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Characteristics and Production Costs of U.S. Sugarbeet Farms

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Sugarbeet production costs varied considerably across farms and regions in the United States on both a per-acre and per-ton basis, according to a U.S. Department of Agriculture survey. Conducted in 2000, the survey asked about production and financial information relating to the 2000 sugarbeet crop. The average cost of producing a ton of sugarbeets in the U.S. was \$37.30 in 2000, ranging from \$15.40 to more than \$60. Yields, input use, irrigation, farm size, and farm location were the major factors affecting cost levels. The cost per ton of producing sugarbeets generally declined as farm size increased. Lower cost growers tended to be in the Red River Valley, which typically produces 50 percent of U.S. sugarbeets. Farms in the region tended to be larger than most (averaging 1,675 total acres with 329 acres of beets). Most high-cost and small family farms producing sugarbeets were in the Great Plains region. These farms tended to be less diversified than farms in other regions and contributed less to sugarbeet production. At the average price of \$34.20 per ton in 2000, 88 percent of U.S. sugarbeet producers were able to cover their operating costs, 74 percent were able to cover their operating and ownership costs, and 35 percent were able to cover their total (economic) costs.

Keywords: sugarbeet farms, costs of production, input use, production practices, farm characteristics, Agricultural Resource Management Survey.

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Overview

Sugarbeets and sugarcane are the two major raw-material sources of manufactured sugar. The United States is the world's fourth largest sugar producer, after Brazil, India, and the European Union. In 2000, U.S. sugar production was about 9 million tons, more than half from sugarbeets. Sugarbeet area grew significantly over the last decade. Growth can be tied primarily to an expanded capacity among sugarbeet factories. There are 26 beet-sugar processing factories in the United States. The U.S. plants are located in or near production areas to minimize transportation costs of hauling beets and deterioration of sugar content after the beets are harvested. In 2000, U.S. farmers planted sugarbeets on 1.56 million acres and produced 32.54 million tons of beets. The national sugarbeet price averaged \$34.20 per ton in 2000 (USDA, NASS, 2001).

Sugarbeets are a cool-weather crop grown most successfully in northern latitudes. But the crop can adapt to many soil and climatic conditions. Since its origin in central Europe in 1802, sugar production from sugarbeets has spread around the world. Sugarbeets were introduced into the United States in 1870, with the first processing plant built in California, followed by plants in Nebraska and Utah. In most of the U.S., the sugarbeet is a colder climate crop (Minnesota, North Dakota) but it also grows in hot climates, such as the Imperial Valley of California.

Sugarbeets are harvested for their roots. After sugar and molasses are extracted from roots, the remaining pulp is processed into a cattle feed. Sugarbeets are highly sensitive to insects, diseases, and weeds and therefore require continuous monitoring and management for control of these problems. Sugarbeets tend to be grown with other crops in 3-year to 5-year rotations. The rotation results in improved soil fertility, fewer problems with diseases, and improved yields and quality of beets.

Currently, sugarbeet production occurs in 12 States (5 geographic areas). One region is east of the Mississippi River; the other four regions are in the Red River Valley, the Great Plains, and Far Western portions of the country. The western regions practice irrigated sugarbeet production while the eastern regions practice dryland farming. Sugarbeet yields and production costs both tend to be higher in the West because of irrigation.

Sugarbeet production regions examined in this report are defined as: Great Lakes (Michigan and Ohio); Red River Valley (Minnesota and eastern North Dakota); Great Plains (Wyoming, Montana, western North Dakota, Colorado, and Nebraska); Northwest (Idaho, Oregon, and Washington); and Southwest (California) (fig. 1). The Southwest is excluded from discussions of the individual regions because of insufficient data.

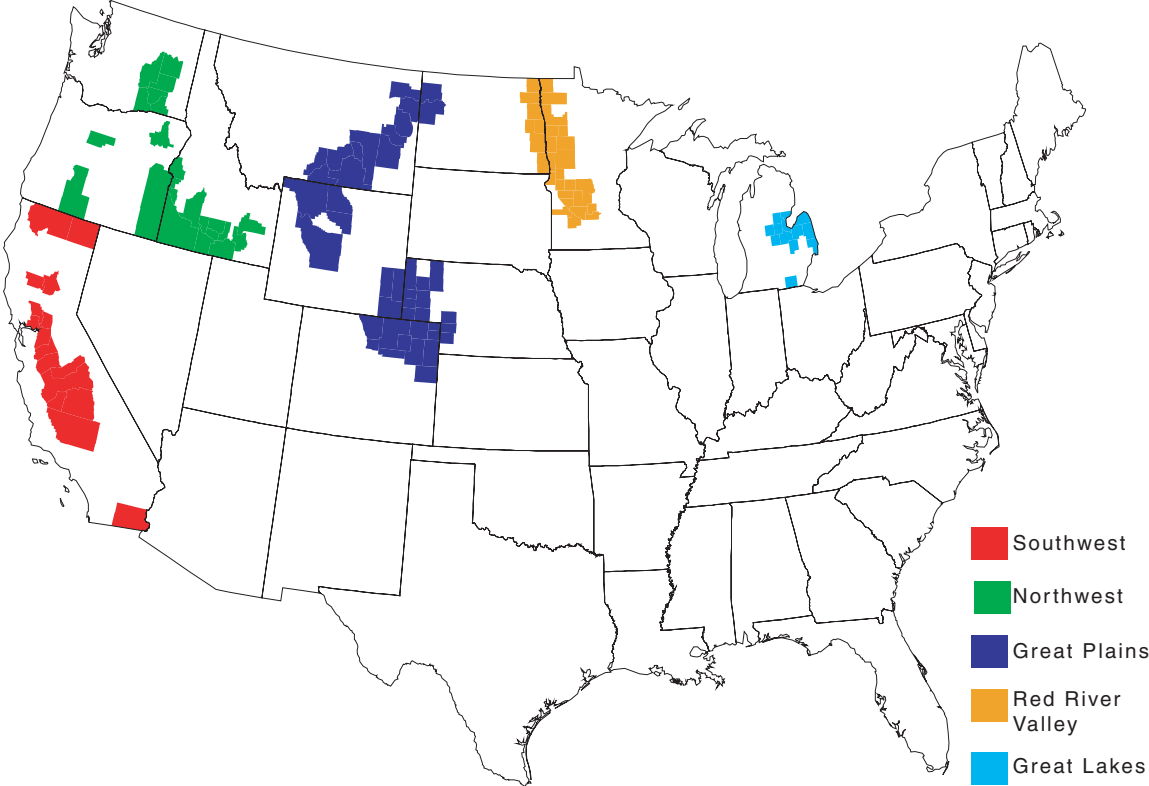
The Red River Valley region is the largest sugarbeet-growing region in the country. Area planted in this region has been growing through the 1990s and totaled 748,000 acres for 2000, or about 48 percent of total sugarbeet acreage. Over the last decade, Minnesota sugarbeet area increased by 121,000 acres while North Dakota area increased by 63,000 acres.

This report's objective is to analyze how costs of producing sugarbeets vary among U.S. farmers. For this purpose, farm characteristics and production practices are examined by grouping farmers according to their cost level for sugarbeet production, production region, enterprise size, and farm typology (see glossary). Data are from the 2000 Agricultural Resource Management Survey (ARMS) of U.S. sugarbeet farms, the only available source of such comprehensive nationwide farm-level information. The ARMS uses a multiframe-stratified sample in which each surveyed farm represents a number of similar farms. The 895 respondents to the sugarbeet version of the 2000 ARMS represented 5,577 sugarbeet farms, about 79 percent of those reported in the 1997 Census of Agriculture. According to the Census of Agriculture, the number of farms growing sugarbeets declined from 1992 to 1997 (8,810 to 7,102) but the average sugarbeet area harvested per farm increased (from 164 to 204 acres). On average, ARMS sugarbeet farms harvested 270 acres of sugarbeets per farm in 2000. They represented about 97 percent of the total U.S. planted beet acreage (USDA, NASS, 2000).

This report uses accounting methods recommended by the American Agricultural Economic Association Task Force on Commodity Costs and Returns (1998) to develop cost and return estimates for each sugarbeet farm surveyed in 2000 (see box on ERS Cost-of-Production and Return Accounts).

Figure 1

Sugarbeet production regions



Source: 2000 USDA Agricultural Resource Management Survey.

ERS Cost-of-Production and Return Accounts

ERS cost-of-production accounts include estimates of both cash and noncash costs. Cash costs are incurred when factors of production are purchased or rented. Noncash costs occur when factors are owned. For example, a farmer who fully owns the land used to produce a commodity (e.g., sugarbeet), has no cost for land rental or loans to pay for purchase of land. Yet, an economic cost arises. By owning the land and using it to grow sugarbeets, 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. Costs in the ERS accounts are estimated using methods recommended by the American Agricultural Association Task Force on Commodity Costs and Returns (1998).

Other relevant factors affecting cost and return estimates:

Production is valued at the seasonal average price, which may not represent exactly individual beet growers' returns. Farmers are paid by beet processors on the basis of extractable sucrose content of their sugarbeets and the level of impurities in the root plus a premium for early harvest.

