29	121.50	115.07
Operating and ownership costs	13.78	5.32	-10.48	-1.03	26.21	-18.70	8.50
Total costs	-35.87	-46.86	-117.76	-87.40	-61.10	-82.58	-50.46
			Bushels per planted acre				
Actual yield	39.4	34.7	68.6	65.0	51.8	45.0	41.7
Expected yield	36.7	36.2	69.0	60.9	52.2	50.5	41.1
			Dollars per bushel				
Price at harvest	2.66	2.91	2.47	2.44	2.46	2.53	2.68
Costs per bushel of actual yield							
Operating costs	1.26	1.50	1.68	1.37	1.47	2.03	1.43
Operating and ownership costs	2.37	2.80	2.68	2.47	2.28	3.12	2.56
Total costs	3.63	4.31	4.25	3.79	3.97	4.54	3.97
Costs per bushel of expected yield							
Operating costs	1.35	1.44	1.67	1.46	1.46	1.81	1.45
Operating and ownership costs	2.54	2.69	2.67	2.63	2.26	2.78	2.59
Total costs	3.90	4.13	4.22	4.05	3.93	4.04	4.03

[1]North Central = Northern Crescent and Heartland resource regions.
[2]Southeast = Eastern Uplands, Southern Seaboard, and Mississippi Portal resource regions.
Source: 1998 USDA Agricultural Resource Management Study.

Farm Characteristics and Production Costs by Cost Group

Differences in wheat acreage, per-acre costs, and yields distinguished low- and high-cost producers.

Costs vary considerably among producers because production practices, yields, and management practices vary by individual wheat growers. To identify various production factors affecting costs, wheat farms were grouped into low-, mid-, and high-cost groups according to their level of operating and ownership costs. Estimated operating and ownership costs were converted to a per-bushel basis and ranked from lowest to highest to form a weighted cumulative distribution of farms and production. The low-cost group was the 25 percent of farms with the lowest operating and ownership costs, and the high-cost group was the 25 percent of farms with the highest operating and ownership costs (fig. 3).

Low-cost farms had per-bushel operating and ownership costs of $1.86 or less and accounted for a third of total U.S. wheat production in 1998. Thirty-five percent of Prairie Gateway wheat farms were in the low-cost group, compared with about 10 percent of Northern Great Plains and Southeast farms (fig. 4). At the other end of distribution, high-cost farms had operating and ownership costs of $3.62 or more per bushel and accounted for 12 percent of U.S. wheat production. Forty percent of the Southeast wheat producers were in the high-cost group, followed by Northern Great Plains and Prairie Gateway farms with about 30 percent.

Differences between low- and high-cost farms in 1998 were primarily attributable to yield differences, location, and enterprise size. Low yields combined with heavier input use raised per-bushel costs on high-cost farms considerably. Low-cost farms had average operating and ownership costs of $82 per planted acre, compared with $125 per acre for high-cost farms (table 6).

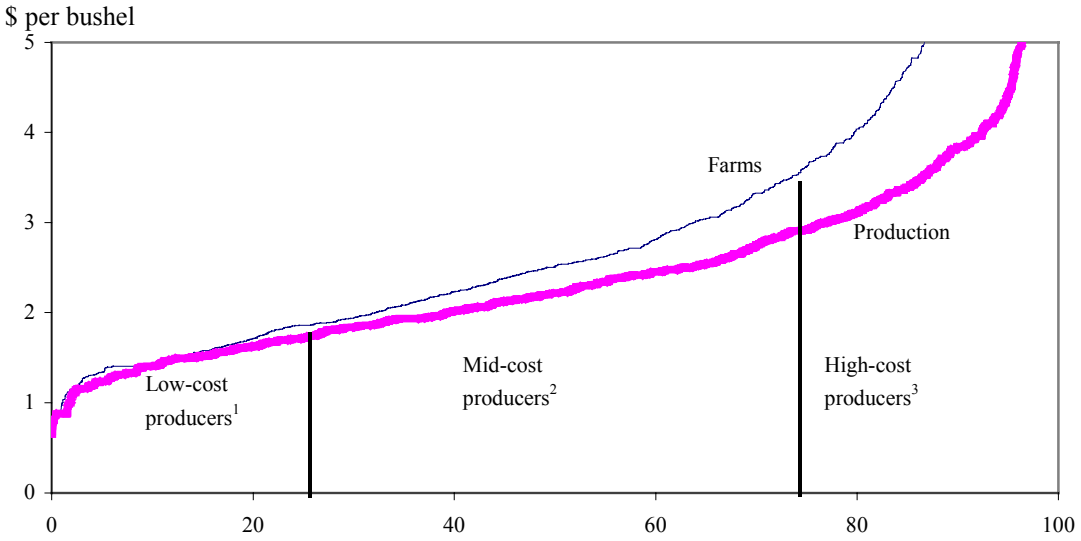
Per-bushel operating and ownership costs varied greatly between cost groups, ranging from an average $1.51 for low-cost producers to $5.43 per bushel for high-cost producers, due primarily to differences in yields. Differences between actual and expected per-acre yields indicate the effect of uncontrollable factors, such as weather, on yields. Actual yields for high-cost producers were 14 bushels below expected levels, while low-cost producers surpassed their expected yield in 1998 by an average of 12 bushels per acre (table 6). The per-acre costs of each group suggest a significant cost advantage for low-cost producers. Total operating and ownership costs were about $42 per acre lower for low-cost farms, a result of lower input use. High-cost producers spent about $10 per acre more for chemicals and fuel than low-cost producers (table 7). On an expected yield basis, per-bushel costs were $1.50 more for high-cost producers. Regardless of the poor yields experienced by many high-cost producers, greater per-acre costs and expected per-bushel costs suggest that many of these producers would be high-cost producers even under more favorable weather conditions.

Farm size and the importance of wheat to a farm's enterprise mix also varied among low- and high-cost wheat farms. The average low-cost farm had larger wheat acreage than high-cost farms, as well as a larger overall farm size. High-cost farms were more diversified than low-cost farms, which resulted in wheat contributing less to their total farm income. Only half of high-cost farms indicated that their farm operations were primarily cash grain farms, compared with 80 percent of low-cost farms (table 8). A larger percentage of high-cost farms specialized in other crops and livestock, compared with low-cost farms. Also, more high- than low-cost producers had a major occupation other than farming and had a higher proportion of older operators.

Figure 3

Cumulative distribution of wheat operating and ownership costs per bushel, 1998

High-cost farms produced wheat for $3.62 or more per bushel but accounted for only 12 percent of total wheat production.

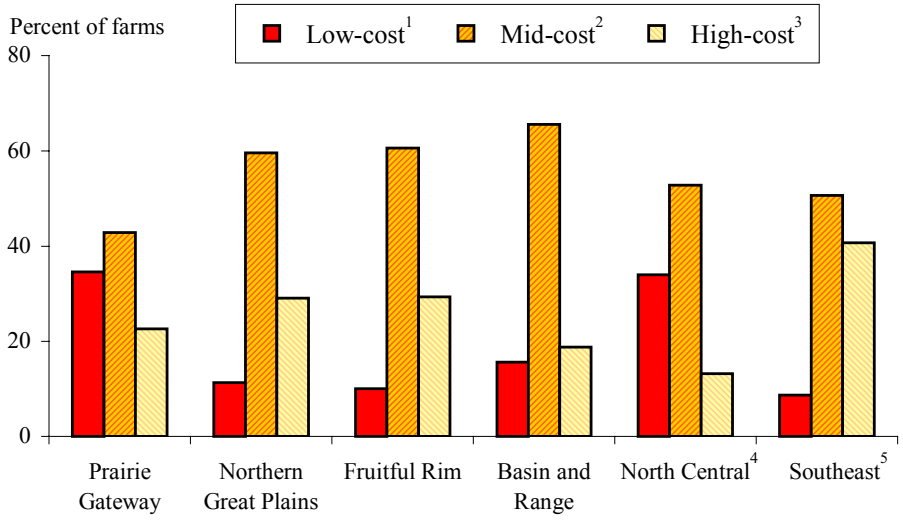


[1]Low-cost = The 25 percent of producers with the lowest operating plus ownership costs.
[2]Mid-cost = The 50 percent of producers in the midrange of operating plus ownership costs.
[3]High-cost = The 25 percent of producers with the highest operating plus ownership costs.
Source: 1998 USDA Agricultural Resource Management Study.

