

Overview of Wheat Farming

Wheat is raised commercially in nearly every State, but the Great Plains (from Texas to Montana) usually accounts for at least two-thirds of total production, with Kansas as the leader (fig.1). Wheat grown in the United States is either “winter wheat” or “spring wheat” depending on the season it is planted. Winter wheat varieties are sown in the fall and make some preliminary growth before cold weather arrives. The plants lie dormant through the winter. In the spring, they resume growth and grow rapidly until summer harvest. Winter wheat usually accounts for about two-thirds of U.S. production. Spring wheat varieties are planted in the spring, when the ground is workable, and grow continuously until harvest in July-August.

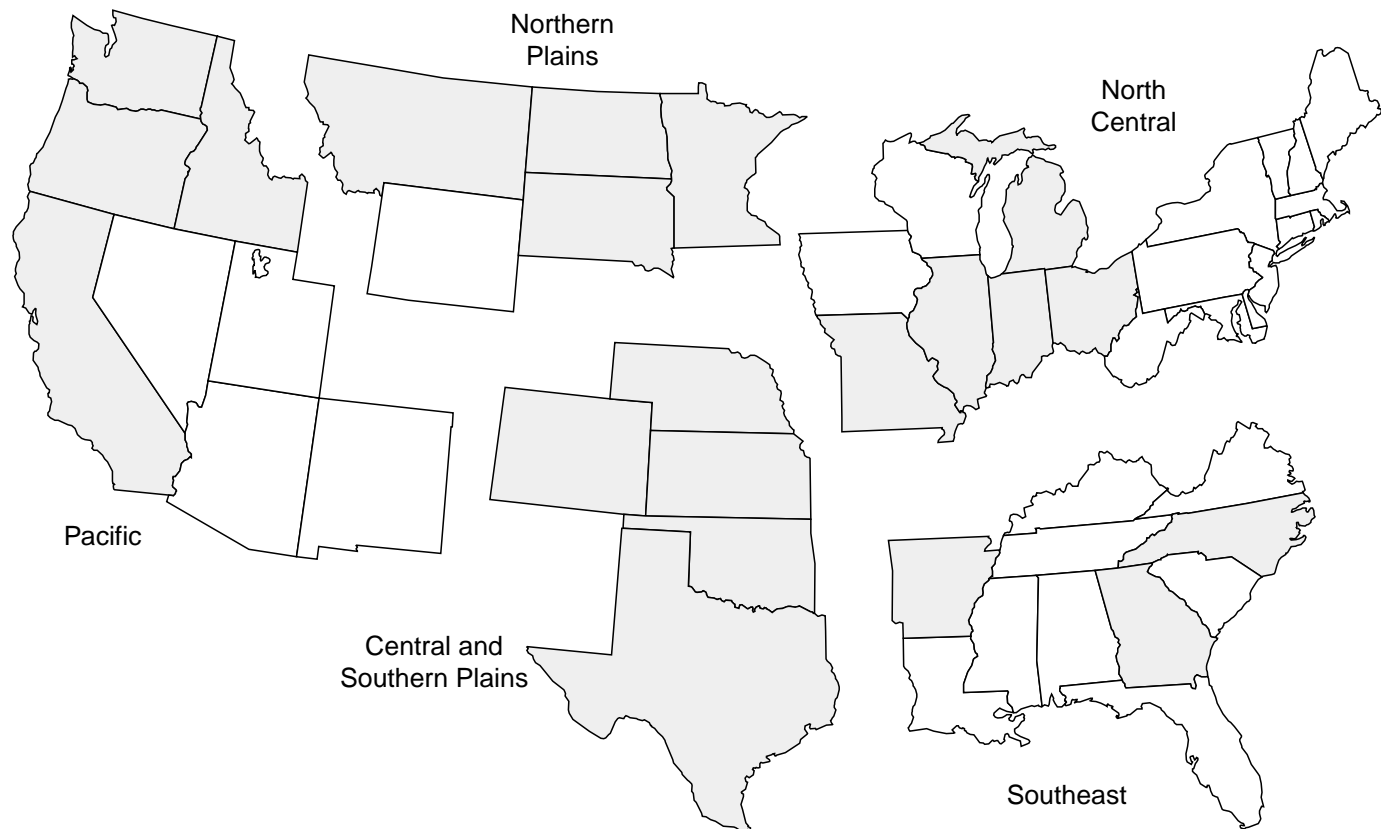
All the many varieties of wheat can be grouped into six basic classes. Each class of wheat is recognized not only by the time of year it is planted but also by

the hardness, color, and shape of the wheat kernel. Each class has its own characteristics, especially as related to milling and baking or other food use. They are Hard Red Winter (HRW), Soft Red Winter (SRW), Hard Red Spring (HRS), Hard White (HW), Soft White (SW), and Durum wheat (see Glossary for details).

HRW is the dominant class in U.S. wheat exports and normally accounts for about 40 percent of total U.S. wheat production. HRW is produced in the Great Plains States and used in a wide variety of products, in particular bread and rolls. HRS is dominant among spring wheat classes (Durum and White Spring wheat) and contains the highest percentage of protein, making it an excellent bread wheat with superior milling and baking characteristics. HRS is produced in Montana, North Dakota, South Dakota, and Minnesota and accounts for almost one-fourth of total U.S. wheat production.

Figure 1

U.S. Department of Agriculture's wheat cost of production regions



In 1994, U.S. farmers planted wheat on 70.3 million acres and produced 2,321 million bushels, down 3.1 percent from 1993. The average yield per harvested acre was 37.6 bushels, down 1.8 percent from 1993. Area harvested for grain was estimated at 61.8 million acres, slightly less than the previous year (USDA, NASS, 1995b). Wheat had a farm value of \$8 billion that year and about 50 percent of the wheat crop was exported.

Regional Differences in Wheat Production

Two factors dominate any economic analysis of wheat production: location and production practices. The region where the wheat is grown determines the class of wheat produced and reflects conditions affecting yields. Growers' choices of production practices reflect the technology chosen for the operation and affect capital costs and efficiency of field operations. Because of the importance of these two factors, the characteristics of the farms surveyed and the production practices that the surveyed farmers reported on their operations will be presented first.

The most important region in terms of wheat production was the Central and Southern Plains, followed by the Northern Plains (fig. 2). Together these two regions account for about two-thirds of total U.S. wheat production. The region with the least wheat was the Southeast, accounting for less than 5 percent of the total U.S. wheat crop. Of the total

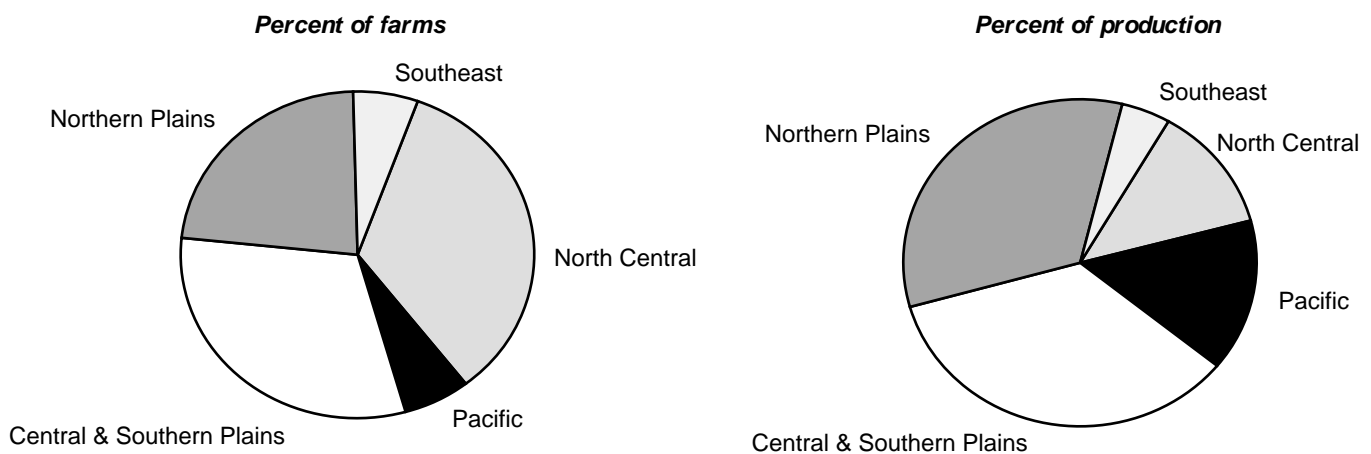
wheat farms surveyed in 1994, about one-third were in the Central and Southern Plains and another third were in the North Central region. One-fourth of the wheat farms surveyed were in the Northern Plains; the Southeast and the Pacific had the smallest percentages of wheat farms surveyed. The Plains regions together accounted for 81 percent of wheat acreage; the Pacific and the North Central each had about 8 percent. The Southeast region had the smallest percentage of wheat acreage.