Processors participating in the USDA sugar loan program must agree to provide payments to producers that are proportional to the value of the loan received for beets delivered by producers. USDA has the authority to establish minimum producer payment amounts. The sugar loan program provides a loan to processors for domestically grown sugarbeets at the rate of 22.9 cents per pound for refined sugar.

Unlike most other commodity programs, sugar loans are made to processors and not directly to producers. This is because beets are bulky and perishable and must be processed into sugar before being traded or stored.

The U.S. sugar program attempted to limit the supply of sugarbeets in 2000 through a Payment-In-Kind (PIK) program. Under the PIK program, about 7 percent of acreage planted to sugarbeets nationwide were not harvested in 2000. Costs incurred on acres diverted from production by the PIK program are included as costs to sugarbeet growers. Impacts of the PIK program on costs and returns are discussed throughout the report.

Accounts include only costs associated with sugarbeet production and end at the point when the commodity is hauled from the field to a factory or to a designated piling site. Accounting methods and measurement procedures used for noncash costs affect the cost 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.

Sugarbeet Production Costs Vary Across the United States

Sugarbeet production costs varied widely across the country because of regional differences in production practices, input use, irrigation, and costs of land, labor, and capital.

Costs of producing sugarbeets on either a per-acre or per-ton basis vary considerably across farms and across regions. This variation can be shown by ranking the sugarbeet farms from lowest to highest costs per ton to form a cumulative distribution of farms and production in 2000 (fig. 2). The cumulative distribution reveals that:

- 50 percent of farms in the survey incurred operating costs (including hired labor) of \$18.40 per ton or less and 75 percent of the farms incurred costs of \$24.75 per ton or less;
- 50 percent of farms in the survey incurred operating and ownership costs of \$26.36 per ton or less and 75 percent of the farms incurred costs of \$35.02 per ton or less;
- 50 percent of farms in the survey incurred total (economic) costs of \$43.02 per ton or less and 75 percent of the farms incurred total (economic) costs of \$52.30 or less.

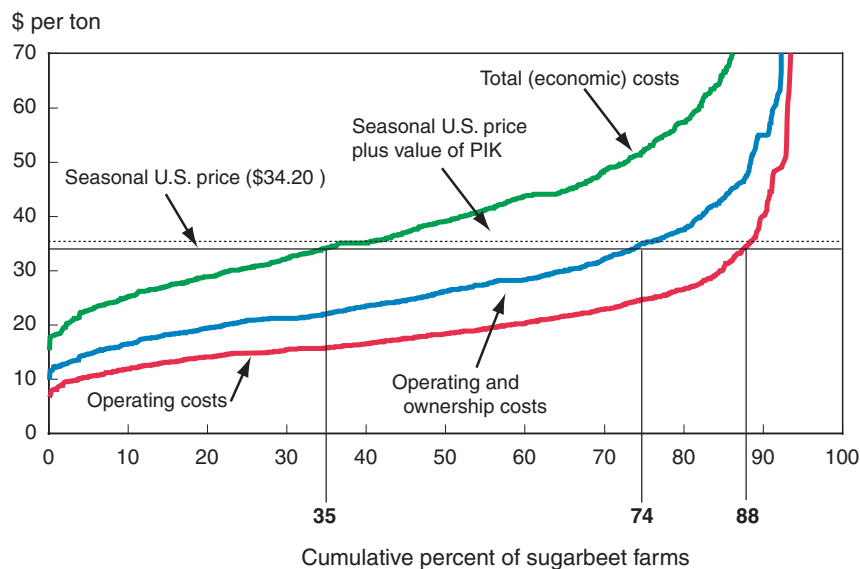
[See glossary for definitions of cost measures.]

The operating costs of producing U.S. sugarbeets in 2000 averaged \$18.37 per ton (\$411.46 per planted acre); operating plus ownership costs averaged \$25.42 per ton (\$569.41 per acre); and total (economic) costs averaged \$37.30 per ton (\$835.58 per acre). Chemicals, hired labor, fuels and fertilizers were major cost components, accounting for 60 percent of the operating costs. 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. sugarbeet farms.

A comparison of costs with prices received by sugarbeet farmers gives a rough indication of how many producers covered their beet production costs. Note that prices received by farmers vary greatly (see box on ERS Cost-of-Production and Return Accounts). At the 2000 average

Figure 2
Cumulative distribution of sugarbeet farms at different cost levels, 2000

The 2000 average seasonal price covered operating and ownership costs on 74 percent of farms, while it covered total (economic) costs on just 35 percent of the sugarbeet farms.



PIK = Payment-In-Kind program.

Source: 2000 USDA Agricultural Resource Management Survey.

sugarbeet price of \$34.20 per ton, about 74 percent of beet farmers were able to cover operating plus ownership costs. Only 35 percent of beet farmers were able to cover total costs of producing beets (fig.2). In 2000, the growers were given the opportunity to participate in the sugar Payment-In-Kind (PIK) Diversion program to destroy sugarbeets on a specified number of acres in

return for a like amount of Government-owned sugar (see box on Sugar Payment-In-Kind (PIK) Diversion program). Growers who participated in the PIK program received an additional \$44 per planted acre on average, which helped offset some production costs. This additional revenue enabled 43 percent of growers to cover total (economic) costs in 2000.¹

¹ Government support for sugarbeet farmers is reflected in the price received by farmers. The support for the processed product (sugar) is the basis for the support for the sugar crop (beets and cane). The policy supports the price of sugar through market limitations and imports. Without these market limitations and imports, low-priced sugar in the world market would be free to enter the U.S. market most likely at a price at which a majority of U.S. beet growers would not be able to cover total (economic) costs.

Sugar Payment-In-Kind Diversion Program

On August 1, 2000, the U.S. Department of Agriculture offered the sugar Payment-In-Kind (PIK) diversion program to sugarbeet growers, giving them the choice of diverting a portion of their crop acreage in exchange for sugar held in inventory by the Commodity Credit Corporation (CCC). The goals of the PIK program were to alleviate overproduction of U.S. sugar, reduce sugar loan forfeitures, and reduce USDA storage expenditure on sugar already owned by the CCC. In 2000, sug-

arbeet acreage diverted from production totaled 101,832.9 acres, about 7 percent of the total planted beet acreage. The CCC transferred title to 277,349 tons of refined sugar to participating growers. All participants elected to assign the sugar awarded to their processor. Transfer of this sugar resulted in about \$555,000 reduction in monthly CCC-storage related outlays. PIK payments were limited to \$20,000 per producer.

Regional Factors Influenced Sugarbeet Production Costs

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

The national data show that, on average for 2000, U.S. beet returns were enough to cover all operating and ownership costs, but not adequate to cover total (economic) costs. Disaggregating the national data to a regional level allows inspection of the variation in costs and returns across the country. The Southwest region was excluded in this section due to limited sample size; however, that region's sugarbeet farms were included in the estimates for all ARMS farms. The most important region in terms of sugarbeet production was the Red River Valley, accounting for nearly half of the total U.S. sugarbeet production. The Great Lakes accounted for the least amount of sugarbeet production of all the major regions (about 10 percent of the total sugarbeet crop). Of all sugarbeet farms surveyed in 2000, 42 percent were in the Red River Valley, while roughly 20 percent were in each of other regions (table 1).

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 sugarbeet farms surveyed in 2000 was 1,387 acres, of which 90 percent was cropland (table 1). Regionally, average farm size ranged from 1,045 acres in the Northwest to 1,675 acres in the Red River Valley. Harvested cropland as a percentage of total operated acres was much larger in the Great Lakes and Red River Valley, more than 90 percent compared with 57 percent in Great Plains region. The Great Plains region had the lowest percentage of cropland harvested, suggesting a large portion of land used for pasture.

Nationwide, sugarbeet farmers owned nearly 40 percent of the total land they operated and rented more than half on a cash-rent basis. In the Great Lakes region about two-thirds of the sugarbeet acreage was operator-owned, compared with half of the sugarbeet acreage in the Red River Valley and Northwest regions. The Great Plains region had the lowest share of operator-owned

land planted to sugarbeets. The most common rental arrangement was cash in the Red River Valley, while share-rental arrangements were most common in the Great Plains.

On average, 20 percent of cropland on farms growing sugarbeets was harvested for sugarbeets, ranging from 15 percent in the Great Lakes to about 25 percent in the Great Plains and Northwest regions. Other crops harvested on farms growing sugarbeets included wheat followed by soybeans, corn, and edible beans. Crops grown on sugarbeet farms varied greatly among regions. The sugarbeet farms in the Red River Valley harvested soybeans on 26 percent of their total harvested land, followed by dry edible beans and wheat. This pattern contrasts with Northwest sugarbeet farms, where 26 percent of harvested land was for wheat followed by other crops such as potatoes, dry edible beans, barley and hay. The Great Plains sugarbeet farms reported a large percent of their harvested land for corn followed by wheat and barley.