Figure 4

Distribution of cost groups, by region, 1998

Nearly half of the Southeast wheat farms were in the high-cost group.



[1]Low-cost = The 25 percent of producers with the lowest operating plus ownership costs.
[2]Mid-cost = The 50 percent of producers in the midrange of operating plus ownership costs.
[3]High-cost = The 25 percent of producers with the highest operating plus ownership costs.
[4]North Central = Northern Crescent and Heartland production resource regions.
[5]Southeast = Eastern Uplands, Southern Seaboard, and Mississippi Portal production resource re

Source: 1998 USDA Agricultural Resource Management Study.

Table 6—Wheat production costs and returns, by operating plus ownership cost group, 1998

Item	Low-cost farms[1]	Mid-cost farms[2]	High-cost farms[3]
		Dollars per planted acre	
Gross value of production	147.62	120.39	66.08
Wheat grain	143.83	117.25	62.85
Wheat straw/grazing	3.79	3.14	3.23
Operating costs			
Seed	6.45	8.07	7.77
Fertilizer	15.06	20.12	18.8
Chemicals	3.97	8.36	8.65
Custom operations	6.82	7.34	5.31
Fuel, lube, and electricity	4.23	5.64	9.49
Repairs	6.76	8.85	11.86
Purchased irrigation water and baling	0.23	0.74	0.58
Interest on operating capital	1.04	1.42	1.50
Hired labor	1.22	2.39	2.45
Ownership costs			
Capital recovery (machinery and equipment)	33.16	43.32	54.61
Taxes and insurance	3.41	3.80	3.77
Other costs			
General farm overhead	6.33	6.84	6.27
Opportunity cost of land	35.50	39.52	34.81
Opportunity costs of unpaid labor	11.78	14.33	19.53
Total operating costs	45.78	62.93	66.41
Total operating and ownership costs	82.35	110.05	124.79
Total costs	135.96	170.74	185.40
Returns above			
Operating costs	101.84	57.46	-0.33
Operating and ownership costs	65.27	10.34	-58.71
Total costs	11.66	-50.35	-119.32
		Bushels per planted acre	
Actual yield	54.7	43.5	23.0
Expected yield	43.2	42.0	36.7
		Dollars per bushel	
Price at harvest	2.63	2.69	2.74
Costs per bushel of actual yield			
Operating costs	0.84	1.45	2.89
Operating and ownership costs	1.51	2.53	5.43
Total costs	2.49	3.93	8.06
Costs per bushel of expected yield			
Operating costs	1.06	1.50	1.81
Operating and ownership costs	1.91	2.62	3.40
Total costs	3.15	4.07	5.05
ARMS share		*Percent*	
Wheat farms	25	50	25
Wheat acres	24	54	22
Wheat production	32	56	12

[1]Low-cost = The 25 percent of producers with the lowest operating and ownership costs.
[2]Mid-cost = The 50 percent of producers in the midrange of operating and ownership costs.
[3]High-cost = The 25 percent of producers with the highest operating and ownership costs.
Source: 1998 USDA Agricultural Resource Management Study.

Table 7—Input use of wheat production operations, by operating plus ownership cost group, 1998

Item	Low-cost farms[1]	Mid-cost farms[2]	High-cost farms[3]
Field size (acres)	65	65	56
Seed			
Rate per acre, one time (bushels/acre)	1.3	1.4	1.5
Homegrown seed (percent of seed)	59	59	62
Fertilizer use (percent of farms)			
Any fertilizer	93	93	87
Nitrogen	91	92	84
Phosphorus	69	74	67
Potassium	25	31	30
Fertilizer application rate (pounds/acre)			
Nitrogen	56	64	58
Phosphorus	19	24	21
Potassium	7	10	6
Chemical use (percent of farms)			
Any chemicals	44	62	63
Herbicides	42	61	61
Insecticides	*	7	5
Tillage system (percent of farms)			
Conventional with moldboard plow	5	6	6
Conventional without moldboard plow	56	61	69
Mulch tillage	21	23	22
No-till	18	10	*
Soil surface covered (percent)	28	24	22
Tillage/planting (field passes)	3.71	3.86	3.84
All field operations (field passes)	6.34	7.07	6.79
Custom operations (percent of farms)			
Any custom operation	63	60	47
Fertilizer/chemical	41	36	33
Harvest/hauling	27	22	9
Fuel use (gallons/acre)			
Diesel	3.6	4.3	5.5
Gasoline	0.7	1.1	1.4

* = 0.1 to less than 5 percent.

[1]Low-cost = The 25 percent of producers with the lowest operating and ownership costs.

[2]Mid-cost = The 50 percent of producers in the midrange of operating and ownership costs.

[3]High-cost = The 25 percent of producers with the highest operating and ownership costs.

Source: 1998 USDA Agricultural Resource Management Study.

Table 8—Characteristics of wheat farms, by operating plus ownership cost group, 1998

Item	Low-cost farms[1]	Mid-cost farms[2]	High-cost farms[3]
Size (acres)			
Operated	1,148	1,375	1,075
Planted wheat	273	326	256
Harvested wheat	260	318	208
Wheat tenure (percent of acres)			
Owned	47	45	44
Cash-rented	10	25	28
Share-rented	43	30	28
Production practices			
Winter wheat (percent of acres)	88	60	59
Spring wheat (percent of acres)	12	40	41
Irrigated (percent of acres)	*	*	10
Fallow (percent of farms)	24	28	19
Double-cropping (percent of farm)	*	*	6
Straw (percent of farms)	14	13	11
Grazing (percent of farms)	6	7	17
Previous crop (percent of farms)			
Wheat	36	38	51
Corn	6	7	6
Soybeans	25	17	*
Production specialty (percent of farms)			
Cash grains	79	70	56
Other crops	*	5	14
Livestock	18	23	30
Livestock (percent of farms)			
Hogs	7	8	10
Beef cattle	62	51	53
Dairy	6	5	*
Other livestock	12	20	19
Farm finances (dollars/farms)			
Wheat production value	33,580	38,082	19,725
Farm production value	170,488	205,007	122,085
Net cash income	35,291	34,490	18,247
Government payments	16,922	20,276	12,830
Assets	640,280	862,012	622,695
Debt	87,578	133,810	91,353
Debt-to-asset ratio (percent)	13.7	15.5	14.7
Favorable (percent of farms)	76	59	60
Wheat crop insurance (percent of farms)	71	62	47
Farm operator characteristic (percent of farms)			
Farming as major occupation	85	78	72
Under 50 years of age	49	44	33
Completed college	13	23	21

* = 0.1 to less than 5 percent.
[1]Low-cost = The 25 percent of producers with the lowest operating and ownership costs.
[2]Mid-cost = The 50 percent of producers in the midrange of operating and ownership costs.
[3]High-cost = The 25 percent of producers with the highest operating and ownership costs.
Source: 1998 USDA Agricultural Resource Management Study.

Farm Characteristics and Production Costs by Enterprise Size

Costs of producing wheat decreased as wheat acreage increased. Producers planting 400 or more acres of wheat accounted for two-thirds of total production.