Average Yields

Nationally, wheat yields averaged 33 bushels per planted acre in 1994,¹ ranging from 28 bushels per acre in the Northern Plains to 60 bushels in the Pacific. Wheat farms in the Pacific reported 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.

¹Yields reported in this analysis do not correspond to official USDA wheat yields as reported by the National Agricultural Statistics Service for two primary reasons: this analysis reports yields per planted acre rather than per harvested acre; and yields in this analysis are based on this particular survey sample, which is not the same sample used for the official USDA yields. The 1994 Farm Costs and Returns Survey was also based on fewer States than USDA's official estimates, which include all major States.

Figure 2
Geographic share of wheat farms and production, 1994



Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

Expected Yields

Actual yields were generally lower in 1994 than growers expected (fig. 3). Wheat growers expected 40 bushels, but harvested 33 bushels of wheat per acre. Regionally, yields in the Plains regions were 7 to 8 bushels below expectations (28 actual bushels versus 36 expected bushels in the Central and Southern Plains, and 28 actual versus 35 expected in the Northern Plains). In the Southeast, growers harvested 47 bushels, slightly above the expected amount, while the North Central growers harvested 53 bushels, the same as their expected amount. Yields in the Pacific were less than 5 bushels short of their expected amount (see Glossary for explanation of “expected yield”).

Production Specialty

A useful measure of the importance of wheat to the operation is its production specialty (table 1). Nearly one-third of farms with wheat also raised some livestock, primarily beef cattle. On average, about 60 percent of U.S. wheat farms specialized in cash grain production.² Most wheat farms in the Central and Southern Plains and North Central regions specialized in cash grains (67 percent), followed by the Northern

Plains (57 percent). Most alternative crops to wheat in these three regions are also cash grains, so one expects most crops to be cash grains. Only 40 percent of the Pacific and Southeast wheat farms specialized in the production of cash grains. Also these regions reported a similar percentage of farms specializing in other crops.³ The Northern Plains had the largest share of wheat farms specializing in livestock production, and the North Central region had the next largest share. Beef cattle were raised on 35 to 52 percent of wheat farms, followed by hogs and dairy (table 1). Wheat farms in the Plains regions had large inventories of beef cattle, while farms in the North Central region had large inventories of hogs. Dairy inventories were reported more often on the North Central and Northern Plains wheat farms than on other regions’ farms.

Land Use and Tenure

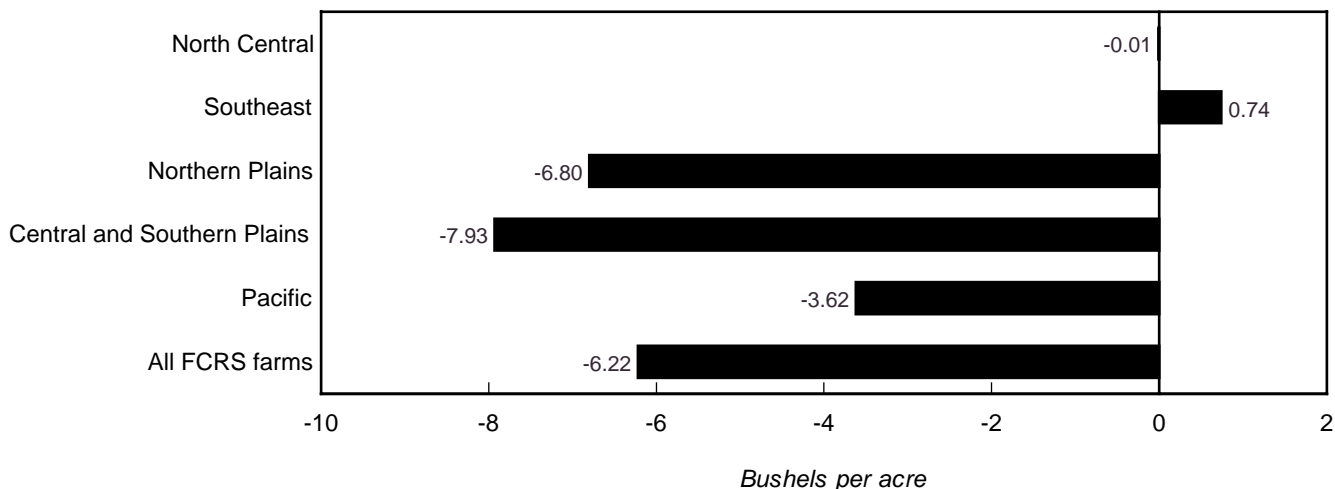
Farm size and land tenure arrangements can influence planning horizons and investment in soil-conserving practices. Small farm size is frequently associated with low-volume production, increased per-unit costs, and low net farm income (Miller et al., 1981). Full-owner operators and landowners with small holdings

²Cash grains include corn, sorghum, small grains, flax, soybeans, cowpeas, beans, peas, and rice.

³Other crops include cotton, tobacco, peanuts, potatoes, sunflowers, sweet potatoes, sugar cane, popcorn, sugarbeets, mint, hops, seed crops, broomcorn, hay, silage, and forage.

Figure 3

Difference between actual and expected yields, 1994



Source: U.S. Department of Agriculture’s 1994 Farm Costs and Returns Survey.

Table 1—Characteristics of wheat farms, by region, 1994

Item	Unit	North Central	Southeast	Northern Plains	Central and Southern Plains	Pacific	All FCRS farms
FCRS wheat farms	<i>Number</i>	90,037	15,763	60,915	82,300	16,230	265,245
FCRS share--							
Wheat acreage	<i>Percent</i>	8	*	40	41	8	100
Wheat production	<i>Percent</i>	13	*	33	35	15	100
Size:							
Operated	<i>Acres</i>	542	653	1,608	1,260	1,284	1,062
Planted wheat	<i>Acres</i>	49	114	370	281	293	214
Harvested wheat	<i>Acres</i>	48	109	362	252	292	202
Sales class:							
\$49,999 or less	<i>Percent of farms</i>	36	17	35	40	26	35
\$50,000-\$99,999	<i>Percent of farms</i>	17	11	24	20	16	19
\$100,000-\$499,999	<i>Percent of farms</i>	42	58	39	38	44	41
\$500,000 or more	<i>Percent of farms</i>	5	14	*	*	14	5
Value of production:							
Wheat production value	<i>Dollars per farm</i>	7,616	16,883	35,835	25,724	63,336	23,675
Farm production value	<i>Dollars per farm</i>	197,795	366,054	117,402	111,675	398,810	174,910
Wheat tenure:							
Owned	<i>Percent of acres</i>	50	31	44	34	33	39
Cash-rented	<i>Percent of acres</i>	24	46	37	16	10	25
Share-rented	<i>Percent of acres</i>	26	23	19	50	57	35
Production practices:							
Winter wheat	<i>Percent of acres</i>	100	100	13	100	86	64
Spring wheat	<i>Percent of acres</i>	0	0	87	0	14	36
Irrigated	<i>Percent of acres</i>	0	0	0	5	25	*
Double-cropped	<i>Percent of acres</i>	21	78	0	*	*	6
Fallow	<i>Percent of acres</i>	*	5	33	31	53	31
Straw	<i>Percent of acres</i>	36	7	*	*	9	6
Grazing	<i>Percent of acres</i>	0	0	0	20	*	9
Previous crop:							
Barley/oats	<i>Percent of farms</i>	10	*	10	0	13	7
Corn	<i>Percent of farms</i>	14	29	15	*	*	11
Soybeans	<i>Percent of farms</i>	68	37	19	8	0	32
Wheat	<i>Percent of farms</i>	0	*	12	46	10	18
Fallow	<i>Percent of farms</i>	3	5	28	30	35	19
Crop rotation:							
Continuous wheat	<i>Percent of farms</i>	0	0	9	38	*	14
Fallow-wheat	<i>Percent of farms</i>	0	0	17	21	20	12
Fallow-other	<i>Percent of farms</i>	3	5	9	5	5	5
Corn-soybeans	<i>Percent of farms</i>	6	14	*	*	0	*
Corn-other	<i>Percent of farms</i>	8	16	11	*	*	7
Soybeans-soybeans	<i>Percent of farms</i>	17	16	*	*	0	7
Soybeans-corn	<i>Percent of farms</i>	45	*	10	0	0	18
Production specialty:							
Cash grains	<i>Percent of farms</i>	67	37	57	67	39	61
Other crops	<i>Percent of farms</i>	0	44	*	9	33	8
Livestock	<i>Percent of farms</i>	33	17	43	24	16	30
Livestock:							
Hogs	<i>Percent of farms</i>	30	19	13	*	*	16
Beef cattle	<i>Percent of farms</i>	48	35	52	50	39	48
Dairy cattle	<i>Percent of farms</i>	20	6	10	*	*	10
Wheat for farm use	<i>Percent</i>	6	*	*	*	*	*
Participated in wheat program	<i>Percent of farms</i>	57	45	81	84	69	71
Operator characteristics:							
Individual farm organization	<i>Percent of farms</i>	82	81	85	92	72	85
Partnership	<i>Percent of farms</i>	11	15	13	*	20	10
Farming as major occupation	<i>Percent of farms</i>	84	86	92	79	92	85
Under 50 years of age	<i>Percent of farms</i>	43	49	44	46	44	44
Completed college	<i>Percent of farms</i>	31	40	35	58	66	43

* = 0.1 to less than 5 percent. Totals may not add to 100 percent due to omission of a category or rounding error.