Sugarbeet farms tend to be run as multiple enterprises, with cattle also frequently produced. The value of sugarbeet production averaged \$202,764 per farm in 2000, about 40 percent of the total value of production on farms growing sugarbeets (table 2). This percentage ranged from 35 percent in the Great Lakes to about 50 percent in the Red River Valley, indicating the importance of sugarbeets to farmers in this region.

A farm's production specialty, the commodity or group of commodities that represents the largest portion of its gross income, is a useful measure of the relative importance of sugarbeets to the farm operation. More than half of sugarbeet farmers reported "other crops" as their production specialty (note that sugarbeet was included in other crops). Only 5 percent of sugarbeet farmers specialized in livestock. Beef production was by far the most common livestock specialty reported. Regionally, most sugarbeet farms specialized in "other crops"

Table 1—Land use on sugarbeet farms, by region, 2000

Item	Great Lakes	Red River Valley	Great Plains	Northwest	All ARMS farms
ARMS share (percent)					
Sugarbeet farms	19	42	20	17	100
Sugarbeet acres	11	46	16	23	100
Sugarbeet production	13	49	18	18	100
Size (acres)					
Operated	1,060	1,675	1,377	1,045	1,387
Cropland	1,025	1,637	956	979	1,268
Harvested	1,003	1,551	783	924	1,182
Land tenure (percent of operated acres)					
Owned	47	27	47	51	38
Cash-rent	45	71	26	40	53
Share-rent	9	5	28	11	11
Crops (percent of harvested acres)					
Sugarbeet	15	18	26	26	20
Wheat	9	34	17	26	26
Soybeans	33	26	0	0	19
Corn	24	12	30	5	15
Barley/oats	0	*	10	5	*
Dry edible beans	16	6	8	*	7
Potatoes	0	0	0	16	2
Hay	*	0	7	7	*
Others	*	*	*	12	5

* = 0.1 to less than 5 percent.

Excluded the Southwest region (California) due to insufficient data for disclosure.

Source: 2000 USDA Agricultural Resource Management Survey.

Table 2—Characteristics of sugarbeet farms, by region, 2000

Item	Great Lakes	Red River Valley	Great Plains	Northwest	All ARMS farms
Size (acres)					
Operated	1,060	1,675	1,377	1,045	1,387
Cropland	1,025	1,637	956	979	1,268
Sugarbeet	175	329	250	271	273
Sugarbeet land tenure (percent of acres)					
Owned	67	53	40	53	53
Cash-rented	28	43	23	36	36
Share-rented	5	*	37	11	11
Production specialty (percent of farms)					
Cash grains	61	47	32	3	23
Other crops	28	53	57	92	56
Livestock	11	*	11	5	5
Livestock (percent of farms)					
Beef cattle	16	6	48	20	19
Hogs	*	5	*	*	*
Dairy	5	0	*	*	*
Other livestock	*	*	21	23	10
Farm finances (dollars/farm)					
Farm production value	419,783	468,371	389,091	869,568	529,031
Sugarbeet production value	105,337	221,452	160,574	294,611	202,764
Net farm income	57,478	82,067	29,876	188,604	84,520
Assets	1,817,968	1,475,988	1,187,908	2,555,747	1,725,070
Debt	272,686	404,152	246,869	761,294	433,396
Farm equity	1,545,282	1,071,836	941,039	1,794,453	1,291,673
Debt-to-asset ratio (percent)	15	27	21	30	25
Income solvency group (percent of farms)					
Favorable (percent of farms)	66	52	57	51	55
Marginal income	6	24	10	15	17
Marginal solvency	23	14	24	25	20
Vulnerable	5	10	9	8	9
Sugarbeet Payment-In-Kind Program					
Participated (percent of farms)	41	89	52	98	73
PIK acres (percent of beet planted acres)	5.7	7.2	5.3	7.5	6.6
Co-op share (percent of farms)	0	93	0	93	54
Marketing contracts (percent of farms)	88	99	88	90	93
Operator occupation (percentage)					
Farming as major occupation	85	95	99	97	94
Operator age (percentage)					
Less than 50 years	46	73	57	57	61
50-64 years	48	24	32	36	33
65 years or older	6	*	12	7	6
Operator education (percentage)					
High school or less	75	23	49	24	38
Some college	18	51	30	47	39
Completed college	7	26	21	29	23

* = 0.1 to less than 5 percent. Totals may not add due to rounding or omission of possible categories.

Excluded the Southwest region (California) due to insufficient data for disclosure.

Source: 2000 USDA Agricultural Resource Management Survey.

except in the Great Lakes, where farms specialized in cash grains, such as wheat, corn, and soybeans. Eleven percent of Great Plains and Great Lakes beet farms specialized in livestock, compared with less than 5 percent of farms in other regions.

Production Costs

Cost-of-production estimates are shown on a planted-acre basis (table 3). Costs are included for production that is not harvested because of the PIK program. Production is valued at the seasonal average price times yield per planted acre. Value of PIK sugar is included as returns to growers. Seventy-three percent of U.S. beet growers participated in the PIK program and did not harvest 6.6 percent of total planted beet acreage to comply with the program (table 2). Regionally, participation in the PIK program varied, ranging from 41 percent of farms in the Great Lakes to 98 percent in the Northwest.

The value of PIK sugar ranged from \$27 to \$55 per planted acre among regions. The Red River Valley region, the major sugarbeet producing region, reported that 89 percent of growers participated in the PIK program and on the average, received additional revenue of \$50 per planted acre. Only in the Red River Valley were average returns in 2000 enough to cover total (economic) costs. The largest shortfalls from covering total (economic) costs were in the Great Lakes and the Great Plains regions, with losses averaging \$130 and \$210 per acre, respectively.

Costs of producing sugarbeets varied by region due to differences in production practices, input use, and irrigation. Average operating costs ranged from \$340 per acre in the Red River Valley to \$584 in the Northwest region (table 3). Chemicals, hired labor, fuel, and fertilizer costs accounted for 60 percent of the operating costs across all regions. Input costs varied widely among regions, reflecting differences in production practices.

Operating and ownership costs of producing sugarbeets were the highest for the Northwest region, averaging \$802 per acre, indicating a higher cost of irrigation-related expenses. Despite this region's high yield, an average 28 tons per acre was not enough to cover the incurred irrigation-related expenses. By contrast, Red River Valley farmers produced sugarbeets at the lowest operating and ownership costs, averaging \$470 per acre. Total production costs ranged from \$670 per acre in the Red River Valley to \$1,166 per acre in the Northwest region. This wide range illustrates the differences in capital recovery, labor, overhead and land costs, which were a result of differences in enterprise size and production practices such as irrigation.

On a per-ton basis, production costs varied greatly among regions due primarily to differences in yields. Operating and ownership costs ranged from \$22.78 to \$28.58 per ton on average, while total costs ranged from \$32.52 to \$43.79 per ton. The Red River Valley had the lowest per-ton costs among regions. The Great Plains, on the other hand, had the highest production costs per ton.

Over 80 percent of the Red River Valley growers produced beets for less than the \$34.20 per ton seasonal average price for 2000 when operating and ownership costs were considered, compared with 62-65 percent of growers in the Great Plains and Northwest regions (fig. 3).

When opportunity costs for unpaid labor, land, and other overhead expenses were included, only 15-20 percent of the growers in the Great Plains and Northwest regions produced beets at or below the 2000-seasonal average price, compared with just over half of the beet growers in the Red River Valley (fig. 4). Regionally, additional revenue due to the PIK program enabled an additional 6-12 percent of growers to cover their costs.

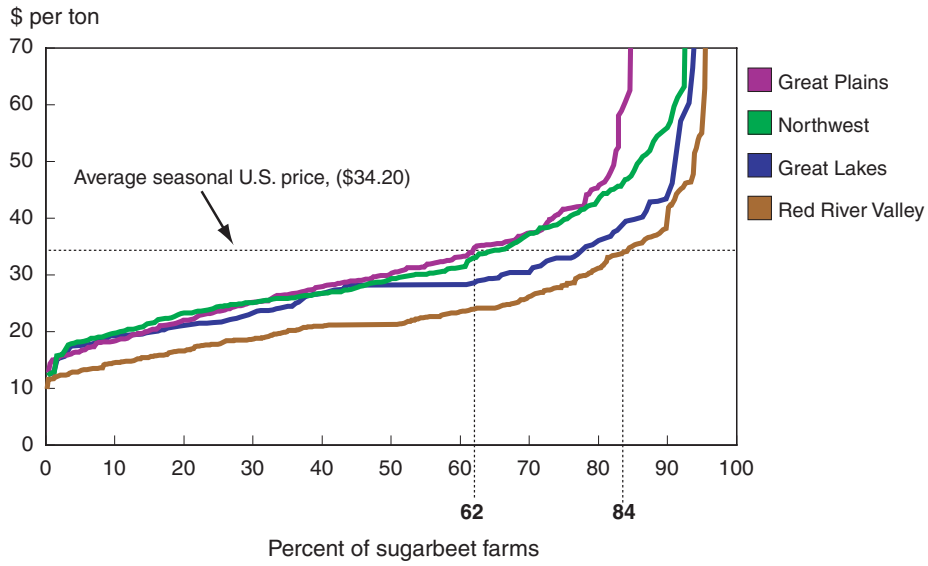
Table 3—Sugarbeet production costs and returns, by region, 2000