Prior analyses of farm businesses and commodity production indicate that enterprise size may affect costs of production. Costs of producing cotton, corn, and wheat have been shown to decline as the size of the enterprise increases, at least to some level of acreage where costs either tend to level off or begin to increase (Brooks, 2001; Foreman, 2001; Ali et al., 1998; and McBride, 1994). The size distribution of 1998 wheat farms was used to identify cost differences among producers. Five size classes were developed according to planted wheat acreage: fewer than 50 acres, 50-199 acres, 200-399 acres, 400-799 acres, and 800 or more acres. Sixty percent of ARMS farms had fewer than 200 wheat acres but accounted for only 15 percent of total wheat production (table 9). Thirty percent of wheat farms were in the group with fewer than 50 wheat acres. Roughly half of U.S. wheat production came from the 10 percent of farms with 800 or more wheat acres.

The acreage of wheat planted was related closely to size of the farming operation. As the total farm acreage increased, the acres planted to wheat increased. Farms in the smallest size group averaged 26 acres of wheat as part of 330 operated acres, or 8 percent of the farm acreage. Farms in the largest size group averaged 1,336 acres of wheat on 3,715 operated acres, or 36 percent of the farm acreage. Wheat farms were generally larger in the Basin and Range and the Northern Great Plains than in the other regions. Seventy percent of growers in the Basin and Range region planted 200 or more acres of wheat and 25 percent planted more than 800 acres, a higher percentage than any other region. The largest concentration of the Prairie Gateway farms was in the 50-199-acre group, while more than 50 percent of the North Central and Southeast wheat farms were in the smallest size group with fewer than 50 wheat acres (fig. 5). The percentage of operator-owned acres decreased as enterprise size increased. Roughly 60 percent of wheat acres in the smallest size group were planted to wheat on operator-owned land, compared with 45 percent of owned acres in the largest size group. The proportion of wheat acreage share-rented also increased with size--from 19 percent on the smallest size farms to more than 30 percent on larger sized farms. Share-rent arrangements often reflect an attempt by the producer to shift part of the production risk to the landlord.

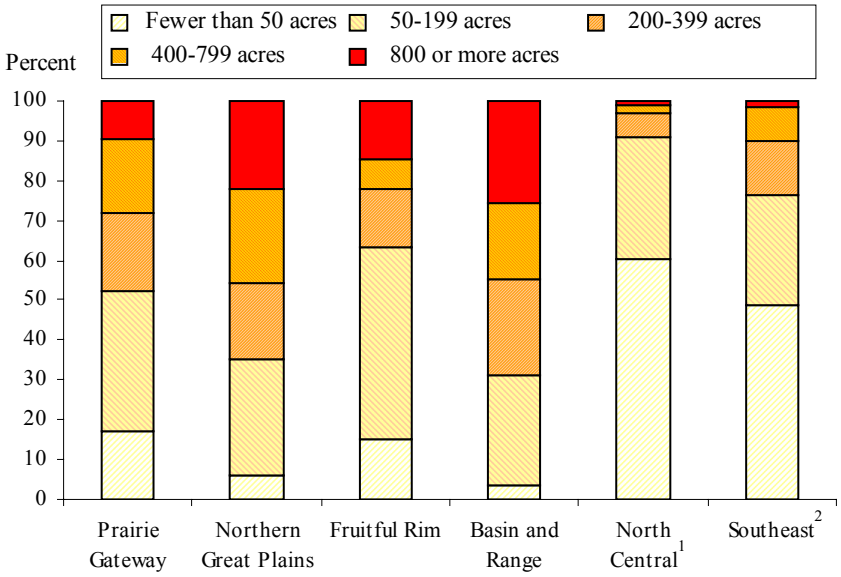
Per-acre total costs decreased with size of the wheat enterprise (table 10). The smallest size farms spent, on average, $200 per acre--$40 more per acre than larger size farms. Fertilizer expense was the single most important input cost item varied greatly among size groups followed by custom operations, chemicals, and seed. These cost items together accounted for an average of 70 percent of operating expenses in each size group. A high percentage of the smallest size farms reported custom operations (table 11). As a result, these farms had higher expenses for custom work than larger farms.

On a per-bushel basis of actual 1998 yields, farms with 50-199 wheat acres had the highest costs at $4.41, compared with $3.75 per bushel for farms with 800 or more wheat acres (table 10). To account for differences between 1998 and a typical year, costs were also compared per bushel of expected yield. Despite lower yields on the large operations, unit costs declined with size due to significantly lower operating and overhead costs on larger farms. When expected yields were used, per-bushel costs decreased from $4.38 per bushel to $3.96 as size increased.

Figure 5

Distribution of wheat farms by enterprise size in each region, 1998

Most of the Northeast farms had fewer than 50 wheat acres while a higher percentage of Basin and Range farms had 800 or more wheat acres.



[1]North Central = Northern Crescent and Heartland production resource regions.

[2]Southeast = Eastern Uplands, Southern Seaboard, and Mississippi Portal production resource regions.

Source: 1998 USDA Agricultural Resource Management Study.

Table 9—Characteristics of wheat farms, by enterprise size, 1998

Item	Fewer than 50 wheat acres	50-199 wheat acres	200-399 wheat acres	400-799 wheat acres	800 or more wheat acres
ARMS share (percent)					
Wheat farms	28	33	15	14	10
Wheat acres	*	12	15	26	45
Wheat production	*	13	15	26	44
Size (acres)					
Operated	330	935	1,402	1,858	3,715
Planted wheat	26	107	278	558	1,336
Harvested wheat	26	100	256	510	1,256
Wheat acres tenure (percent of acres)					
Owned	56	48	52	45	42
Cash-rented	24	24	22	24	21
Share-rented	19	28	26	31	37
Production practices					
Winter wheat (percent of acres)	92	79	74	67	60
Spring wheat (percent of acres)	8	21	26	33	40
Irrigated (percent of acres)	5	9	7	5	*
Fallow (percent of farms)	*	15	25	25	40
Double-cropping (percent of farms)	6	6	*	*	*
Straw (percent of farms)	38	20	11	8	*
Grazing (percent of farms)	*	10	12	9	9
Previous crop (percent of farms)					
Wheat	22	36	35	50	46
Corn	11	9	6	7	*
Soybeans	52	30	21	8	*
Production specialty (percent of farms)					
Cash grains	67	60	73	74	83
Other crops	5	12	6	5	*
Livestock	26	27	21	21	15
Livestock (percent of farms)					
Hogs	12	10	8	*	*
Beef cattle	59	48	58	61	46
Dairy	8	*	*	*	*
Other livestock	19	16	19	20	17
Farm finances (dollars/farm)					
Wheat production value	2,543	11,941	30,089	59,714	146,294
Farm production value	71,449	149,642	220,840	232,484	390,456
Net cash income	10,863	25,785	41,363	35,089	75,661
Government payments	4,870	12,843	19,124	27,591	51,519
Assets	404,329	664,601	853,904	978,136	1,464,550
Debt	32,742	98,476	121,143	150,611	304,886
Debt-to-asset ratio (percent)	8.1	14.8	14.2	15.4	20.8
Favorable (percent of farms)	65	66	62	56	61
Wheat crop insurance (percent of farms)	38	57	71	80	86
Farm operator characteristics (percent of					
Farming as major occupation	61	80	85	90	95
Under 50 years of age	39	41	43	43	51
Completed college	16	18	21	23	33

* = 0.1 to less than 5 percent.
Source: 1998 USDA Agricultural Resource Management Study.