Estimated t-statistics are in the appendix.

Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

have been shown to use minimum tillage less often than other landownership groups (Lee and Stewart, 1983). The recent study by Soule et al. indicated (1999) that cash renters were significantly less likely than owner-operators to use conservation tillage, while share renters behaved much like owner-operators in their use of conservation tillage practices.

The average size of all FCRS wheat farms surveyed in 1994 was 1,062 acres, of which 50 percent was cropland (table 2). Farmers owned half the land they operated. The remainder was rented equally on a cash- and share-rent basis where landlords may be sharing input costs. On average, one-third of the cropland was harvested for wheat. Other crops harvested on farms producing wheat were, chiefly, corn, soybeans, and hay.

Double-Cropping and Fallow

Two other production practices that showed wide variation among regions were summer fallow and double-cropping. Much U.S. wheat is grown in moisture-deficient areas. One of the most common moisture-conserving practices is summer fallow. About 20 percent of wheat farms reported using summer fallow, accounting for one-third of the total wheat acreage. Pacific wheat growers planted 53 percent of their wheat on previously fallowed land,

compared with 31 to 33 percent in the Plains regions. Less than 5 percent of wheat was planted on previously fallowed land in the eastern regions, where double-cropping was more common. In the Southeast, 78 percent of the wheat was double-cropped, usually with soybeans. In the North Central region, 21 percent of the wheat was double-cropped. Less than 5 percent of wheat acres were double-cropped in the Central and Southern Plains and Pacific regions. No double-cropping was reported by farmers in the Northern Plains.

Irrigation

Wheat is especially adaptable to extreme weather conditions, but yields generally improve if irrigation is used. Areas that commonly use irrigation showed higher wheat yields than predominantly dryland areas. In most parts of the country, however, irrigation is a relatively high-cost practice to incorporate into a farm's production plan. 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 FCRS wheat acreage was irrigated. The Pacific region had a large percentage of wheat acres under irrigation (25 percent). Some irrigation was reported in the Central and Southern Plains (5 percent of wheat acres).

Table 2—Land use on wheat farms, by region, 1994

Item	North Central	Southeast	Notthern Plains	Central and Southern Plains	Pacific	All FCRS farms
<i>Acres</i>						
Operated acres	542	653	1,608	1,260	1,284	1,062
Harvested cropland	483	561	845	494	580	580
<i>Percent</i>						
Land tenure:						
Owned	47	34	62	40	36	47
Cash rent	29	38	26	30	18	28
Share rent	24	28	12	32	46	25
Crops harvested:						
Wheat	10	19	43	51	51	35
Corn	38	9	10	14	*	19
Soybeans	35	37	7	*	*	16
All hay	6	*	18	10	15	12
Cotton	7	7	*	9	*	*
Rice	*	12	*	*	*	*
Sorghum	*	*	*	11	*	*
Sunflowers	*	*	7	*	*	*
Barley	*	*	7	*	11	*
Others	8	8	*	*	13	*

* = 0.1 to less than 5 percent. Totals may not add to 100 percent due to omission of a category or rounding error.

Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

Fertilizer and Chemical Use

Most surveyed wheat farms applied nitrogen. Sixty-seven percent of the farms applied phosphorus, while 40 percent used potassium. Wheat growers, on average, applied 57 pounds of nitrogen, 22 pounds of phosphorus, and 8 pounds of potassium per acre. The quantity of nitrogen applied varied among regions, ranging from 50 pounds per acre in the Northern Plains to 85 pounds per acre in the North Central region. Fertilizers were generally applied at higher rates in the eastern regions because of double-cropping and the large amount of wheat acreage harvested for straw. Eastern growers also applied more manure than growers in other regions. Heavy fertilizer applications were reported in the Pacific due to irrigation. The Central and Southern Plains had the lowest fertilizer use among regions. Fertilizer application rates were based on rates per planted acre and averaged over all acres planted to wheat, regardless of whether all acres received treatment. Others often report fertilizer application rates only for acres that actually received treatment (USDA, ERS, 1997b). For this reason and the fact that the samples may differ, application rates for some fertilizers (like potash) may differ since potash is needed only for some fields, and the carryover effect of potash requires it to be applied only every 2 to 3 years.

Generally, wheat is one of the least chemical-intensive crops (USDA, NASS, ERS, 1995). In 1994, herbicides were applied on 43 percent of the wheat farms. Regions that had spring wheats, including Durum, received more herbicide treatments because of more intense weed pressure. More than 85 percent of the wheat farms in the Northern Plains and Pacific regions applied herbicides to their wheat crop, compared with about 20 percent in the North Central region. Thirty-eight percent of the wheat farms in the Central and Southern Plains and Southeast treated wheat with herbicides. North Central growers used considerably fewer chemicals than growers in other regions.

The most widely used herbicide on wheat land was MCPA, followed by 2,4-D and Glyphosate. However, the type of herbicide used on wheat acreage varied among regions. The most widely used herbicide was Chlorosulfuron in the Central and Southern Plains, MCPA in the Northern Plains and in the Pacific, 2,4-D in the North Central, and Harmony in the Southeast

Top five herbicides used on regional wheat acreage

North Central:	2,4-D, Harmony, Glyphosate, MCPA, and Landmaster
Southeast:	Harmony, 2,4-D, Karmex, Hoelon, and Glyphosate
Northern Plains:	MCPA, 2,4-D, Glyphosate, Banvel, and Harmony
Central and Southern Plains:	Chlorosulfuron, 2,4-D, Metribuzin, Glyphosate, and MCPA
Pacific:	MCPA, Glyphosate, Harmony, Metribuzin, and 2,4-D
All FCRS wheat farms:	MCPA, 2,4-D, Glyphosate, Banvel, and Harmony

(see the Top five herbicides used on regional wheat acreage box).

Less than 5 percent of surveyed farms used insecticides and fungicides on wheat. Regionally, insecticide and fungicide use was relatively higher in the Southeast, followed by the Pacific and Central and Southern Plains regions. Among insecticides, Methomyl was widely used, followed by Chlorpyrifos, Dimethoate, and Parathion. Tilt was the most commonly used fungicide on the 1994 wheat crop.

Field operations. Typically, a farm's cost effectiveness in producing wheat will be heavily affected by the choice and number of field operations. For this analysis, each field operation was measured in times over (field passes), which is the acreage covered in the operation divided by the total acreage planted to wheat (table 3). The total times over required for all field operations was lower in the eastern regions (North Central and Southeast) than in other regions. The Pacific had the highest times over due to more harrowing and fertilizer or chemical applications than in other regions. Tillage accounted for 50 percent of

the times over for all field operations. Most differences between one region and another were in plowing, disking, and harrowing operations.

Tillage ranges from preparing the seedbed to plowing and cultivating. Tillage systems may be used for many reasons, such as incorporating residues and

fertilizers; improving soil physical properties to control soil erosion, reduce water loss, or to control insects, diseases, and weeds; and enhancing seed placement. The type of tillage system employed in the production of wheat influences the levels of chemicals, fertilizers, fuel, and labor (see the 1994 FCRS of U.S. Wheat Farming box for details). Variation in the type

Table 3—Field operations in wheat production, by region, 1994¹

Item	North Central	Southeast	Nothern Plains	Central and Southern Plains	Pacific	All FCRS farms
	<i>Times-over</i>					
All field operations	5.44	5.36	7.20	6.96	7.88	6.97
Tillage:						
Plowing	0.08	0.40	1.13	1.80	0.79	1.27
Disking	0.72	1.06	0.23	1.24	0.80	0.75
Cultivation	0.18	0.25	0.99	0.76	0.78	0.79
Harrowing	0.16	0.21	0.40	0.52	1.82	0.54
Other tillage ²	0.12	0.09	0	0.06	0.11	0.05
Fertilizer and chemical application	1.28	1.17	2.03	1.00	1.62	1.49
Seeding	0.99	0.94	0.98	0.94	0.94	0.96
Harvesting	0.92	0.87	1.22	0.58	0.91	0.90
Mowers and balers	0.43	0.10	0.07	0.01	0.03	0.07
Other implements	0.58	0.28	0.14	0.08	0.07	0.15

¹Excludes custom operations.

²Includes bedders, shapers, and packers.

Source: U.S. Department of Agriculture's 1994 Costs and Returns Survey.