Item	Great Lakes	Red River Valley	Great Plains	Northwest	All ARMS farms
<i>Dollars per planted acre</i>					
Gross return					
Sugarbeets	642.59	723.41	642.81	1,051.50	767.87
Beet tops/grazing	0.00	0.00	0.77	0.00	0.14
Value of PIK sugar ¹	27.21	49.84	36.51	55.34	43.84
Total gross return	669.80	773.25	680.09	1,106.84	811.85
Operating costs					
Seed	38.93	44.89	48.13	41.44	44.21
Fertilizer	66.50	28.74	53.73	71.87	46.86
Chemicals	74.17	109.03	77.68	88.64	94.28
Custom operations	28.52	23.49	35.86	50.46	36.04
Fuel, lube, and electricity	50.19	24.86	54.26	109.89	50.90
Repairs	49.73	32.52	48.01	57.58	41.42
Purchased irrigation water	0.00	0.06	8.04	16.49	5.77
Freight and dirt hauling	18.87	13.62	11.91	13.76	14.23
Miscellaneous	3.12	13.30	15.42	26.62	16.43
Hauling allowance (-)	0.00	10.34	9.04	2.16	7.69
Interest on operating capital	9.52	8.38	10.18	13.75	10.31
Hired labor	29.10	51.76	52.40	95.36	58.7
Total operating costs	368.65	340.31	406.58	583.70	411.46
Return over total operating costs	301.15	432.94	273.51	523.14	400.39
Ownership costs					
Capital recovery (machinery & equipment)	166.02	114.64	158.82	198.30	142.07
Taxes and insurance	13.75	14.57	14.97	20.24	15.88
Total operating and ownership costs	548.42	469.52	580.37	802.24	569.41
Return over total operating and ownership costs	121.38	303.73	99.72	304.60	242.44
Other costs					
General farm overhead	27.05	27.37	33.44	43.00	34.46
Opportunity cost of land	126.17	83.85	132.47	211.14	126.61
Opportunity cost of unpaid labor	97.52	49.63	143.10	92.95	83.04
Opportunity cost of coop share	0.00	39.77	0.00	17.11	22.06
Total (economic) costs	799.16	670.14	889.38	1,166.44	835.58
Return over total (economic) costs	-129.36	103.11	-209.29	-59.60	-23.73
<i>Tons per planted acre</i>					
Yield	20.5	20.6	20.3	28.1	22.4
<i>Dollars per ton</i>					
Cost of production					
Total operating costs	17.96	16.51	20.02	20.75	18.37
Total operating and ownership costs	26.71	22.78	28.58	28.52	25.42
Total (economic) costs	38.93	32.52	43.79	41.47	37.30
Season-average price	31.30	35.10	31.65	37.38	34.28

¹Payments on acres diverted from production by the Payment-In-Kind (PIK) program. Excluded the Southwest region (California) due to insufficient data for disclosure. Source: 2000 USDA Agricultural Resource Management Survey.

Figure 3

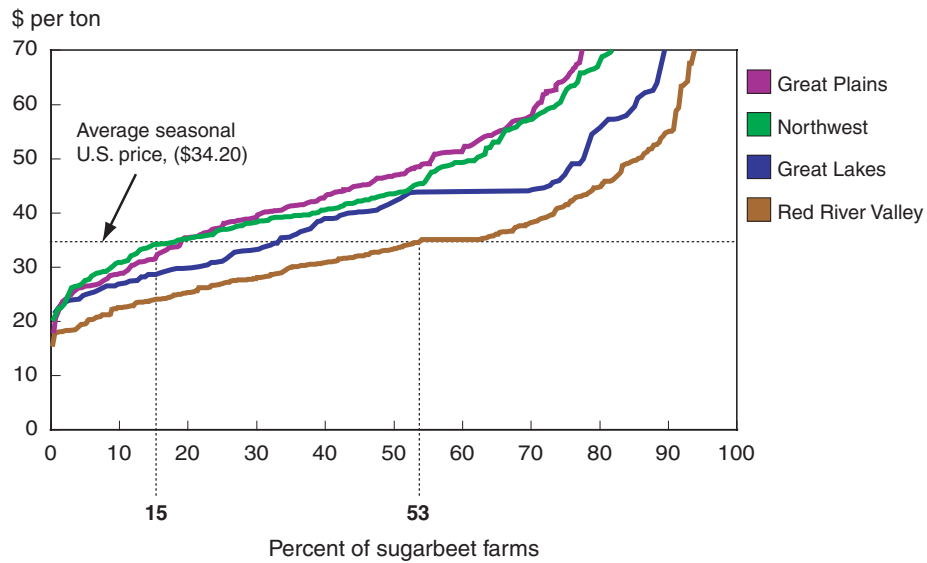
Cumulative distribution of sugarbeet farms by region and operating plus ownership costs per ton, 2000



Note: The Southwest region has been excluded because of insufficient data for disclosure.
Source: 2000 USDA Agricultural Resource Management Survey.

Figure 4

Cumulative distribution of sugarbeet farms by region and total costs per ton, 2000



Note: The Southwest region has been excluded because of insufficient data for disclosure.
Source: 2000 USDA Agricultural Resource Management Survey.

Production Practices

Sugarbeet yields are enhanced by irrigation. However, the high costs of irrigation in the Northwest make sugarbeet production less profitable compared with other regions 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. Nearly 40 percent of ARMS sugarbeet acreage was under irrigation (table 4). Virtually all sugarbeet acres were irrigated in the Great Plains and Northwest regions. Sugarbeet farmers in the Northwest had the highest costs per acre because of irrigation-related expenses, followed by the Great Plains.

Crop rotation is a common practice associated with sugarbeet production and can have implications for nitrogen management throughout the cropping cycle (Meyer et al., 2001). Most sugarbeets are grown in 3-year to 5-year rotations with small grains commonly preceding and succeeding sugarbeets. Crop rotations are primarily used to control diseases and nematodes that affect sugarbeets. The preceding crop can also influence the level of nitrogen available for sugarbeets and had a significant impact on nitrogen use and net returns (Daberkow et al., 2003). For example, legume crops, such as soybean and alfalfa, can add to soil nitrogen, while crops like corn may deplete soil nitrogen, meaning that more nitrogen needs to be applied. This is probably why sugarbeets planted after a crop of small grains or legumes required less nitrogen.

In addition, sugarbeet tops (or foliage) contain large amounts of nitrogen and are typically incorporated into the soil after the harvest, which provides nutrients for the crop following the beets. Sugarbeets were grown after small grains, primarily wheat, by 36 percent of U.S. sugarbeet farmers in 2000. Only 21 percent of sugarbeet farmers planted sugarbeets after corn. Regionally, more than 60 percent of the Red River Valley farmers planted sugarbeets after wheat compared with none in the Great Lakes region. Nearly 40 percent farmers planted sugarbeets after other crops in the Northwest region, while the Great Plains farmers usually planted beets after corn.

Precision agriculture (PA) technologies, such as grid soil tests, yield monitors, remote sensors, and variable rate applicators, are tools to manage sub-field variability of soils, pests, landscape, and microclimates by spatially adjusting input use to enhance economic and/or environmental benefits. The adoption level for many PA technologies is modest for most commodities (Daberkow et al., 2002). Swinton and Lowenberg-DeBoer (1998) hypothesized PA was much less likely to increase profitability for low-value crops, such as wheat and barley, and more likely for high-value crops like sugarbeets. Several studies that focused on PA in sugarbeet production reported significant economic benefits to this technology (Smith and Rains, 1997; *The Sugarbeet Grower*, 1996).

Nearly 40 percent of sugarbeet farmers used precision technologies, with Global Positioning System (GPS) and remote sensing being the most common (table 4). Regionally, the percentage of farms reporting precision technologies varied greatly, ranging from 16 percent to 70 percent. Red River Valley sugarbeet farmers reported the highest use of precision technologies, with remote sensing the most common. Also, this region's growers reported a higher use of GPS and variable-rate fertilizer applicators than any other region. The Northwest and Great Plains regions had the lowest use of precision technologies.

Nitrogen fertilizer management is a key factor in the profitability of sugarbeet production. Nitrogen is not only the most important yield-limiting nutrient but its management also is critical for producing high-quality sugarbeets. Production of high-quality beets is important in a quality-based payment system because farmers are paid on the basis of extractable sucrose content of their sugarbeets and the level of impurities in the root. Nitrogen sources for sugarbeet production include soil organic matter and sugarbeet foliage, both of which vary spatially across fields, and commercial nitrogen fertilizer can be applied (using conventional as well as variable-rate applicators). Adequate nitrogen fertilizer use normally increases yield of both roots and sugar. However, excessive use of nitrogen fertilizer decreases the sucrose content in the root.