Table 10—Wheat production costs and returns per planted acre, by enterprise size, 1998

Item	Fewer than 50 wheat acres	50-199 wheat acres	200-399 wheat acres	400-799 wheat acres	800 or more wheat acres
			Dollars per planted acre		
Gross value of production	139.11	121.04	109.05	111.60	116.19
Wheat grain	117.53	112.65	104.29	109.24	114.96
Wheat straw/grazing	21.58	8.39	4.76	2.36	1.23
Operating costs					
Seed	11.67	9.71	7.61	7.10	7.18
Fertilizer	27.09	21.62	20.43	18.45	16.96
Chemicals	2.98	4.16	5.65	6.91	9.13
Custom operations	11.91	9.03	8.63	6.40	5.58
Fuel, lube, and electricity	5.79	6.96	6.25	6.37	5.81
Repairs	7.08	9.33	9.11	8.71	9.14
Purchased irrigation water and baling	1.23	1.32	0.75	0.52	0.35
Interest on operating capital	1.62	1.49	1.40	1.30	1.30
Hired labor	0.99	1.48	1.70	2.00	2.53
Ownership costs					
Capital recovery (machinery and equipment)	38.05	45.8	43.54	42.56	43.38
Taxes and insurance	5.66	4.12	4.10	3.38	3.54
Other costs					
General farm overhead	10.01	7.93	6.83	6.67	5.98
Opportunity cost of land	46.6	44.28	37.28	34.45	37.15
Opportunity costs of unpaid labor	29.53	23.55	17.51	15.40	10.90
Total operating costs	70.36	65.1	61.53	57.76	57.98
Total operating and ownership costs	114.07	115.02	109.17	103.70	104.9
Total costs	200.21	190.78	170.79	160.22	158.93
Returns above					
Operating costs	68.75	55.94	47.52	53.84	58.21
Operating and ownership costs	25.04	6.02	-0.12	7.90	11.29
Total costs	-61.10	-69.74	-61.74	-48.62	-42.74
			Bushels per planted acre		
Actual yield	47.8	43.3	39.2	40.5	42.4
Expected yield	45.7	45.0	41.4	40.7	40.1
			Dollars per bushel		
Price at harvest	2.46	2.60	2.66	2.70	2.71
Costs per bushel of actual yield					
Operating costs	1.47	1.50	1.57	1.43	1.37
Operating and ownership costs	2.39	2.66	2.78	2.56	2.47
Total costs	4.19	4.41	4.36	3.96	3.75
Costs per bushel of expected yield					
Operating costs	1.54	1.45	1.49	1.42	1.45
Operating and ownership costs	2.50	2.56	2.64	2.55	2.62
Total costs	4.38	4.24	4.13	3.94	3.96

Source: 1998 USDA Agricultural Resource Management Study.

Table 11—Input use of wheat production operations, by enterprise size, 1998

Item	Fewer than 50 wheat acres	50-199 wheat acres	200-399 wheat acres	400-799 wheat acres	800 or more wheat acres
Field size (acres)	17	31	50	70	107
Yield (bushels per acre)					
Actual yield	48	43	39	41	42
Expected yield	45.7	45.0	41.4	40.7	40.1
Seed					
Rate per acre, one time (bushels/acre)	1.9	1.6	1.5	1.4	1.3
Homegrown seed (percent of seed)	32	40	58	64	66
Fertilizer use (percent of farms)					
Any fertilizer	94	88	89	93	94
Nitrogen	89	86	88	91	94
Phosphorus	68	66	72	72	74
Potassium	56	44	30	23	12
Fertilizer application rate (pounds/acre)					
Nitrogen	65	64	60	61	59
Phosphorus	31	27	27	23	18
Potassium	29	20	14	8	*
Chemical use (percent of farms)					
Any chemicals	30	43	58	69	70
Herbicides	30	40	56	69	69
Insecticides	*	7	5	6	6
Tillage system (percent of farms)					
Conventional with moldboard plow	7	8	6	*	5
Conventional without moldboard plow	63	63	68	70	48
Mulch tillage	10	15	14	23	38
No-till	19	14	11	*	9
Soil covered (percent)	24	23	23	22	30
Tillage/planting (field passes)	2.90	3.49	3.80	4.11	4.18
All field operations (field passes)	4.74	5.36	5.68	6.53	7.07
Custom operations (percent of farms)					
Any custom operation	68	55	59	57	55
Fertilizer/chemical	50	39	38	33	32
Harvest/hauling	31	19	24	19	14
Fuel use (gallons/acre)					
Diesel	3.4	4.1	4.2	4.4	4.5
Gasoline	1.6	1.4	1.3	1.1	0.9

* = 0.1 to less than 5 percent.

Source: 1998 USDA Agricultural Resource Management Study.

Farm Characteristics and Production Costs Vary by Typology

Eighty percent of wheat farms were small family farms that accounted for more than half of total production.

The ERS farm typology classifies farms according to gross value of farm product sales, farmer's occupation, and farm asset values (Hoppe et al., 2000). The wheat version of the 1998 ARMS survey did not have adequate sample size to use all the classes in the typology. The three smallest classes of farms (limited-resource, retirement, and residential/lifestyle) have been combined for this report and will be called residential farms (see glossary). Eighty-one percent of ARMS wheat farms were small family farms (gross sales under $250,000), similar to the share reported in the 1997 Census of Agriculture. This group accounted for 56 percent of total U.S. wheat production (table 12). Small family farms were fairly evenly distributed, with 22-30 percent of all wheat farms in each subgroup of the small farm typology. The largest share of wheat production came from high-sales small family farms (28 percent). Eleven percent of surveyed wheat farms were large farms, accounting for 25 percent of total wheat production. Roughly 20 percent of wheat production came from the 5 percent of farms classified as very large farms. A larger percentage of very large family farms were in the Southeast and Fruitful Rim (fig. 6). Most low-sales small family farms were in the Prairie Gateway and Northern Great Plains. Nearly half of the North Central wheat farms were classified as residential.

As discussed earlier, both wheat value of production and total farm value of production rose with farm size. But unlike the acreage concentrations, the largest farms did not have the highest concentration of sales from wheat (fig. 7). Low-sales small family farms had the highest proportion of sales coming from wheat followed by residential and high-sales farms. Larger farms were less specialized in cash grains and more likely to specialize in other crops and livestock (table 12).

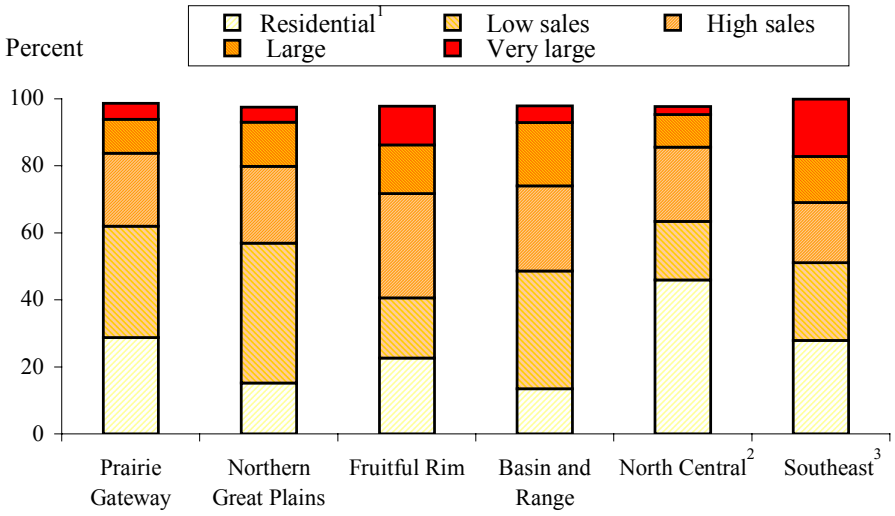
Production costs varied among the typology groups, but most of the significant differences were between small and large family farms, particularly for seed, fertilizer, chemicals, custom operations, labor, and overhead expenses. On a per-acre basis, very large farms had the highest total costs, averaging $191 per acre, compared with $150-$160 per acre for small farms (table 13). Very large farms had the highest per-acre production costs due primarily to irrigation-related expenses but they also had the highest yield. As a result, these farms had the lowest per-bushel cost, averaging $3.77, compared with $4.83 per bushel for the low-sales small family farms.

Residential farmers with an average of 110 wheat acres had production costs similar to those of other small farms. A high percentage of residential farmers reported custom harvest and hauling operations (table 14). As a result, these farmers had higher expenses for custom work than farmers who reported farming as a major occupation. The North Central region had the highest percentage of residential farmers.