1994 Farm Costs and Returns Survey of U.S. Wheat Farming

The 1994 FCRS of U.S. wheat farming reveals that production practices, such as crop rotation, fallow, and inputs varied greatly by region. Notable differences include:

- About 50 percent of U.S. wheat acres in 1994 were owned, with the remaining acres evenly split among cash- and share-rent.
- Spring wheat was more commonly grown in the Northern Plains, while winter wheat was more common in the Central and Southern Plains and the eastern regions.
- Wheat is seldom irrigated. The only region with enough samples to study was the Pacific region.
- Letting land lie fallow (no crop harvested in the previous 12 to 21 months) was a common rotation that helps conserve moisture.
- One-fourth of surveyed farms reported using some form of conservation tillage, most commonly in the Northern Plains, North Central, and Southeast.
- More than 80 percent of wheat growers in the Pacific region used custom operations, with custom fertilizer or chemical applications most common. Custom harvesting and hauling were also important in the Central and Southern Plains and the Pacific regions.

of tillage system used in producing spring wheat may be partly due to weather-soil relationships and the use of fallow in the areas producing spring wheat, while a gradual increase in no-till and conventional tillage without the moldboard plow has occurred in winter wheat production since 1988 (USDA, ERS, 1997b).

Conventional tillage without a moldboard plow was the most common practice for producing wheat (mainly chisel and disk). Twenty-eight percent of the wheat farms reported conservation tillage systems (table 4). Among regions, conservation tillage was most common in the Northern Plains and the North Central regions (36 percent), followed by the Southeast (26 percent). In the Pacific and Central and Southern Plains, about 15 percent of the wheat farms used conservation tillage. The type of conservation tillage practiced varied greatly among regions. A no-till system was common in the North Central, while a mulch-till system was common in other regions, particularly in the Northern Plains (fig. 4).

Custom operations. The decision to custom-hire some field operations depends on several factors, such as size of farm and machines, availability of capital and labor, importance of timely operations, and weather-related factors. The use of custom work influences wheat production costs by reducing the costs of operating and owning the machines and labor, while increasing the costs of custom operations. Sixty

percent of U.S. wheat farms used custom operations, with custom fertilizer or chemical applications the most common, followed by custom harvesting and land preparation (fig. 5). The percentage of farms reporting custom operations ranged from 83 percent in the Pacific region to 50 percent in the North Central. Between 60 and 75 percent of wheat farms used custom operations in the Southeast and Plains regions. Custom harvesting and hauling were most common in the Central and Southern Plains and Pacific regions (about 35 percent of the farms), followed by the Southeast (27 percent). The North Central region had the lowest percentage of farms using custom harvesting (13 percent). The Pacific region wheat farms also had more custom land preparation or cultivation than other regions.

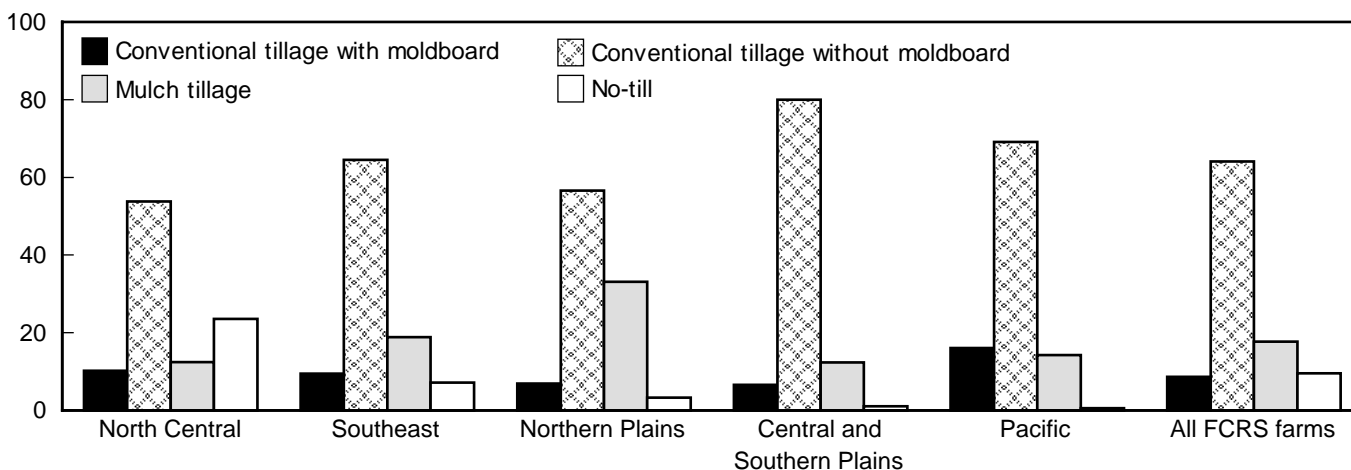
Size Distribution of Wheat Farms

Earlier analyses of farm businesses and commodity production indicate that the size of the wheat enterprise may affect the costs of producing wheat. Much has been written about economies of size in agriculture (Hallam, 1993). Costs have been shown to decline as the size of enterprise increases (Ahearn, 1993; Helmers et al., 1989; and Madden, 1967). There comes a point, however, when economies of size have been achieved and costs level off or begin to increase (Olson and Lohano, 1999; and Miller et al., 1981). Analysis of the size distribution of wheat farms will identify cost

Figure 4

Tillage system, by region, 1994

Percent



Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

Table 4—Input use of wheat production operations, by region, 1994

Item	Unit	North Central	Southeast	Northern Plains	Central and Southern Plains	Pacific	All FCRS farms
Wheat yield:							
Actual yield	<i>Bushels/acre</i>	53.44	47.03	27.85	28.46	59.96	33.40
Expected yield	<i>Bushels/acre</i>	53.45	46.79	34.65	36.39	63.58	39.62
Seed:							
Rate (one time)	<i>Bushels/acre</i>	2.02	2.07	1.59	1.10	1.40	1.42
Acres reseeded	<i>Percent of acres</i>	*	0	*	5	*	*
Home-grown seed	<i>Percent of seed</i>	29	19	54	49	23	45
Fertilizer use:							
Any fertilizer	<i>Percent of farms</i>	100	99	89	83	95	92
Nitrogen	<i>Percent of farms</i>	100	92	89	83	94	91
Phosphorus	<i>Percent of farms</i>	87	51	79	44	44	70
Potassium	<i>Percent of farms</i>	81	58	28	6	13	40
Manure	<i>Percent of farms</i>	*	11	10	*	*	5
Fertilizer application rate:							
Nitrogen	<i>Pounds/acre</i>	84.88	74.07	50.47	52.44	72.58	56.56
Phosphorus	<i>Pounds/acre</i>	58.99	27.10	22.48	15.31	12.89	21.75
Potassium	<i>Pounds/acre</i>	66.18	44.15	3.06	1.25	2.19	8.48
Manure	<i>Tons/acre</i>	0.11	0.24	0.05	0.01	0.09	0.05
Chemical use:							
Any chemicals	<i>Percent of farms</i>	19	46	85	38	94	46
Herbicides	<i>Percent of farms</i>	19	39	85	35	94	45
Insecticides/fungicides	<i>Percent of farms</i>	*	10	*	8	9	*
Herbicide	<i>Acre treatments</i>	0.18	0.55	1.23	0.36	1.27	0.77
Insecticides/fungicides	<i>Acre treatments</i>	0	0.17	0.01	0.09	0.01	0.05
Tillage system:							
Conventional with moldboard plow	<i>Percent of farms</i>	10	10	7	7	16	9
Conventional without moldboard plow	<i>Percent of farms</i>	54	65	57	80	69	64
Mulch tillage	<i>Percent of farms</i>	12	19	33	12	14	18
No-till	<i>Percent of farms</i>	24	7	*	*	*	10
Custom operations:							
Any custom operations	<i>Percent of farms</i>	50	75	57	70	83	61
Land preparation/cultivation	<i>Percent of farms</i>	*	7	21	14	33	13
Planting	<i>Percent of farms</i>	*	7	*	6	8	*
Fertilizer/chemical application	<i>Percent of farms</i>	44	67	44	50	70	49
Harvesting/hauling	<i>Percent of farms</i>	13	27	19	36	34	23
Fuel use:							
Diesel	<i>Gallons/acre</i>	2.99	4.17	4.13	5.41	7.82	4.87
Gasoline	<i>Gallons/acre</i>	2.73	2.43	2.42	2.58	2.80	2.55
LP gas	<i>Gallons/acre</i>	0	0.04	0.11	0.20	0.13	0.14
Natural gas	<i>1,000 cubic feet/acre</i>	0	0	0	0.59	0	0.24
Electricity	<i>Kilowatt hours/acre</i>	0	0	0	0.02	1.61	0.14
Labor use:							
Unpaid labor	<i>Hours/acre</i>	1.36	1.12	0.95	1.52	2.03	1.31
Paid labor	<i>Hours/acre</i>	0.43	0.63	0.25	0.34	1.13	0.39

* = 0.1 to less than 5 percent. Totals may not add to 100 percent due to omission of a category or rounding error.

Estimated t-statistics are in the appendix.

Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

differences (and sources of cost variation) among producers.

Four size classes were developed according to planted wheat acreage: fewer than 50 acres, 50 to 199 acres, 200 to 399 acres, and 400 or more acres. Three-fourths of FCRS farms had fewer than 200 wheat acres, but these farms accounted for only one-fourth of total wheat acreage and production (table 5). The highest number of wheat farms was in the group with

fewer than 50 wheat acres (42 percent). Roughly two-thirds of production and acreage came from the 17 percent of farms with 400 wheat acres or more (fig. 6).

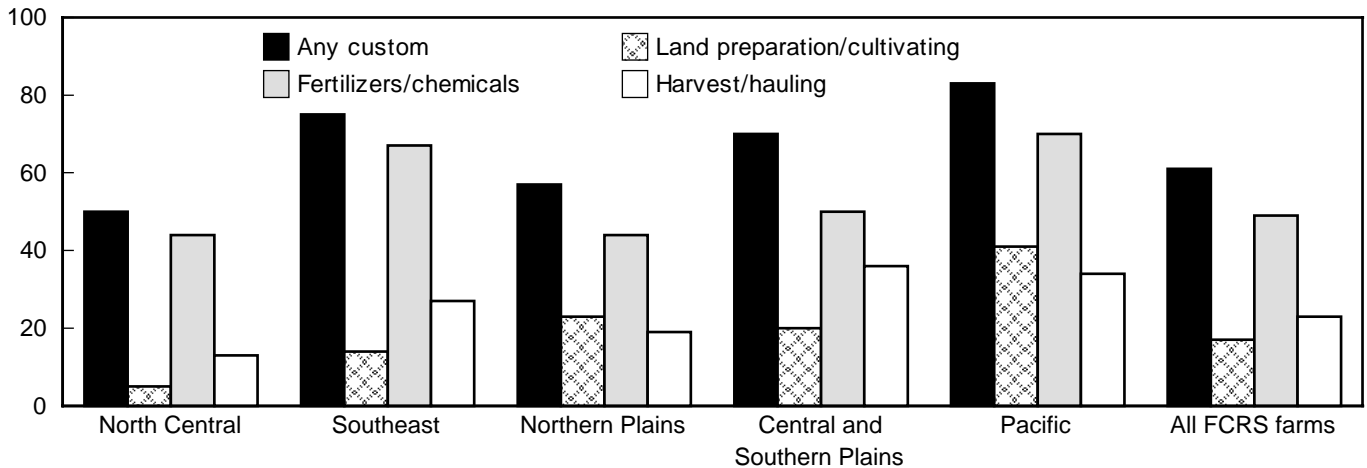
Several characteristics varied according to enterprise size:

Wheat sales — On the smallest farms, wheat contributed 2 percent of the average farm value of production and 5 percent of total acreage. In contrast,

Figure 5

Farms using custom operations, by region, 1994

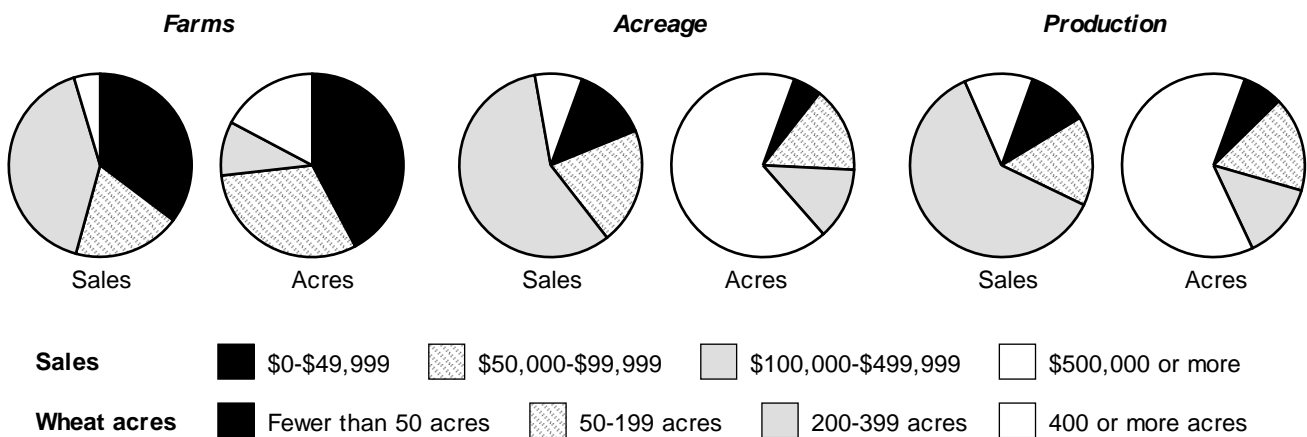
Percent of farms



Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

Figure 6

Share of wheat farms, acreage, and production, by size, 1994



Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

Table 5—Characteristics of wheat farms, by enterprise size, 1994

Item	Unit	Fewer than 50 wheat acres	50-199 wheat acres	200-399 wheat acres	400 or more wheat acres
FCRS wheat farms	<i>Number</i>	111,977	82,230	25,260	45,778
FCRS share of--					
Wheat acreage	<i>Percent</i>	5	15	13	67
Wheat production	<i>Percent</i>	7	17	14	63
Size:					
Operated	<i>Acres</i>	563	1,019	1,175	2,296
Planted wheat	<i>Acres</i>	26	104	285	830
Harvested wheat	<i>Acres</i>	24	96	268	792
Sales class:					
\$49,999 or less	<i>Percent of farms</i>	48	36	30	6
\$50,000-\$99,999	<i>Percent of farms</i>	14	23	23	21
\$100,000-\$499,999	<i>Percent of farms</i>	34	37	39	65
\$500,000 or more	<i>Percent of farms</i>	*	*	7	8
Value of production:					
Wheat production value	<i>Dollars per farm</i>	3,501	12,409	33,384	87,903
Farm production value	<i>Dollars per farm</i>	161,973	155,222	174,804	241,980
Wheat tenure:					
Owned	<i>Percent of acres</i>	64	47	36	36
Cash-rented	<i>Percent of acres</i>	19	22	21	28
Share-rented	<i>Percent of acres</i>	17	31	43	36
Production practices:					
Winter wheat	<i>Percent of acres</i>	84	73	75	58
Spring wheat	<i>Percent of acres</i>	16	27	25	42
Irrigated	<i>Percent of acres</i>	5	5	*	*
Double-cropped	<i>Percent of acres</i>	10	12	11	*
Fallow	<i>Percent of acres</i>	14	24	23	35
Straw	<i>Percent of acres</i>	34	16	*	*
Grazing	<i>Percent of acres</i>	*	8	10	9
Previous crop:					
Barley/oats	<i>Percent of farms</i>	*	*	*	*
Corn	<i>Percent of farms</i>	12	16	7	*
Soybeans	<i>Percent of farms</i>	46	29	24	5
Wheat	<i>Percent of farms</i>	5	17	29	40
Fallow	<i>Percent of farms</i>	13	19	26	27
Crop rotation:					
Continuous wheat	<i>Percent of farms</i>	*	14	22	35
Fallow-wheat	<i>Percent of farms</i>	7	9	22	23
Fallow-other	<i>Percent of farms</i>	5	8	*	*
Corn-soybeans	<i>Percent of farms</i>	*	6	*	*
Corn-other	<i>Percent of farms</i>	8	9	6	*
Soybeans-soybeans	<i>Percent of farms</i>	12	5	7	0
Soybeans-corn	<i>Percent of farms</i>	26	20	8	*
Production specialty:					
Cash grains	<i>Percent of farms</i>	56	51	77	82
Other crops	<i>Percent of farms</i>	8	10	6	*
Livestock	<i>Percent of farms</i>	35	37	17	14
Livestock:					
Hogs	<i>Percent of farms</i>	24	11	*	9
Beef cattle	<i>Percent of farms</i>	52	51	48	34
Dairy cattle	<i>Percent of farms</i>	18	6	*	*
Wheat for farm use	<i>Percent</i>	10	*	*	*
Participated in wheat program	<i>Percent of farms</i>	54	75	83	97
Operator characteristics:					
Individual farm organization	<i>Percent of farms</i>	88	85	89	77
Partnership	<i>Percent of farms</i>	7	14	*	15
Farming as major occupation	<i>Percent of farms</i>	82	83	92	91
Under 50 years of age	<i>Percent of farms</i>	47	37	43	51
Completed college	<i>Percent of farms</i>	38	37	42	65

* = 0.1 to less than 5 percent. Totals may not add to 100 percent due to omission of a category or rounding error.

Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

wheat contributed 36 percent of farm value of production and total acreage for the largest size group.

Tenure — Two-thirds of wheat acreage on the smallest farms was owned, compared with one-third owned on the largest farms. The proportion of wheat acreage share-rented also increased with size—from 17 percent on the smallest farms to more than 30 percent on large farms.