Table 4—Selected inputs and management practices of sugarbeet production, by region, 2000

Item	Great Lakes	Red River Valley	Great Plains	Northwest	All ARMS farms
Previous crop (percent of farms)					
Wheat	0	63	15	14	36
Corn	24	19	37	8	21
Soybeans	8	*	0	8	*
Other crops	31	13	29	41	23
Irrigation (percent of beet acres)	0	*	99	100	39
Expected yield (tons per acre)	21.0	21.0	23.4	29.6	23.5
Seed (pounds/acre)	1.83	1.60	1.57	1.36	1.59
Fertilizer use (percent of farms)					
Any fertilizer	100	96	96	98	97
Nitrogen	100	96	95	98	97
Phosphorus	97	93	87	87	91
Potassium	96	47	43	46	53
Fertilizer application rate (pounds/acre)					
Nitrogen	136	76	127	137	104
Phosphorus	62	56	61	89	64
Potassium	167	18	14	34	39
Chemical use (percent of farms)					
Any chemicals	99	100	98	100	99
Herbicides	99	100	96	100	98
Insecticides	79	99	82	92	90
Tillage system (percent of farms)					
Conventional with moldboard plow	58	20	67	70	48
Conventional without moldboard plow	15	44	27	26	33
Reduced tillage	10	16	*	*	8
Mulch tillage	18	20	*	*	10
Soil surface covered (percent)	13	15	*	*	8
Custom operations (percent of farms)					
Any custom operation	76	97	90	98	92
Cultivation/planting	*	*	*	19	6
Fertilizer application	40	86	68	77	72
Chemical application	36	54	41	57	72
Harvest/hauling	37	24	15	42	29
Fuel use (units/acre)					
Diesel (gallons)	12.3	12.4	21.6	23.3	17.9
Gasoline (gallons)	24.6	8.3	6.6	7.8	9.7
Electricity (kilowatt hours)	0.0	*	284.5	1,699.9	347.7
Labor use (hours/acre)					
Unpaid labor	6.4	3.2	7.5	5.5	4.7
Paid labor	2.4	3.7	3.7	8.2	4.5

—Continued

Table 4—Selected inputs and management practices of sugarbeet production, by region, 2000 (con't)

Item	Great Lakes	Red River Valley	Great Plains	Northwest	All ARMS farms
Precision technology (percent of farms)					
Any technology	34	70	17	16	38
GPS	20	36	15	14	23
Remote sensing	3	58	*	6	23
VRT fertilizer	6	15	*	*	7
Fertilizer management practices					
Soil nitrogen test	19	96	73	83	73
Soil phosphate test	59	95	73	83	79
Plant tissue test	*	*	15	38	16
Nitrogen applications					
Less than recommended	6	20	24	36	22
More than recommended	94	22	46	41	45
Equal to recommended	0	58	30	23	33
Basis for nitrogen decision					
Routine practice	51	32	55	63	48
Soil/tissue test	19	82	59	73	63
Crop consultant	18	33	16	30	25
Fertilizer dealer	31	14	20	41	23
Extension services	6	10	*	*	6
Nitrogen/crop prices	*	5	7	11	6
Factory recommendation	22	28	10	21	20
Pest management practices					
Scouting weeds	92	100	97	100	98
Scouting insects	84	95	90	96	92
Scouting diseases	94	98	89	97	95
Scouting records	19	59	19	19	34
Pre-emergence herbicides					
Routine practice	54	7	51	47	35
Field mapping	*	*	7	6	5
Dealer recommendation	*	*	8	18	7
Consultant recommendation	*	*	9	*	*
Post-emergence herbicides					
Routine practice	63	58	67	70	62
Field mapping	67	59	54	75	61
Dealer recommendation	29	21	15	45	26
Consultant recommendation	15	44	20	5	25
Reasons for insecticide applications					
Preventive schedule	6	53	58	71	49
Scouting data	*	11	11	23	13
History of problem	*	35	39	44	32
Local information	9	5	8	20	9
Own determination of infestation level	79	99	82	92	90

* = 0.1 to less than 5 percent. Totals may not add due to rounding or omission of possible categories.

Excluded the Southwest region (California) due to insufficient data for disclosure.

Source: 2000 USDA Agricultural Resource Management Survey.

Most sugarbeet farmers applied nitrogen and phosphorus, while half of them applied potassium. Farmers, on average, applied 104 pounds of nitrogen, 64 pounds of phosphorus, and 39 pounds of potassium per acre of sugarbeets. Regionally, the quantity of nitrogen applied varied, ranging from 76 pounds per acre in the Red River Valley to 137 pounds per acre in the Northwest. Higher fertilizer application in the Northwest and Great Plains was due to irrigation. Farmers in the Great Lakes region also applied fertilizers at higher rates, where beets were not irrigated. Fewer than 20 percent of Great Lakes farmers used soil nitrogen tests, compared with more than 75 percent in other regions.

In the Great Lakes region, fertilizers were generally applied as a routine practice rather than as a result of recommendations based on soil tests, and farmers generally applied more than recommended amounts. By contrast, virtually all of the Red River Valley farmers reported results of soil tests for nitrogen and phosphorus as their primary decision factor for applying fertilizers. The Red River Valley region had the lowest fertilizer costs, averaged \$29 per acre, compared with \$54-\$72 per acre in other regions, possibly due to better fertilizer management practices.

Sugarbeet is one of the most chemical-intensive crops and is a challenging crop to produce. Sugarbeets are highly sensitive to pests, diseases, and weeds from the time of planting through harvest. This requires continuous monitoring, management, and control of these problems. Most sugarbeet farmers applied herbicides, either pre- or post-emergent applications, to their sugarbeet crop as a routine practice. Also, most of them used scouting for weeds, insects or diseases as a part of their pest management program. One-third of U.S. sugarbeet farmers used scouting records. Nearly, 60 percent of the Red River Valley farmers used scouting records, compared with fewer than 20 percent in other regions. Despite using better pest management practices, the Red River Valley farmers used considerably more chemicals than did farmers in other regions due to greater pest and weed pressure. Also, this region used relatively more

insecticides than other regions in 2000, resulting in the highest chemical costs, averaging \$110 per acre compared with \$75-\$90 per acre in other regions.

The use of custom operations influences sugarbeet production costs by reducing the farmers' costs of operating and owning machines and providing labor, while increasing operating 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.

A majority of U.S. sugarbeet farmers used custom operations in 2000, with custom fertilizer or chemical applications being the most common, followed by custom harvesting and hauling. The share of farms reporting custom operations ranged from 98 percent in the Northwest to 76 percent in the Great Lakes. Virtually all sugarbeet farms in the Red River Valley used custom operations, with fertilizer applications being the most common, followed by chemical applications.

Nearly one-third of U.S. sugarbeet farms reported custom harvesting and hauling. Custom harvesting and hauling were most common in the Northwest followed by the Great Lakes. Northwest sugarbeet farmers also reported custom fertilizer and chemical applications. As a result, this region had the highest cost for custom work, averaging \$50 per acre, compared with \$25-\$35 per acre in the other regions.

Conventional tillage, primarily with a moldboard plow, was the most common tillage practice for U.S. sugarbeet farmers. Less than 20 percent of surveyed sugarbeet farms used conservation tillage. Conventional tillage with a moldboard plow was the most common practice in all regions except the Red River Valley, where tillage with chisel and disk was most commonly used. Among regions, conservation tillage with reduced or mulch tillage was most common in the Red River Valley, followed by the Great Lakes region.

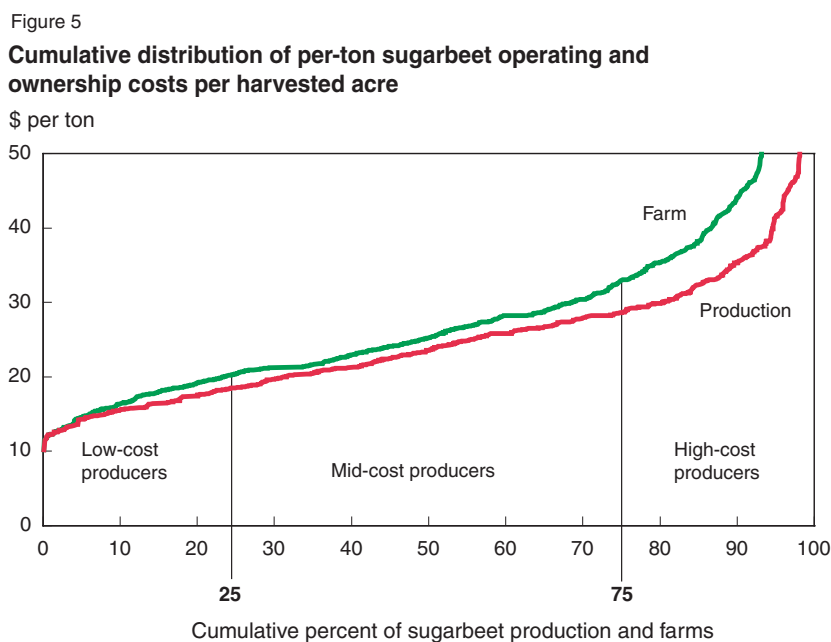
Characteristics and Costs of Sugarbeet Production Varied by Cost Group

Differences in enterprise size, production practices, per-acre costs, and yields distinguished low- and high-cost producers.