Figure 6

Distribution of farms by farm typology in each region, 1998

Thirty-three percent of the Prairie Gateway and 42 percent of the Northern Great Plains farms were low-sales small family farms.



[1]Residential farms = Small family farms that include limited-resource, retirement, and residential/lifestyle farms.

[2]North Central = Northern Crescent and Heartland regions.

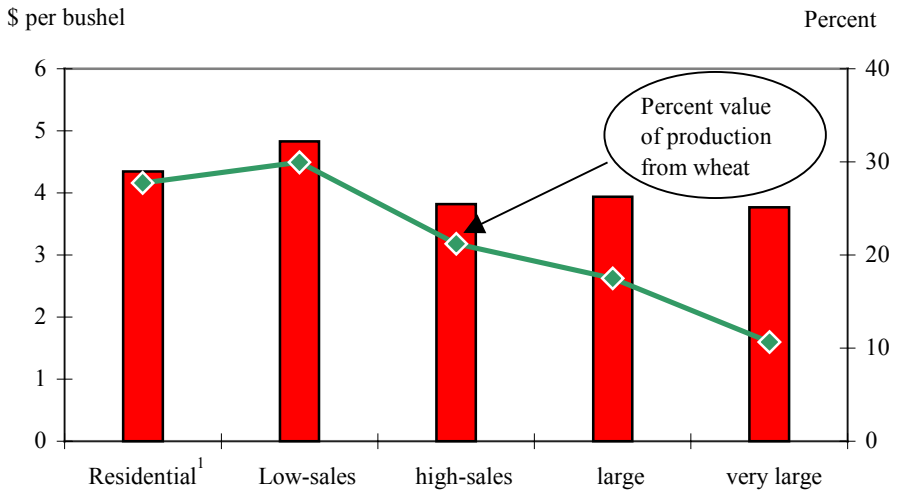
[3]Southeast = Eastern Uplands, Southern Seaboard, and Mississippi Portal regions.

Source: 1998 USDA Agricultural Resource Management Study.

Figure 7

Wheat production costs and contribution to total value of production, by farm typology, 1998

Wheat contributed a smaller share of total value of production on large farms.



[1]Residential farms = Small family farms that include limited-resource, retirement, and residential/lifestyle farms.

Source: 1998 USDA Agricultural Resource Management Study.

Table 12—Characteristics of wheat farms, by farm typology, 1998

Item	Small family farms			Large family farms	
	Residential[1]	Low-sales	High-sales	Large	Very large
ARMS share (percent)					
Wheat farms	30	29	22	11	5
Wheat acres	11	23	29	20	15
Wheat production	10	18	28	24	18
Size (acres)					
Operated	392	988	1,621	2,127	3,795
Planted wheat	110	232	384	512	818
Harvested wheat	102	202	355	505	793
Wheat tenure (percent of acres)					
Owned	42	50	49	42	35
Cash-rented	27	26	20	22	29
Share-rented	31	24	32	36	37
Production practices					
Winter wheat (percent of acres)	76	61	60	56	67
Spring wheat (percent of acres)	24	39	40	44	33
Irrigated (percent of acres)	*	*	*	5	16
Fallow (percent of farms)	22	27	27	24	13
Double-cropping (percent of farms)	5	*	*	*	*
Straw (percent of farms)	14	12	11	15	6
Grazing (percent of farms)	9	11	10	*	10
Previous crop (percent of farms)					
Wheat	43	46	39	32	28
Corn	*	*	6	11	20
Soybeans	31	11	18	25	12
Production specialty (percent of farms)					
Cash grains	82	60	65	69	43
Other crops	6	6	6	9	24
Livestock	11	34	29	21	30
Livestock (percent of farms)					
Hogs	6	8	11	12	10
Beef cattle	51	60	57	50	47
Dairy	0	*	11	9	*
Other livestock	12	25	17	18	20
Farm finances (dollars/farm)					
Wheat production value	9,995	19,659	40,303	67,213	108,584
Farm production value	36,034	65,639	190,216	383,991	1,021,502
Net cash income	480	2,213	30,091	79,386	248,325
Government payments	5,082	9,181	19,898	40,162	71,658
Assets	319,747	552,620	889,013	1,295,422	2,316,703
Debt	29,285	52,233	129,556	212,867	593,366
Debt-to-asset ratio (percent)	9.2	9.5	14.6	16.4	25.6
Favorable (percent of farms)	67	56	66	65	65
Wheat crop insurance (percent of farms)	48	57	72	66	73
Farm operator characteristics (percent of farms)					
Farming as major occupation	33	100	99	94	93
Under 50 years of age	40	26	46	64	72
Completed college	19	12	20	31	36

* = 0.1 to less than 5 percent.
[1]Residential farms = Small family farms that include limited-resource, retirement, and residential/lifestyle farms.
Source: 1998 USDA Agricultural Resource Management Study.

Table 13—Wheat production costs and returns per planted acre, by farm typology, 1998

Item	Small family farms			Large family farms	
	Residential[1]	Low-sales	High-sales	Large	Very large
	Dollars per planted acre				
Gross value of production	95.31	92.43	108.44	127.59	136.36
Wheat grain	91.14	89.96	106.37	122.48	134.61
Wheat straw/grazing	4.17	2.47	2.07	5.11	1.75
Operating costs					
Seed	6.84	7.42	7.20	8.29	9.10
Fertilizer	16.59	15.48	17.30	23.31	24.18
Chemicals	5.45	6.14	6.06	10.24	10.06
Custom operations	14.22	5.74	5.65	4.07	10.26
Fuel, lube, and electricity	4.37	5.48	5.11	7.75	8.14
Repairs	6.53	9.01	8.22	9.63	10.77
Purchased irrigation water and baling	0.30	0.38	0.29	0.77	1.66
Interest on operating capital	1.30	1.19	1.19	1.53	1.78
Hired labor	0.71	1.33	2.16	2.63	3.70
Ownership costs					
Capital recovery (machinery and equipment)	31.76	43.64	40.43	47.99	45.61
Taxes and insurance	3.90	4.16	3.79	3.79	2.72
Other costs					
General farm overhead	7.12	6.99	6.18	6.54	5.68
Opportunity cost of land	32.96	30.32	32.01	41.37	47.00
Opportunity costs of unpaid labor	18.24	22.91	14.61	12.99	10.38
Total operating costs	56.31	52.17	53.18	68.22	79.65
Total operating and ownership costs	91.97	99.97	97.40	120.00	127.98
Total costs	150.29	160.19	150.20	180.90	191.04
Returns above					
Operating costs	39.00	40.26	55.26	59.37	56.71
Operating and ownership costs	3.34	-7.54	11.04	7.59	8.38
Total costs	-54.98	-67.76	-41.76	-53.31	-54.68
	Bushels per planted acre				
Yield	34.60	33.20	39.40	45.90	50.70
	Dollars per bushel				
Price at harvest	2.63	2.71	2.70	2.67	2.66
Costs per bushel					
Operating costs	1.63	1.57	1.35	1.49	1.57
Operating and ownership costs	2.66	3.01	2.47	2.61	2.52
Total costs	4.34	4.83	3.81	3.94	3.77

[1]Residential farms = Small family farms that include limited-resource, retirement, and residential/lifestyle farms.

Source: 1998 USDA Agricultural Resource Management Study.