Previous crop — Wheat was grown before wheat by 40 percent of farms with more than 400 wheat acres, while soybeans was the most common crop grown prior to wheat by farms with fewer than 50 wheat acres.

Fallow — Thirty-five percent of wheat acres were previously fallowed on the largest farms, compared with 14 percent on the smallest farms.

Chemical use — One-third of the growers with fewer than 50 wheat acres applied herbicides versus three-fourths of growers with more than 400 wheat acres.

Custom — As size increased, custom operations, particularly land preparation or cultivation, fertilizer or chemical application, and harvesting, became more common.

Production costs — Relationships between production costs per acre and farm size were not as clear for wheat as they were in earlier studies of other crops such as corn (McBride, 1994a). Total economic costs decreased from \$181 per acre for farms with fewer than 50 wheat acres to \$151 per acre for those with 400 or more acres (table 6). However, farms with 50 to 199 and 200 to 399 wheat acres had similar costs averaging \$158 per acre.

For actual 1994 yields, farms with fewer than 50 wheat acres had the lowest production costs: \$3.88 per bushel compared with \$4.84 per bushel for farms with more than 400 acres. Note that although farms with 50 wheat acres or less had higher per-acre costs, their higher yields gave them the lowest per-bushel costs. When expected yields were used, both of the smallest acreage classes had per-bushel costs of \$3.62, the lowest for all classes. However, there was little difference among the classes using expected yields: \$3.75 per bushel for farms planting 200 to 399 acres of wheat and \$3.68 per bushel for farms planting 400 or more acres. These expected yield costs are slightly

understated, since there is no way to add in the additional harvesting expenses had farmers realized their expected yields.

Fertilizer expense was the single most important cost item in wheat production, followed by repairs and fuel. These cost items together accounted for an average of 60 to 67 percent of variable cash expenses in each size group. Fertilizer expense was negatively related to size, varying from \$25 per acre for farms with fewer than 50 acres of wheat to \$14 per acre for farms with 400 acres or more (fig. 7). This is because smaller farms are located in regions with good rainfall. Total variable and fixed cash expenses accounted for 78 percent of the gross value of production on the largest acreage, compared with 58 percent on the smallest acreage. While the gross value of production exceeded cash expenses for all size classes, high capital replacement and land charges caused residual returns to management and risk to be negative across all size groups (table 6). Residual returns per acre were less negative on small farms, however, than on large farms. This is due to a high straw/grazing value on smaller farms.

Regional and Size Differences in Costs

Regional differences in production practices, input use, and irrigation were reflected in farmers' cash costs. Total cash costs ranged from a low of \$70 per acre in the Northern Plains to \$147 in the Pacific. The highest costs, which were in the Pacific region, were due to irrigation-related expenses. Fertilizer, repairs, and fuel combined accounted for 58 to 70 percent of variable cash expenses across the regions (fig. 8). Input costs varied widely among regions, reflecting differences in acreage covered and application rates. Seed costs varied because of differences in seeding rates, replanting, and use of home-grown seed. Seeding rates were much higher in the Southeast. Although initial quantities of seed used for planting in the Southeast were higher, Southeast wheat growers did not report reseeding, but growers in the other regions did (table 4).

Total economic costs ranged from \$137 per acre in the Central and Southern Plains to \$271 per acre in the Pacific region (table 7). This wide range illustrates the differences in cash expenses, replacement costs, and allocated costs (such as land), which are a result of irrigation and other cropping practices and rental arrangements (fig. 9).

Table 6a—Wheat production cash costs and returns per planted acre, by enterprise size, 1994

Item	Wheat acres planted				All FCRS farms
	Fewer than 50 acres	50-199 acres	200-399 acres	400 or more acres	
<i>Dollars per planted acre</i>					
Gross value of production:					
Wheat grain	139.85	113.72	110.04	100.38	105.64
Wheat straw/grazing	29.61	8.03	2.80	2.19	4.55
Total, gross value of production	169.46	121.75	112.84	102.56	110.19
Cash expenses:					
Seed	11.98	9.10	7.01	6.83	7.46
Fertilizer	24.72	21.01	20.60	14.38	16.70
Chemicals	2.36	3.55	4.87	6.58	5.69
Custom operations	7.45	5.47	4.93	5.76	5.70
Fuel, lube, and electricity	7.80	6.91	10.01	8.70	8.55
Repairs	9.41	10.05	12.54	12.08	11.69
Hired labor	2.31	2.80	4.06	4.14	3.83
Purchased water and baling	1.62	0.78	0.16	0.21	0.36
Total, variable cash expenses	67.66	59.67	64.18	58.68	59.99
General farm overhead	8.87	7.01	5.49	4.70	5.36
Taxes and insurance	15.69	10.56	8.96	8.58	9.29
Interest	6.66	6.41	7.91	8.24	7.84
Total, fixed cash expenses	31.22	23.98	22.36	21.52	22.49
Total, cash expenses	98.88	83.65	86.54	80.20	82.48
Gross value of production less cash expenses	70.58	38.10	26.30	22.37	27.71
<i>Dollars per bushel</i>					
Harvest-period price	3.00	3.07	3.10	3.22	3.16
<i>Bushels per planted acre</i>					
Yield	46.63	37.03	35.54	31.17	33.40

Table 6b—Wheat production economic costs and returns per planted acre, by enterprise size, 1994

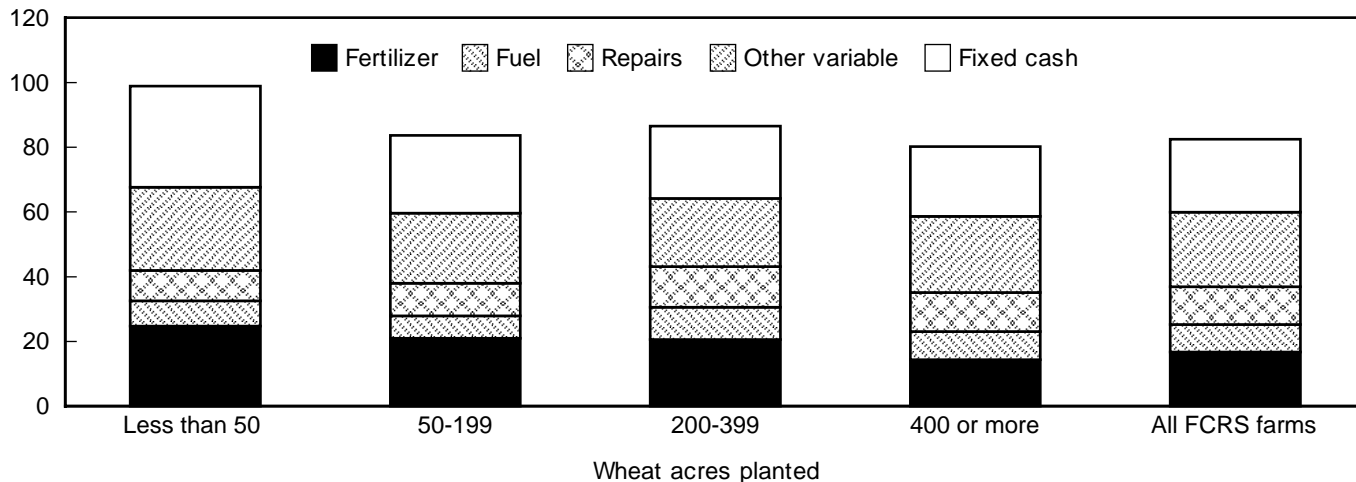
Item	Wheat acres planted				All FCRS farms
	Fewer than 50 acres	50-199 acres	200-399 acres	400 or more acres	
<i>Dollars per planted acre</i>					
Gross value of production:					
Wheat grain	139.85	113.72	110.04	100.38	105.64
Wheat straw/grazing	29.61	8.03	2.80	2.19	4.55
Total, gross value of production	169.46	121.75	112.84	102.56	110.19
Economic (full-ownership) costs:					
Variable cash expenses	67.66	59.67	64.18	58.68	59.99
General farm overhead	8.87	7.01	5.49	4.70	5.36
Taxes and insurance	15.69	10.56	8.96	8.58	9.29
Capital replacement	19.42	19.70	22.63	22.41	21.87
Operating capital	1.58	1.39	1.50	1.37	1.40
Other nonland capital	13.60	11.89	12.22	11.15	11.52
Land	39.83	37.67	34.02	37.06	36.91
Unpaid labor	14.31	10.66	9.10	7.02	8.20
Total, economic costs	180.96	158.54	158.11	150.95	154.54
Residual returns to management and risk	-11.50	-36.79	-45.27	-48.39	-44.35
<i>Dollars per bushel</i>					
Harvest-period price	3.00	3.07	3.10	3.22	3.16
<i>Bushels per planted acre</i>					
Yield	46.63	37.03	35.54	31.17	33.40

Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

Figure 7

Components of cash costs, by enterprise size, 1994

Dollars per planted acre

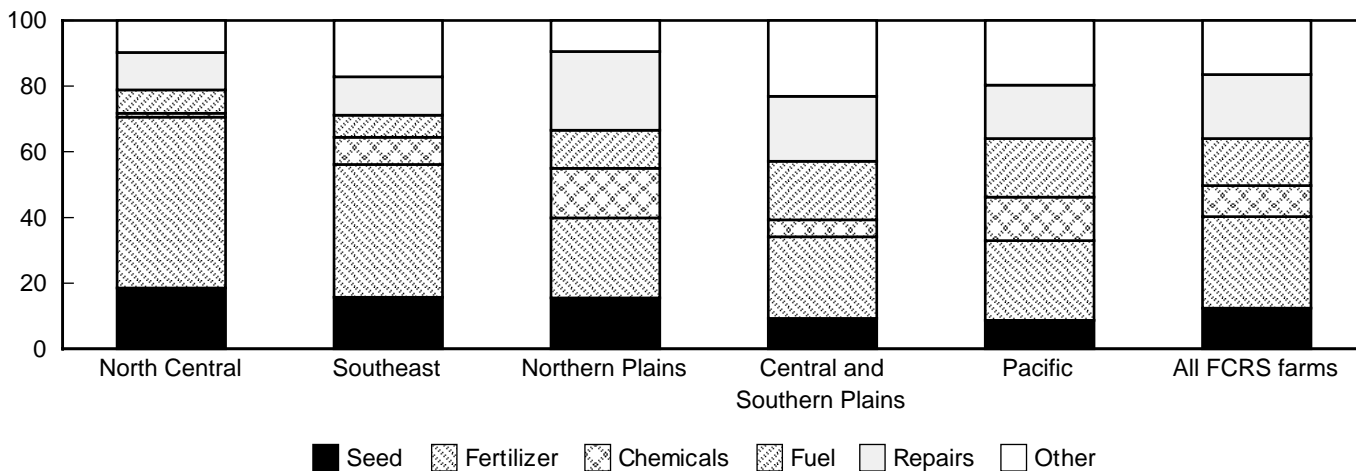


Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

Figure 8

Major components of variable cash expenses, by region, 1994

Percent



Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

On a per-bushel basis, cash costs varied greatly among regions, ranging from \$1.94 in the North Central region to \$2.67 in the Central and Southern Plains; the differences in per-bushel costs arise because of differences in yields. Economic costs ranged from \$3.24 in the Southeast to \$5.14 per bushel in the Northern Plains. Although the Plains growers had lower per-acre costs, compared with growers in the other regions, they had the highest per-bushel costs due to poor yields. Northern Plains producers reported

that yields were 25 percent less than expected at planting. Here again, it is important to look at costs based on expected yields for more understanding of the wheat industry from a long range perspective. There was little difference between total costs per expected and actual bushel in the North Central, Southeast, and Pacific regions. However, in the Northern Plains and Central and Southern Plains, expected per-bushel total costs were down 25 and 29 percent from actual per-bushel total costs, respectively.

Table 7a—Wheat production cash costs and returns per planted acre, by region, 1994

Item	North Central	Southeast	Nothern Plains	Central and Southern Plains	Pacific	All FCRS farms
<i>Dollars per planted acre</i>						
Gross value of production:						
Wheat grain	155.73	135.88	92.33	87.20	200.48	105.64
Wheat straw/grazing	27.25	4.97	0.60	4.56	1.95	4.55
Total, gross value of production	182.98	140.85	92.92	91.76	202.43	110.19
Cash expenses:						
Seed	13.42	12.78	7.83	5.09	9.62	7.46
Fertilizer	37.50	32.90	12.25	13.70	26.95	16.70
Chemicals	0.86	6.76	7.61	2.82	14.68	5.69
Custom operations	4.49	6.67	2.54	8.62	7.18	5.70
Fuel, lube, and electricity	5.15	5.52	5.82	9.80	19.79	8.55
Repairs	8.17	9.53	12.07	10.85	18.06	11.69
Hired labor	1.84	6.95	2.17	4.03	11.49	3.83
Purchased water and baling	0.73	0.30	0.03	0.06	3.11	0.36
Total, variable cash expenses	72.14	81.41	50.31	54.97	110.90	59.99
General farm overhead	8.13	3.91	4.18	5.22	9.67	5.36
Taxes and insurance	15.55	11.39	7.83	8.01	15.81	9.29
Interest	7.57	4.52	7.61	7.75	10.86	7.84
Total, fixed cash expenses	31.25	19.82	19.62	20.98	36.34	22.49
Total, cash expenses	103.41	101.22	69.93	75.95	147.23	82.48
Gross value of production less cash expenses	79.58	39.63	23.00	15.81	55.20	27.71
<i>Dollars per bushel</i>						
Harvest-period price	2.91	2.89	3.31	3.06	3.34	3.16
<i>Bushels per planted acre</i>						
Yield	53.44	47.03	27.85	28.46	59.96	33.40

Table 7b—Wheat production economic costs and returns per planted acre, by region, 1994

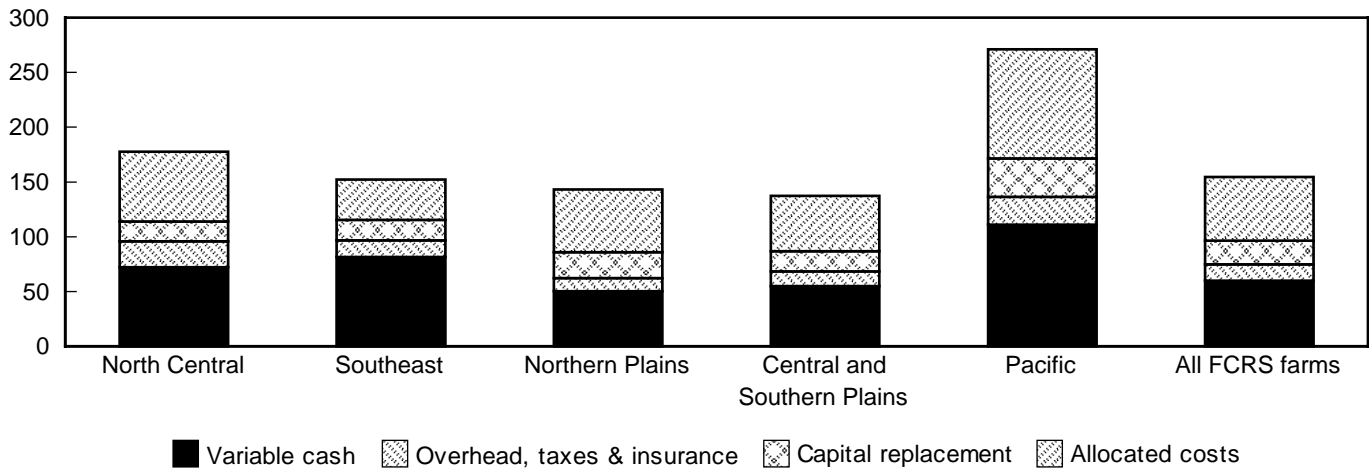
Item	North Central	Southeast	Nothern Plains	Central and Southern Plains	Pacific	All FCRS farms
<i>Dollars per planted acre</i>						
Gross value of production:						
Wheat grain	155.73	135.88	92.33	87.20	200.48	105.64
Wheat straw/grazing	27.25	4.97	0.60	4.56	1.95	4.55
Total, gross value of production	182.98	140.85	92.92	91.76	202.43	110.19
Economic (full-ownership) costs:						
Variable cash expenses	72.14	81.41	50.31	54.97	110.90	59.99
General farm overhead	8.13	3.91	4.18	5.22	9.67	5.36
Taxes and insurance	15.55	11.39	7.83	8.01	15.81	9.29
Capital replacement	18.19	18.60	23.41	18.63	35.02	21.87
Operating capital	1.68	1.90	1.17	1.28	2.58	1.40
Other nonland capital	10.39	10.37	13.14	9.62	14.60	11.52
Land	42.99	18.06	37.37	30.14	69.12	36.91
Unpaid labor	8.60	6.61	5.79	9.55	13.37	8.20
Total, economic costs	177.68	152.23	143.19	137.43	271.07	154.54
Residual returns to management and risk	5.30	-11.38	-50.27	-45.67	-68.64	-44.35
<i>Dollars per bushel</i>						
Harvest-period price	2.91	2.89	3.31	3.06	3.34	3.16
<i>Bushels per planted acre</i>						
Yield	53.44	47.03	27.85	28.46	59.96	33.40

Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

Figure 9

Components of economic costs, by region, 1994

Dollars per planted acre



Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

Analyzing per-bushel costs or returns for the 1994 wheat crop can describe conditions in that year, but 1994 yields were lower than expected for many wheat growers, particularly in the Northern Plains. In the 1994 survey, farm operators were also asked to give their expected yields, around which most planting decisions and early input applications were made. These expected or normal yields can be used to estimate per-bushel costs and returns and will give additional information better suited to indicate long-term conditions and trends.