There is considerable cost variation among producers since production practices and yields vary for individual sugarbeet farmers. To identify various production factors affecting costs, sugarbeet farms were grouped into low-, mid- and high-cost groups according to their level of operating and ownership costs. Operating plus ownership costs are used since farmers must be able to meet their short-term operating costs and, in the longer run, replace assets consumed during the production. The analysis used costs and returns based on harvested acres rather than planted acres to eliminate the influence of acres diverted from production by the Payment-In-Kind (PIK) program. Estimated operating and ownership costs were converted to a per-ton 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. 5).

Twenty-five percent of farms had per-ton operating and ownership costs of \$20.40 or less. These low-cost growers accounted for 35 percent of U.S. beet production. Nearly 40 percent of Red River Valley sugarbeet farms were in the low-cost group, compared with fewer than 15 percent of Northwest farms (fig. 6). The average operating and ownership costs per ton for this group of farms was \$16.88. At the other end of distribution, 25 percent of farms had operating and ownership costs of \$33.01 or more per ton (high-cost), and accounted for only 14 percent of beet production. One-third of the Great Plains and the Northwest beet farmers were in the high-cost group. The average operating and ownership costs per ton for the high-cost group was \$41.20 (table 5).

Differences between low- and high-cost farms in 2000 were primarily attributable to differences in yield, production practices, and enterprise size. Low yields combined with heavier input use raised per-ton costs on high-cost farms considerably. Low-cost farms had average



operating and ownership costs of \$432 per harvested acre compared with \$810 per acre for high-cost farms. Costs of most inputs were significantly lower for low-cost producers than for high-cost producers. For example, low-cost producers spent \$130 per acre less for fuels and hired labor together on average than did high-cost producers. Heavier input use and higher capital recovery costs on high-cost farms were a result of production practices such as irrigation. Operators of high-cost farms irrigated half of their sugarbeet acreage, compared with one-fourth on the low-cost farms (table 6).

Per-ton operating and ownership costs varied greatly between cost groups, ranging from an average \$16.88 per ton for low-cost producers to \$41.20 per ton for high-cost producers, due primarily to differences in yields. Differences between actual and expected per-acre yields indicate the extent to which uncontrollable factors, such as weather, affect yields. Actual yields for high-cost producers were 4.3 tons below what was expected, while low-cost producers surpassed their expected yields in 2000 by an average of 2.2 tons per acre. On an expected yield basis, per-ton costs were \$15

more for high-cost producers, averaging \$33.81 per ton. Regardless of the poor yields experienced by many high-cost producers, greater per-acre costs and expected per-ton costs suggest that many of these producers would be high-cost producers even under more favorable weather conditions.

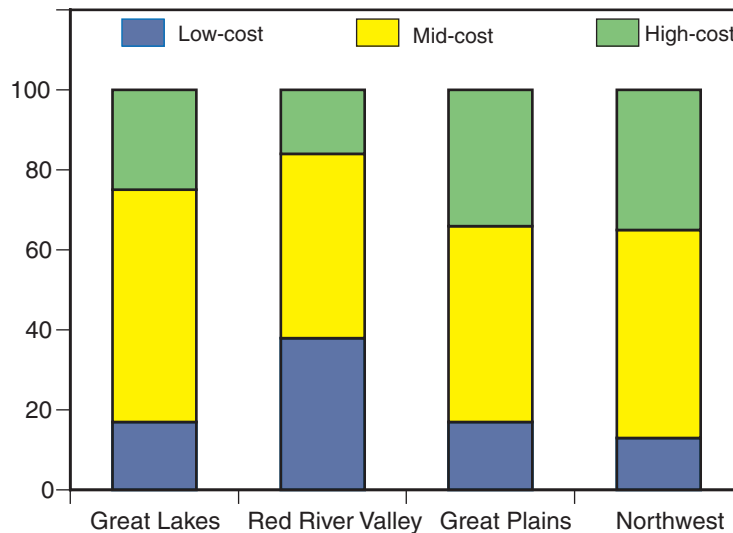
There were significant differences in crop rotation on low- and high-cost farms, with small grains or corn commonly preceding sugarbeets (table 6). Nearly sixty percent of low-cost farmers planted sugarbeets after wheat, compared with 26 percent of high-cost producers. In contrast, 32 percent of high-cost farmers planted sugarbeets after corn, compared with less than 11 percent for the low-cost farmers.

Production practices also vary between low- and high-cost farmers. Low-cost farmers were more likely to use fertilizer and pest management practices, such as soil testing, scouting records for pest, and precision technologies. Low-cost producers applied considerably less fertilizer per acre and used less tillage than did high-cost producers. Thirty-six percent of low-cost operators used

Figure 6

Distribution of cost groups in each region, 2000

Percent



Note: The Southwest region has been excluded because of insufficient data for disclosure.
Source: 2000 USDA Agricultural Resource Management Survey.

remote sensing, compared with only 15 percent of the high-cost farms. Practices such as soil testing and remote sensing help producers to more accurately determine fertilizer needs. Operators of high-cost farms generally applied more than the recommended amount of fertilizer.

The farm's size and the importance of the sugarbeet crop to the whole farm's enterprise mix were important differences among low- and high-cost farms. The average low-cost farm had larger sugarbeet acreage than high-cost

farms, as well as a larger overall farm size (table 7). Farms in the low-cost group averaged 322 acres of sugarbeets as part of 1,655 operated acres, compared with 202 sugarbeet acres out of 928 operated acres on high-cost farms.

Relatively more high-cost farms than low-cost farms specialized in livestock. More low-cost producers were highly leveraged than were high-cost farmers. Also, more high- than low-cost producers had a major occupation other than farming. The high-cost group had a higher proportion of older operators and had less formal education.

Table 5—Sugarbeet production costs and returns, by cost group, 2000

Item	Low-cost farms	Mid-cost farms	High-cost farms
	<i>Dollars per harvested acre</i>		
Gross return			
Sugarbeets	884.83	786.80	674.34
Beet tops/grazing	0.00	0.05	0.50
Total gross return	884.83	786.80	674.34
Operating costs			
Seed	41.00	44.70	48.34
Fertilizer	37.34	49.84	56.73
Chemicals	86.99	96.51	107.48
Custom operations	32.59	38.61	35.79
Fuel, lube, and electricity	24.17	59.63	85.31
Repairs	27.31	44.14	67.53
Purchased irrigation water	5.3	5.19	8.91
Freight and dirt hauling	15.02	15.02	12.49
Miscellaneous	14.48	14.31	29.39
Hauling allowance (-)	7.34	8.84	5.66
Interest on operating capital	8.50	10.78	13.21
Hired labor	35.02	62.17	103.42
Total operating costs	320.38	432.06	562.94
Return over total operating costs	564.45	354.74	111.40
Ownership costs			
Capital recovery (machinery & equipment)	97.51	149.76	230.03
Taxes and insurance	14.46	16.52	17.12
Total operating and ownership costs	432.35	598.34	810.09
Return over total operating and ownership costs	452.48	188.46	-135.75
Other costs			
General farm overhead	33.86	33.91	37.44
Opportunity cost of land	109.30	138.65	128.49
Opportunity cost of unpaid labor	55.21	91.89	107.01
Opportunity cost of coop share	29.07	19.09	17.60
Total (economic) costs	659.79	881.88	1100.63
Return over total (economic) costs	225.04	-95.08	-426.29
	<i>Tons per harvested acre</i>		
Actual yield	25.6	23.1	19.7
Expected yield	23.4	23.6	24.0
	<i>Dollars per ton</i>		
Cost of production			
Total operating costs	12.51	18.72	28.63
Total operating and ownership costs	16.88	25.92	41.20
Total (economic) costs	25.76	38.21	55.98
Season-average price	34.55	34.09	34.30

Source: 2000 USDA Agricultural Resource Management Survey.