Table 14—Input use of wheat production operations, by farm typology, 1998

Item	Small family farms			Large family farms	
	Residential[1]	Low-sales	High-sales	Large	Very large
Field size (acres)	42	47	63	76	92
Yield (bushels/acre)					
Actual yield	35	33	39	47	51
Expected yield	35	36	38	46	49
Seed					
Rate per acre, one time (bushels/acre)	1.4	1.4	1.4	1.6	1.4
Homegrown seed (percent of seed)	52	64	63	69	44
Fertilizer use (percent of farms)					
Any fertilizer	83	86	95	95	97
Nitrogen	82	84	94	94	96
Phosphorus	65	63	79	76	67
Potassium	30	24	30	35	38
Fertilizer application rate (pound/acre)					
Nitrogen	47	52	57	73	84
Phosphorus	21	20	24	26	21
Potassium	8	5	6	13	10
Chemical use (percent of farms)					
Any chemicals	50	59	57	60	71
Herbicides	49	58	57	60	68
Insecticides	7	5	8	5	14
Tillage system (percent of farms)					
Conventional with moldboard plow	7	7	*	*	*
Conventional without moldboard plow	63	63	68	70	48
Mulch tillage	14	22	27	26	31
No-till	6	*	14	16	10
Soil covered (percent)	20	21	28	30	27
Tillage/planting (field passes)	3.80	3.98	3.61	3.53	3.42
All field operations (field passes)	5.42	6.81	7.15	7.29	6.14
Custom operations (percent of farms)					
Any custom operation	62	43	54	61	81
Fertilizer/chemical	43	25	35	41	46
Harvest/hauling	40	18	16	8	24
Fuel use (gallons/acre)					
Diesel	3.5	4.8	4.0	4.6	4.8
Gasoline	1.0	1.2	0.9	1.2	1.0

* = 0.1 to less than 5 percent.

[1]Residential farms = Small family farms that include limited-resource, retirement, and residential/lifestyle farms.

Source: 1998 USDA Agricultural Resource Management Study.

Agricultural Resource Management Study (ARMS). This annual survey of U.S. farmers and ranchers is USDA's major source of financial information on U.S. agriculture. A subsample of the survey collects production practice information for individual crop and livestock commodities and is the primary source of data used in this report. Wheat cost and return estimates in this report are derived from the responses of 1,941 wheat farmers in 20 states (CA, CO, GA, ID, IL, KS, LA, MN, MO, MS, MT, NC, NE, ND, OH, OK, OR, SD, TX, and WA). The survey included information on wheat production practices, input use, and costs of production for the 1998 wheat crop. The target population for the survey was farmers who planted wheat with the intention of harvesting the wheat for grain.

Cost group:

- ***Low-cost*** producers represent the 25 percent of U.S. wheat producers with the lowest per-bushel operating plus ownership costs. These wheat producers had operating plus ownership costs of $1.86 per bushel or less.
- ***High-cost*** producers represent the 25 percent of U.S. wheat producers with the highest per-bushel operating plus ownership costs. These wheat producers had operating plus ownership costs of $3.62 per bushel or more.

Debt-to-asset ratio is a balance sheet measure calculated by dividing the farm's total liabilities by total assets.

Enterprise size is an acreage measure which in this report is one of five categories: farms with fewer than 50 wheat acres, 50-199 wheat acres, 200-399 wheat acres, 400-799 wheat acres, and 800 or more wheat acres.

Expected yield is the reported wheat yield per acre that farmers expected on their operation at the time of planting.

Farm resource regions. ERS developed farm resource regions according to farm characteristics, previous production regions, USDA's land resource regions, and NASS crop reporting districts which are aggregates of counties (Heimlich, 2000). Due to sample size limitations in the 1998 wheat survey, the Northern Crescent and the Heartland resource regions were combined into the **North Central** region while the Eastern Uplands, Southern Seaboard, and Mississippi Portal resource regions were combined into the **Southeast** (see fig. 2).

Farm typology is a classification developed by ERS to categorize farms and ranches into more homogeneous groups than classifications based on sales volume alone. Farms vary widely in size and other characteristics, ranging from very small retirement and residential farms to establishments with sales in the millions. The typology is based on the occupation of operators and the sales class of farms, including the operation's asset base and total household income.

- ***Small family farms*** have sales of $250,000 or less. Family farms exclude farms organized as nonfamily corporations or cooperatives and farms operated by hired managers.
- ***Residential farms*** are small family farms that combine limited-resource, retirement, and residential/lifestyle farms. These three typology groups were combined in this report due to sample size limitations. Limited-resource farms have sales less than $100,000, total farm assets less than $150,000, and total operator household income less than $20,000. They may report farming, a nonfarm occupation, or retirement as their major occupation. Retirement farms have sales less than $250,000; these operators report they are retired (excludes limited-resource farms operated by retired farmers). Residential/ lifestyle farms have sales less than $250,000 and the operators report a major occupation

other than farming (excludes limited-resource farms with operators reporting a nonfarm major occupation).

- ***Low-sales family farms*** have sales less than $100,000 and the operators report farming as their major occupation (excludes limited-resource farms whose operators report farming as their major occupation).
- ***High-sales family farms*** have sales between $100,000 and $249,999 and the operators report farming as their major occupation.
- ***Large family farms*** have sales between $250,000 and $499,999.
- ***Very large family farms*** have sales of $500,000 or more.
- ***Nonfamily farms*** are organized as nonfamily corporations or cooperatives, as well as farms operated by hired managers.

Favorable financial position is indicated by a positive net farm income and debt/asset ratio less than 0.40. Farms in this position are generally considered financially stable.

Production costs:

- ***Operating costs*** are the costs for purchased inputs that are consumed in one production period. These costs include seed; fertilizer; chemicals; custom operations; fuel, lube, and electricity; repairs; purchased irrigation water; baling; hired labor; and interest on operating inputs.

- ***Operating and ownership costs*** include the sum of operating costs and asset ownership costs. Ownership costs are mainly the costs of maintaining the capital stock used in production, including asset depreciation and interest (capital recovery), taxes, and insurance.

- ***Total costs*** are operating costs and ownership costs plus all other allocated long-term costs that account for all production inputs, without regard to the ownership or equity position of farm operators. These costs are operating costs, paid and unpaid labor charges, an imputed cost for capital recovery, the opportunity cost of land, as well as the enterprise share of general farm overhead, taxes, and insurance.

Production specialty is the farm's production classification that represents the largest proportion of gross commodity receipts from the farm operation.

Tillage systems are defined by the amount of crop residue remaining on the soil.

- ***Conventional tillage systems*** leave less than 30 percent of crop residue remaining on the soil when wheat is planted.
- ***Conventional tillage systems with moldboard plow*** include any tillage system uses a mold board plow.
- ***Conventional tillage without moldboard plow*** include any tillage system that has less than 30 percent remaining residue and does not use a moldboard plow.
- ***Conservation tillage*** leaves 30 percent or more of the previous crop residue covering the soil when wheat is planted.
- ***No-till*** leaves the soil undisturbed from harvest to planting except for nutrient injection. Planting or drilling is accomplished in a narrow seedbed or slot created by coulters, row cleaners, disk openers, in-row chisels, or roto-tillers. Weed control is accomplished primarily with herbicides. Cultivation may be used for emergency weed control.
- ***Mulch-till*** disturbs the soil prior to planting. Tillage tools such as chisels, field cultivators, disks, weeps, or blades are used. Weed control is accomplished with herbicides and/or cultivation.

Value of production is an estimate of the total value of all farm products produced on farm, excluding the value of intermediate products, such as corn fed to livestock.

Wheat class:

- ***Winter wheat*** is a general category of wheat that is seeded in the fall, lies dormant in the

winter, and is harvested the following spring or summer.

- ***Spring wheat*** is a general term for wheat that is planted in the spring and harvested in summer or fall, relatively high in protein content, and used in bread flours (includes durum and other spring wheat).

Wheat farms represent those operations selected in the 1998 ARMS. Wheat farms are defined as farm operations that planted one or more acres of wheat with the intention of harvesting as grain.

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Appendix 1: Data Reliability

Survey results are only indications of the total population. They may differ from data collected in a complete census using the same questionnaires, instructions, and enumerators. A measure of this sample variability, called sampling error, is available from survey results. Sampling error may be expressed as a percentage of the estimate. These percentages represent the relative standard error of the estimate and are often referred to as coefficients of variation (C.V.). In general, the smaller the C.V., the greater the reliability of the estimate (appendix tables 1-4).