On average, the value of wheat at harvesttime covered the cash costs in every region, while it covered cash costs plus capital replacement in all regions except the Central and Southern Plains. Total economic costs were covered only in the North Central region, giving this region's wheat growers positive returns to operator-supplied management and risk. Relatively

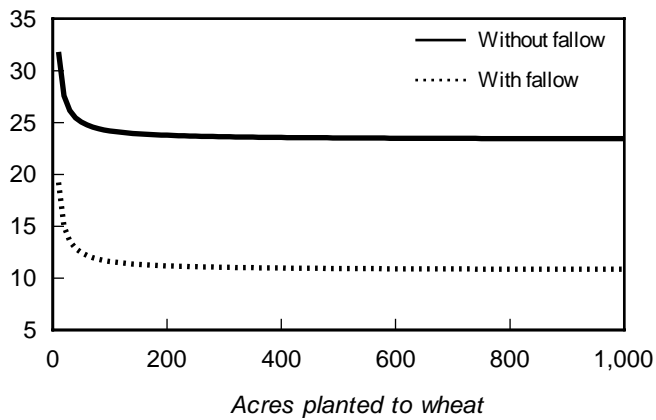
higher grain yields there and a large portion of wheat acreage harvested for straw, which has a high value as a secondary product, contributed to the positive returns.

Size-cost relationships indicate that most economies in use of fertilizers, fuels, hired labor, and custom services are realized at a relatively small wheat acreage (see the Estimated Relationship Between Size of Dryland Wheat Enterprise and ... box). The per-acre costs for these inputs level out at around 100 acres of wheat. Chemical costs, however, tend to increase until about 1,500 wheat acres. Machinery and repair costs follow the same pattern as chemicals, but total variable, fixed, and economic costs show that most economies have been obtained at 200 to 400 wheat acres. These cost-size relationships can, of course, vary among regions.

Estimated relationship between size of dryland wheat enterprise and . . .

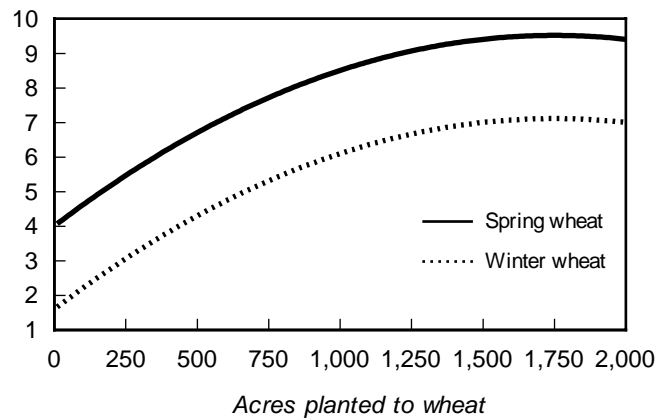
Fertilizer expenses

Dollars per acre



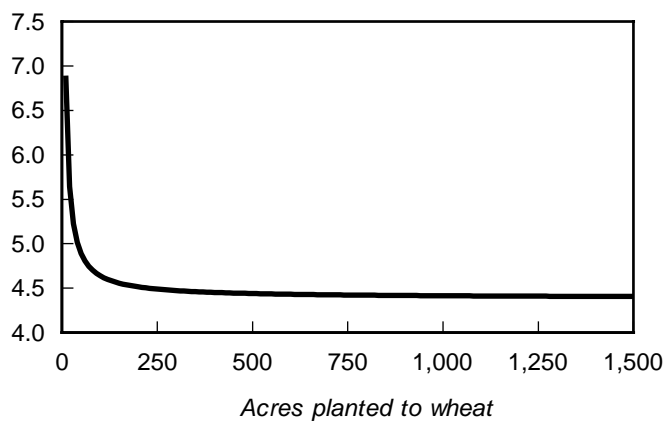
Chemical expenses

Dollars per acre



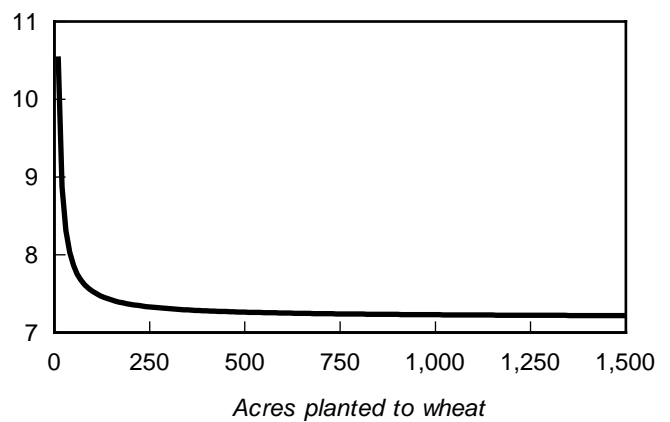
Fuel expenses

Dollars per acre



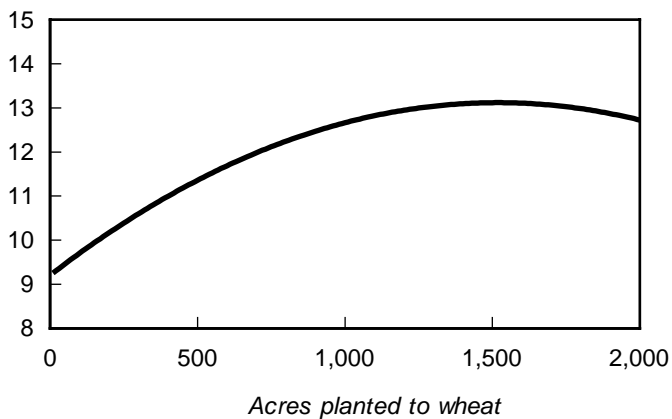
Custom expenses

Dollars per acre



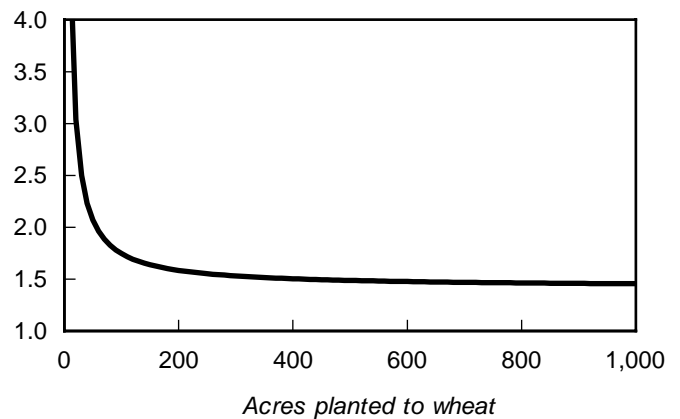
Repair expenses

Dollars per acre



Total labor hours

Hours per acre



Estimated relationship between size of dryland wheat enterprise and . . . (continued)

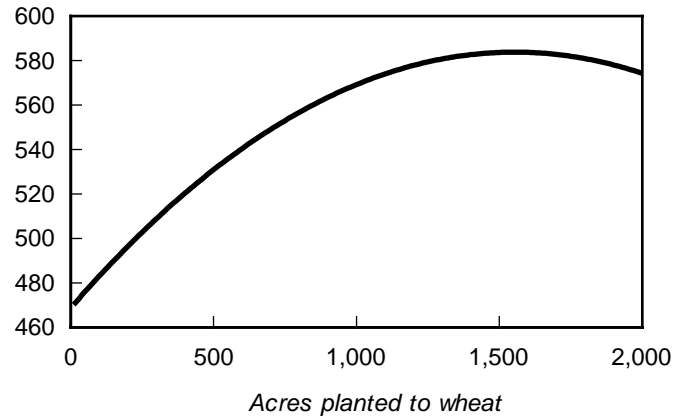
Horsepower of largest tractor

Horsepower



Machinery value

Dollars per acre



Variable cash expenses

Dollars per acre



Total cash expenses

Dollars per acre



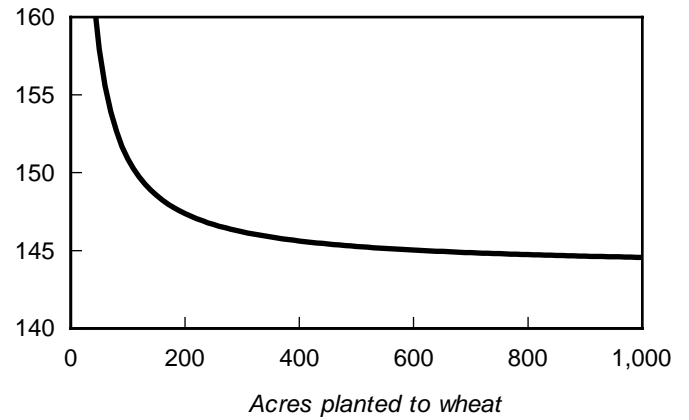
Ratio of fixed to cash expenses

Ratio



Economic costs

Dollars per acre



Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.