Table 6—Inputs and management practices of sugarbeet production, by cost group, 2000

Item	Low-cost farms	Mid-cost farms	High-cost farms
Irrigation (percent of beet acres)	26	44	49
Previous crop (percent of farms)			
Wheat	57	26	26
Corn	11	21	32
Soybeans	0	*	*
Other crops	18	26	27
Seed (pounds/acre)	1.46	1.67	1.6
Fertilizer use (percent of farms)			
Any fertilizer	95	98	97
Nitrogen	95	98	97
Phosphorus	88	92	90
Potassium	49	57	54
Fertilizer application rate (pounds/acre)			
Nitrogen	97	104	121
Phosphorus	59	66	71
Potassium	26	47	41
Chemical use (percent of farms)			
Any chemicals	99	100	100
Herbicides	99	98	100
Insecticides	96	89	88
Tillage system (percent of farms)			
Conventional with moldboard plow	34	49	62
Conventional without moldboard plow	42	31	25
Reduced tillage	11	7	5
Mulch tillage	12	11	7
Soil surface covered (percent)	10	9	5
Custom operations (percent of farms)			
Any custom operation	92	92	93
Cultivation/planting	*	6	6
Fertilizer application	78	69	73
Chemical application	56	46	45
Harvest/hauling	24	33	34
Fuel use (units/acre)			
Diesel (gallons)	12.6	19	25.1
Gasoline (gallons)	4.7	10.9	16.3
Electricity (kilowatt hours)	54.3	437.2	664.4
Labor use (hours/acre)			
Unpaid labor	3.3	5.2	6.0
Paid labor	2.7	4.6	8.3

—Continued

Table 6—Inputs and management practices of sugarbeet production, by cost group, 2000 (con't)

Item	Low-cost farms	Mid-cost farms	High-cost farms
Precision technology (percent of farms)			
Any technology	45	36	36
GPS	26	23	23
Remote sensing	36	19	15
VRT fertilizer	8	7	7
Fertilizer management practices			
Soil nitrogen test	75	73	72
Soil phosphate test	79	81	76
Plant tissue test	10	18	20
Nitrogen applications			
Less than recommended	17	23	20
More than recommended	37	48	50
Equal to recommended	46	29	29
Basis for nitrogen decision			
Routine practice	51	43	57
Soil/tissue test	62	64	61
Crop consultant	19	30	24
Fertilizer dealer	16	24	28
Extension services	5	7	*
Nitrogen/crop prices	*	6	10
Factory recommendation	17	22	22
Pest management practices			
Scouting weeds	99	98	98
Scouting insects	91	95	91
Scouting diseases	97	96	92
Scouting records	38	34	31
Pre-emergence herbicides			
Routine practice	29	37	36
Field mapping	*	6	6
Dealer recommendation	*	7	11
Consultant recommendation	6	*	5
Post-emergence herbicides			
Routine practice	62	64	62
Field mapping	57	63	64
Dealer recommendation	19	29	30
Consultant recommendation	32	22	27
Reasons for insecticide applications			
Preventive schedule	50	48	48
Scouting data	13	13	14
History of problem	31	30	37
Local information	10	9	10
Operator determination of infestation	96	89	88

* = 0.1 to less than 5 percent. Totals may not add due to rounding or omission of possible categories.

Source: 2000 USDA Agricultural Resource Management Survey.

Table 7—Characteristics of sugarbeet farms, by cost group, 2000

Item	Low-cost farms	Mid-cost farms	High-cost farms
ARMS share (percent)			
Sugarbeet farms	25	50	25
Sugarbeet acres	30	51	19
Sugarbeet production	35	51	14
Size (acres)			
Operated	1,655	1,575	928
Cropland	1,580	1,391	877
Sugarbeet	322	300	202
Sugarbeet land tenure (percent of acres)			
Owned	54	54	51
Cash-rented	37	35	35
Share-rented	9	11	16
Production specialty (percent of farms)			
Cash grains	39	41	34
Other crops	57	54	59
Livestock	*	5	7
Livestock (percent of farms)			
Beef cattle	11	17	23
Hogs	*	*	*
Other livestock	*	8	17
Farm finances (dollars/farm)			
Farm production value	620,263	606,109	386,029
Sugarbeet production value	244,664	232,686	141,296
Net farm income	114,968	115,635	16,774
Assets	1,825,238	2,042,144	1,294,550
Debt	484,374	497,750	313,101
Farm equity	1,340,865	1,544,394	981,449
Debt-to-asset ratio (percent)	27	24	24
Income solvency group (percent of farms):			
Favorable (percent of farms)	60	60	44
Marginal income	22	15	15
Marginal solvency	11	18	29
Vulnerable	6	7	13
Coop share (percent of farms)	68	52	49
Marketing contracts (percent of farms)	96	94	93
Operator occupation (percentage)			
Farming	98	92	94
Operator age (percentage)			
Less than 50 years	67	56	63
50-64 years	29	38	30
65 years or older	*	7	7
Operator education (percentage)			
High school or less	26	42	43
Some college	48	37	34
Completed college	26	21	22

* = 0.1 to less than 5 percent. Totals may not add due to rounding or omission of possible categories.

Source: 2000 USDA Agricultural Resource Management Survey.

Characteristics and Costs of Sugarbeet Production Varied by Enterprise Size

Farms with larger sugarbeet enterprises had more of their sales from sugarbeets and also had lower costs per ton than farms with smaller sugarbeet enterprises.

Prior evidence from analyses of farm businesses and commodity production indicates that enterprise size may affect costs of production. Costs of producing cotton, corn, soybeans, and wheat have been shown to decline to a varying extent as the size of the enterprise increases (Ali 2002; Foreman and Livezey, 2002; Brooks, 2001; Foreman, 2001; Ali et al., 1998; and McBride, 1994). The size distribution of sugarbeet farms in 2000 was used to identify cost differences among producers. Five size classes were developed according to planted sugarbeet acreage: fewer than 50 acres, 50-149 acres, 150-249 acres, 250-499 acres, and 500 acres or more.

Sixty-four percent of ARMS sugarbeet farms had fewer than 250 sugarbeet acres and accounted for only 30 percent of total sugarbeet production, while about 35 percent of the farms with more than 250 acres accounted for 70 percent of the total sugarbeet crop. Sixty percent of Great Plains farms had fewer than 150 acres of sug-

arbeets. In contrast, one-half of Red River Valley sugarbeet farms had 250 or more acres of beets. A large percentage of Great Plains and Northwest farms were in the 50-149 acres group (fig. 7).

Sugarbeet acres were related closely to size of the farming operation. As the total farm acreage increased, acres planted to beets increased. Farms in the smallest size group averaged 33 acres of beets as part of 299 operated acres, or 11 percent of the farm acreage. Farms in the largest size group averaged 785 acres of sugarbeets on 3,311 operated acres, or 24 percent of the farm acreage. Sugarbeets accounted for 27 percent of the total value of production on farms (or \$19,925 per farm) with fewer than 50 sugarbeet acres, compared with 40 percent on farms with 500 or more acres (or \$565,457 per farm) (table 8).

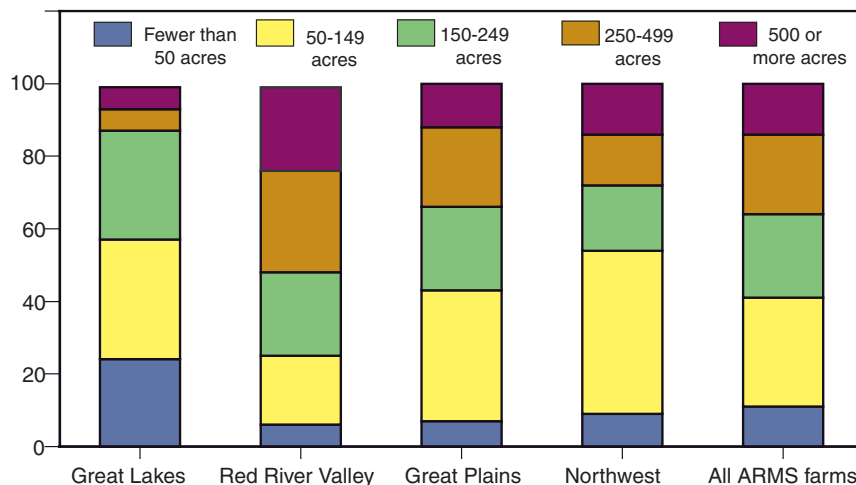
Among regions, larger sugarbeet farms were generally concentrated in the Red River Valley. Twenty-one percent

Figure 7

Distribution of sugarbeet farms by enterprise size in each region, 2000

Most Great Lakes farms had fewer than 150 sugarbeet acres while most of Red River Valley farms had 250 or more sugarbeet acres.

Percent



Note: The Southwest region has been excluded because of insufficient data for disclosure.
Source: 2000 USDA Agricultural Resource Management Survey.

of this region's sugarbeet farmers planted 500 or more acres of sugarbeets, compared with about 13 percent in the Great Plains and Northwest regions and only 6 percent in the Great Lakes. Most of the Northwest farms were in the 50-149 acres group (fig. 7). The percentage of owned acres decreased as enterprise size increased. Roughly 63 percent of sugarbeet acres in the smallest size group were owned land, compared with 52 percent of sugarbeet acres in the largest size group. The proportion of sugarbeet acreage cash-rented also increased with size—from 26 percent on the smallest size farms to 40 percent on the largest farms (table 8).

Production costs varied among size groups, but most of the differences were between the smallest and largest sugarbeet enterprises. Overhead, taxes, and insurance expenses declined as enterprise size increased (table 9). Less than 10 percent of the smallest sugarbeet enterprises reported use of precision technologies, such as remote sensing and GPS, compared with about 50 percent for the largest sugarbeet enterprises (table 10). Operators of the smallest sugarbeet enterprises were less likely to use soil testing for nitrogen and generally applied more than the recommended amount of fertilizer. Also, these operators more often used conventional tillage with a moldboard plow and less often conservation tillage (such as reduced or

mulch tillage) than operators of the largest sugarbeet enterprises. Labor use was also greater on the smallest sugarbeet enterprise. Despite higher per-acre costs on larger operations, per ton costs declined with enterprise size due to higher yields and lower labor and other overhead expenses.