The average operating costs of production for all farms, $59.53 per acre, has a C.V. of 4.4 percent (appendix table 1). Therefore, the confidence interval for operating costs per acre of producing wheat in the United States is estimated to be between $54.40 and $64.66 per planted acre based on a 95-percent probability (appendix table 5). The relative standard error of an estimate can also be used to evaluate the statistical significance of differences between groups. For example, the appropriate t-statistic for a comparison of operating and ownership costs per bushel between low- and high-cost farms would be constructed by taking the difference between the mean of the two groups (OPOWC) and dividing by the square root of the sum of the squared standard errors (SE^2) of the two groups. This is estimated as follows:

$$t = \frac{(OPOWC_{Low\text{-}cost} - OPOWC_{High\text{-}cost})}{(SE^2_{Low\text{-}cost} + SE^2_{High\text{-}cost})^{0.5}}$$

$$= (1.5062 - 5.4345)/(0.0310^2 + 0.1917^2)^{0.5}$$

$$= -20.67$$

Conclusion: The difference in per-bushel operating plus ownership costs is highly significant (at 0.01 level) between the low- and high-cost farms.

Differences among means of wheat production characteristics and costs items for the various groupings presented in this report were statistically tested. Although t-statistics are not reported here, the discussion in each section emphasizes comparisons among the groups only when means were significantly different at the 90-percent level.

Survey data are also influenced by nonsampling errors, which are not measurable or known. Enumerators, respondents, and questionnaire design, among other factors, may introduce nonsampling errors. Efforts were made to minimize these errors and maintain survey accuracy, including training of data collectors, detailed review and edit of data, and analysis for comparability and consistency.

Appendix table 1—Coefficients of variation of wheat production costs, region

Item	Prairie Gateway	Northern Great Plains	Fruitful Rim	Basin and Range	North Central[1]	Southeast[2]	All ARMS farms
				Percent			
Operating costs							
Seed	4.3	3.2	8.7	4.7	8.1	7.0	2.2
Fertilizer	6.4	5.0	10.0	9.0	5.0	5.1	2.8
Chemicals	16.6	5.9	7.2	8.6	16.5	23.2	5.4
Custom operations	8.8	13.9	12.5	16.5	15.8	20.5	4.8
Fuel, lube, and electricity	10.6	5.8	11.7	6.6	4.7	5.2	6.0
Repairs	4.9	4.4	5.4	6.6	5.3	8.9	3.1
Purchased irrigation water and baling	53.8	20.4	14.9	50.5	18.8	29.1	14.6
Interest on operating capital	4.3	2.8	5.0	6.0	3.8	4.2	2.2
Hired labor	11.6	16.7	11.4	17.5	16.4	14.6	7.7
Ownership costs							
Capital recovery (machinery and equipment)	4.0	4.2	4.2	6.8	4.9	8.1	2.5
Taxes and insurance	8.6	4.0	11.0	4.3	11.4	7.6	3.9
Other costs							
General farm overhead	5.9	5.2	10.7	9.4	17.8	11.5	4.3
Opportunity cost of land	3.6	5.3	5.4	9.2	6.3	9.2	3.2
Opportunity costs of unpaid labor	6.0	7.3	7.6	21.1	8.2	12.3	3.0
Operating costs	2.2	4.1	3.0	5.0	6.1	3.8	4.4
Operating and ownership costs	3.3	2.9	3.8	5.8	3.1	2.4	2.1
Total costs	2.9	2.5	3.3	6.9	3.5	3.0	2.0
Yield	4.3	3.4	3.9	4.0	2.7	2.6	2.7
Costs per bushel							
Operating costs	4.0	2.5	4.1	3.5	5.1	5.5	2.0
Operating and ownership costs	3.9	2.5	3.4	3.8	4.5	4.4	1.8
Total costs	3.7	2.2	3.7	4.6	5.2	5.4	1.5

Coefficient of Variation = (Standard Error/Estimate)*100.

[1]North Central = Northern Crescent and Heartland resource regions.

[2]Southeast = Eastern Uplands, Southern Seaboard, and Mississippi Portal resource regions.

Source: 1998 USDA Agricultural Resource Management Study.

Appendix table 2—Coefficients of variation of wheat production costs, by cost group

Item	Low-cost farms[1]	Mid-cost farms[2]	High-cost farms[3]
		Percent	
Operating costs			
Seed	3.4	3.2	5.5
Fertilizer	4.2	3.5	4.5
Chemicals	15.3	6.0	15.9
Custom operations	9.1	6.9	17.8
Fuel, lube, and electricity	9.6	4.9	13.0
Repairs	6.5	2.8	6.2
Purchased irrigation water and baling	32.7	18.9	24.8
Interest on operating capital	2.5	2.4	4.3
Hired labor	11.8	9.0	9.0
Ownership costs			
Capital recovery of machinery and equipment	3.5	2.7	5.8
Taxes and insurance	7.7	5.6	8.1
Other costs			
General farm overhead	6.0	4.8	10.2
Opportunity cost of land	4.0	3.9	7.9
Opportunity costs of unpaid labor	6.6	5.5	7.5
Total operating costs	2.6	2.4	4.3
Total operating and ownership costs	2.5	2.1	4.2
Total costs	2.0	2.2	3.8
Yield	2.0	2.6	6.0
Costs per bushel			
Operating costs	2.3	1.2	4.8
Operating and ownership costs	2.1	1.0	3.5
Total costs	2.0	1.3	3.2

Coefficient of Variation = (Standard Error/Estimate)*100.

[1]Low-cost = The 25 percent of producers with the lowest operating and ownership costs.

[2]Mid-cost = The 50 percent of producers in the midrange of operating and ownership costs.

[3]High-cost = The 25 percent of producers with the highest operating and ownership costs.

Source: 1998 USDA Agricultural Resource Management Study.

Appendix table 3—Coefficients of variation of wheat production costs, by enterprise size

Item	Fewer than 50 wheat acres	50-199 wheat acres	200-399 wheat acres	400-799 wheat acres	800 or more wheat acres
			Percent		
Operating costs					
Seed	10.4	6.0	3.7	4.6	5.0
Fertilizer	6.3	8.3	6.3	6.2	5.2
Chemicals	21.0	8.0	11.0	7.5	8.8
Custom operations	25.3	15.1	6.9	12.0	10.1
Fuel, lube, and electricity	18.4	14.8	9.7	9.8	6.0
Repairs	14.0	4.7	6.1	5.2	4.5
Purchased irrigation water and baling	21.6	13.8	29.6	49.7	42.3
Interest on operating capital	3.8	5.9	4.4	4.3	3.7
Hired labor	42.4	21.0	10.3	10.1	10.1
Ownership costs					
Capital recovery (machinery and equipment)	14.0	5.0	6.6	4.5	3.7
Taxes and insurance	18.2	11.2	11.7	5.6	4.7
Other costs					
General farm overhead	11.2	8.6	6.5	9.3	7.2
Opportunity cost of land	11.8	4.2	6.7	5.6	5.0
Opportunity costs of unpaid labor	17.4	3.9	8.7	10.0	7.0
Total operating costs	4.1	6.0	4.5	4.2	3.8
Total operating and ownership costs	5.8	3.8	4.9	3.9	2.7
Total costs	8.3	3.2	4.2	4.3	2.5
Yield	5.6	3.6	5.1	2.9	3.8
Costs per bushel					
Operating costs	4.9	4.7	4.7	2.9	4.9
Operating and ownership costs	9.7	3.0	5.7	3.0	3.6
Total costs	12.4	2.9	4.8	3.2	3.6

Coefficient of Variation = (Standard Error/Estimate)*100.

Source: 1998 USDA Agricultural Resource Management Study.

Appendix table 4—Coefficients of variation of wheat production costs, by farm typology

Item	Small family farms			Large family farms	
	Residential[1]	Low-sales	High-sales	Large	Very large
			Percent		
Operating costs					
Seed	4.0	7.2	4.5	4.1	7.0
Fertilizer	6.1	7.4	4.8	6.7	11.7
Chemicals	17.6	13.7	12.1	18.0	13.0
Custom operations	17.7	15.0	12.7	12.6	19.2
Fuel, lube, and electricity	6.7	5.2	6.3	12.8	15.9
Repairs	6.5	6.6	3.3	4.6	12.3
Purchased irrigation water and baling	45.0	56.0	15.5	27.2	36.7
Interest on operating capital	6.7	5.5	2.9	5.0	8.7
Hired labor	22.9	19.6	15.0	16.2	13.0
Ownership costs					
Capital recovery (machinery and equipment)	6.6	5.9	3.9	3.8	7.2
Taxes and insurance	16.4	16.0	11.9	10.6	18.1
Other costs					
General farm overhead	17.2	9.7	8.3	10.0	23.9
Opportunity cost of land	5.6	8.2	5.4	10.4	11.9
Opportunity costs of unpaid labor	7.6	13.9	3.9	9.6	17.7
Total operating costs	6.6	5.8	2.8	4.8	8.3
Total operating and ownership costs	4.2	5.1	2.5	3.3	7.5
Total costs	3.6	5.7	2.7	4.2	7.7
Yield	8.9	6.0	3.4	5.9	7.1
Costs per bushel					
Operating costs	6.8	7.7	3.9	4.7	5.8
Operating and ownership costs	8.5	7.7	2.6	4.9	4.5
Total costs	8.5	7.1	2.8	5.6	4.4

Coefficient of Variation = (Standard Error/Estimate)*100.

[1]Residential farms = Small family farms that include limited-resource, retirement, and residential/lifestyle farms.

Source: 1998 USDA Agricultural Resource Management Study.

Appendix table 5—Statistical reliability of wheat production costs per planted acre

Item	95-percent confidence interval								
	Operating costs			Operating and ownership costs			Total costs		
	Lower	Mean	Upper	Lower	Mean	Upper	Lower	Mean	Upper
	Dollars per planted acre								
All ARMS wheat farms	54.40	59.53	64.66	102.18	106.57	110.96	159.04	165.53	172.02
Region									
Prairie Gateway	47.64	49.69	51.73	87.33	93.37	99.41	134.89	143.02	151.15
Northern Great Plains	48.02	52.22	56.42	91.68	97.21	102.74	142.07	149.39	156.71
Fruitful Rim	108.20	114.96	121.72	170.42	184.13	197.84	272.56	291.41	310.26
Basin and Range	80.37	89.10	97.83	142.04	160.26	178.48	213.28	246.63	279.98
North Central[1]	67.23	76.36	85.49	110.91	118.08	125.25	191.30	205.39	219.48
Southeast[2]	84.63	91.44	98.25	133.60	140.20	146.80	192.08	204.08	216.08
Costs group									
Low-cost[3]	43.45	45.78	48.11	78.31	82.35	86.39	130.63	135.96	141.29
Mid-cost[4]	59.97	62.93	65.89	105.52	110.05	114.58	163.38	170.74	178.10
High-cost[5]	60.81	66.41	72.01	114.52	124.79	135.06	171.59	185.4	199.21
Enterprise size group									
Fewer than 50 acres	64.71	70.36	76.01	101.10	114.07	127.04	167.64	200.21	232.78
50-199 acres	57.44	65.10	72.76	106.45	115.02	123.59	178.81	190.78	202.75
200-399 acres	56.10	61.53	66.96	98.69	109.17	119.65	156.73	170.79	184.85
400-799 acres	53.01	57.76	62.51	95.77	103.70	111.63	146.72	160.22	173.72
800 acres or more	53.66	57.98	62.30	99.35	104.90	110.45	151.14	158.93	166.72
Farm typology									
Residential[6]	49.03	56.31	63.59	84.40	91.97	99.54	139.69	150.29	160.89
Low-sales	46.24	52.17	58.10	89.98	99.97	109.96	142.29	160.19	178.09
High-sales	50.26	53.18	56.10	92.63	97.4	102.17	142.25	150.2	158.15
Large	61.80	68.22	74.64	112.24	120.00	127.76	166.01	180.90	195.79
Very large	66.69	79.65	92.61	109.17	127.98	146.79	162.21	191.04	219.87

[1]North Central = Northern Crescent and Heartland production resource regions.

[2]Southeast = Eastern Uplands, Southern Seaboard, and Mississippi Portal production resource regions.

[3]Low-cost = The 25 percent of producers with the lowest operating and ownership costs.

[4]Mid-cost = The 50 percent of producers in the midrange of operating and ownership costs.

[5]High-cost = The 25 percent of producers with the highest operating and ownership costs.

[6]Residential = Small family farms that include limited-resource, retirement, and residential/lifestyle farms.

Source: 1998 USDA Agricultural Resource Management Study.

Appendix table 6—Statistical reliability of wheat production costs per bushel

Item	Operating costs			Operating and ownership costs			Total costs		
	Lower	Mean	Upper	Lower	Mean	Upper	Lower	Mean	Upper
	Dollars per bushel								
All ARMS wheat farms	1.37	1.43	1.49	2.47	2.56	2.65	3.85	3.97	4.09
Region									
Prairie Gateway	1.16	1.26	1.36	2.19	2.37	2.55	3.37	3.63	3.89
Northern Great Plains	1.43	1.50	1.57	2.66	2.80	2.94	4.12	4.31	4.50
Fruitful Rim	1.54	1.68	1.82	2.50	2.68	2.86	3.94	4.25	4.56
Basin and Range	1.28	1.37	1.46	2.29	2.47	2.65	3.45	3.79	4.13
North Central[1]	1.32	1.47	1.62	2.08	2.28	2.48	3.57	3.97	4.37
Southeast[2]	1.81	2.03	2.25	2.85	3.12	3.39	4.06	4.54	5.02
Costs group									
Low-cost[3]	0.80	0.84	0.88	1.45	1.51	1.57	2.39	2.49	2.59
Mid-cost[4]	1.42	1.45	1.48	2.48	2.53	2.58	3.83	3.93	4.03
High-cost[5]	2.62	2.89	3.16	5.06	5.43	5.80	7.55	8.06	8.57
Enterprise size group									
Fewer than 50 acres	1.33	1.47	1.61	1.94	2.39	2.84	3.17	4.19	5.21
50-199 acres	1.36	1.50	1.64	2.50	2.66	2.82	4.16	4.41	4.66
200-399 acres	1.43	1.57	1.71	2.47	2.78	3.09	3.95	4.36	4.77
400-799 acres	1.35	1.43	1.51	2.41	2.56	2.71	3.71	3.96	4.21
800 acres or more	1.24	1.37	1.50	2.30	2.47	2.64	3.49	3.75	4.01
Farm typology									
Residential[6]	1.41	1.63	1.85	2.22	2.66	3.10	3.62	4.34	5.06
Low-sales	1.33	1.57	1.81	2.56	3.01	3.46	4.16	4.83	5.50
High-sales	1.25	1.35	1.45	2.34	2.47	2.60	3.60	3.81	4.02
Large	1.35	1.49	1.63	2.36	2.61	2.86	3.51	3.94	4.37
Very large	1.39	1.57	1.75	2.30	2.52	2.74	3.44	3.77	4.10

[1]North Central = Northern Crescent and Heartland production resource regions.

[2]Southeast = Eastern Uplands, Southern Seaboard, and Mississippi Portal production resource regions.

[3]Low-cost = The 25 percent of producers with the lowest operating and ownership costs.

[4]Mid-cost = The 50 percent of producers in the midrange of operating and ownership costs.

[5]High-cost = The 25 percent of producers with the highest operating and ownership costs.

[6]Residential = Small family farms that include limited-resource, retirement, and residential/lifestyle farms.

Source: 1998 USDA Agricultural Resource Management Study.