Average farm asset, debt, and equity values increased as the enterprise size increased. Value of farm assets rose from an average of \$491,534 for farms with fewer than 50 sugarbeet acres to \$3,872,637 for farms with 500 or more beet acres. A similar increase occurs for farm debt as enterprise size increased.

Farm income averaged \$22,476 for the smallest sugarbeet enterprise compared with \$241,426 for farms with more than 500 sugarbeet acres. Equity ranged from an average of \$407,660 per farm to \$2,568,090 for farms with the smallest and largest sugarbeet enterprise, respectively. Farms with fewer than 250 acres of sugarbeets had lower debt-to-asset ratios than farms with larger sugarbeet enterprises. Smaller sugarbeet enterprises were less specialized in other crops (note that sugarbeet is included in other crops) and more specialized in livestock than larger size enterprises. Operators of small sugarbeet enterprises were generally older and had less formal education, and were less likely to report farming as their primary occupation.

Table 8—Selected characteristics of sugarbeet farms, by enterprise size, 2000

Item	Sugarbeet planted acres				
	Fewer than 50	50-149	150-249	250-499	500 or more
ARMS share (percent)					
Sugarbeet farms	11	30	23	22	14
Sugarbeet acres	*	11	18	29	41
Sugarbeet production	*	11	18	30	40
Size (acres)					
Operated	299	701	1,232	1,737	3,311
Cropland	248	546	1,083	1,529	2,804
Sugarbeet	33	98	205	362	785
Sugarbeet land tenure (percent of acres)					
Owned	63	50	62	49	52
Cash-rented	26	31	25	39	40
Share-rented	11	19	13	12	9
Production specialty (percent of farms)					
Cash grains	40	36	46	38	28
Other crops	49	55	50	59	71
Livestock	11	9	*	*	*
Livestock (percent of farms)					
Beef cattle	*	5	5	*	0
Hogs	24	27	15	14	10
Dairy	5	*	*	0	0
Other livestock	16	14	10	8	*
Farm finances (dollars/farm)					
Farm production value	72,006	246,394	390,088	682,460	1,435,643
Sugarbeet production value	19,925	76,315	150,970	278,131	565,457
Net farm income	22,476	52,131	81,159	58,676	241,426
Assets	491,534	1,065,523	1,621,569	1,908,299	3,872,637
Debt	83,874	193,209	244,968	553,732	1,304,546
Farm equity	407,660	872,314	1,376,601	1,354,567	2,568,090
Debt-to-asset ratio (percent)	17	8	15	9	34
Income solvency group (percent of farms):					
Favorable (percent of farms)	65	55	68	45	43
Marginal income	9	15	12	24	22
Marginal solvency	19	26	14	18	18
Vulnerable	8	*	7	12	17
Sugarbeet Payment-In-Kind Program					
Participated (percent of farms)	60	71	62	81	92
PIK acres (percent of planted acres)	25.0	14.5	6.6	6.1	4.1
Coop share (percent of farms)	40	47	50	68	68
Marketing contracts (percent of farms)	86	91	96	96	93
Operator occupation (percentage)					
Farming as major occupation	74	95	98	99	93
Operator age (percentage)					
Less than 50 years	64	60	54	66	65
50-64 years	24	32	43	30	30
65 years or older	12	8	*	*	5
Operator education (percentage)					
High school or less	53	44	44	25	27
Some college	33	38	34	45	46
Completed college	14	18	22	30	27

* = 0.1 to less than 5 percent. Totals may not add due to rounding or omission of possible categories.

Source: 2000 USDA Agricultural Resource Management Survey.

Table 9—Sugarbeet production costs and returns, by enterprise size, 2000

Item	Sugarbeet planted acres				
	Fewer than 50	50-149	150-249	250-499	500 or more
	<i>Dollars per planted acre</i>				
Gross return					
Sugarbeets	540.09	715.41	736.80	738.12	823.70
Beet tops/grazing	0.00	0.10	0.36	0.17	0.04
Value of PIK sugar ¹	199.84	99.81	32.65	44.81	31.14
Total gross return	739.93	815.32	769.81	783.10	854.88
Operating costs					
Seed	37.54	44.61	42.88	44.37	44.80
Fertilizer	66.66	58.52	51.93	43.99	42.91
Chemicals	87.92	99.68	79.01	99.04	96.72
Custom operations	55.21	42.59	24.15	29.26	44.17
Fuel, lube, and electricity	29.17	47.57	52.40	41.71	58.33
Repairs	33.61	40.93	51.29	39.10	38.85
Purchased irrigation water	7.56	10.26	5.42	4.50	5.60
Freight and dirt hauling	15.48	16.05	15.92	13.19	13.68
Miscellaneous	10.07	22.82	15.62	13.70	17.26
Hauling allowance (-)	3.68	6.01	6.12	7.60	9.03
Interest on operating capital	9.96	11.60	9.84	9.60	10.72
Hired labor	32.17	58.21	43.83	57.87	67.13
Total operating costs	381.67	446.83	386.17	388.73	431.14
Return over total operating costs	358.26	368.49	383.64	394.37	423.74
Ownership costs					
Capital recovery (machinery & equipment)	111.78	138.41	168.89	133.78	137.37
Taxes and insurance	26.82	23.10	15.43	15.36	14.24
Total operating and ownership costs	520.27	608.34	570.49	537.87	582.75
Return over total operating and ownership costs	219.66	206.98	199.32	245.23	272.13
Other costs					
General farm overhead	48.47	49.19	30.05	32.56	33.60
Opportunity cost of land	123.60	141.26	134.81	104.45	134.96
Opportunity cost of unpaid labor	147.89	157.73	117.44	71.80	53.54
Opportunity cost of coop share	9.67	15.07	17.44	26.39	23.29
Total (economic) costs	849.90	971.59	870.23	773.07	828.14
Return over total (economic) costs	-109.97	-156.27	-100.42	10.03	26.74
	<i>Tons per planted acre</i>				
Yield	16.2	21.1	21.9	21.4	23.9
	<i>Dollars per ton</i>				
Cost of production					
Total operating costs	23.59	21.22	17.66	18.19	18.03
Total operating and ownership costs	32.16	28.89	26.09	25.17	24.37
Total economic costs	52.53	46.13	39.79	36.18	34.64
Season-average price	33.38	33.97	33.69	34.54	34.45

¹Payments on acres diverted from production by the Payment-In-Kind (PIK) program.

Source: 2000 USDA Agricultural Resource Management Survey.

Table 10—Selected inputs and management practices of sugarbeet farms, by enterprise size, 2000

Item	Sugarbeet planted acres				
	Fewer than 50	50-149	150-249	250-499	500 or more
Previous crop (percent of farms)					
Wheat	12	15	30	45	38
Corn	28	34	12	22	20
Soybeans	13	*	0	*	*
Other crops	31	33	21	21	23
Irrigation (percent of beet acres)	40	51	35	31	44
Expected yield (tons per acre)	23.8	25.5	22.6	22.8	23.5
Seed (pounds/acre)	1.52	1.63	1.62	1.5	1.63
Fertilizer use (percent of farms)					
Any fertilizer	96	97	97	96	98
Nitrogen	96	97	97	96	98
Phosphorus	88	91	91	89	91
Potassium	69	55	57	49	51
Fertilizer application rate (pounds/acre)					
Nitrogen	133	111	115	98	102
Phosphorus	67	62	66	64	63
Potassium					
Chemical use (percent of farms)					
Any chemicals	97	98	99	100	100
Herbicides	96	98	99	98	98
Insecticides	77	88	91	91	91
Tillage system (percent of farms)					
Conventional with moldboard plow	78	70	46	39	39
Conventional without moldboard plow	16	23	31	38	38
Reduced tillage	*	*	6	9	13
Mulch tillage	*	*	16	11	11
Soil surface covered (percent)	*	*	12	9	10
Custom operations (percent of farms)					
Any custom operation	87	93	83	94	96
Cultivation/planting	16	15	5	*	*
Fertilizer application	56	72	69	80	70
Chemical application	58	45	43	50	49
Harvest/hauling	36	32	21	24	38
Fuel use (units/acre)					
Diesel (gallons)	13.4	21.7	15.2	15.9	19.7
Gasoline (gallons)	6.9	6.6	18.4	8.7	7.2
Electricity (kilowatt hours)	52.4	176.2	183.7	225.5	565.7
Labor use (hours/acre)					
Unpaid labor	8.2	8.4	7	4.1	3.1
Paid labor	2.4	4.9	3.4	4.5	5.1

—Continued

Table 10—Selected inputs and management practices of sugarbeet farms, by enterprise size, 2000 (cont'd)

Item	Sugarbeet planted acres				
	Fewer than 50	50-149	150-249	250-499	500 or more
Precision technology (percent of farms)					
Any technology	9	24	34	45	49
GPS	0	*	0	*	*
Remote sensing	7	18	24	27	25
VRT fertilizer	5	8	21	30	30
Fertilizer management practices					
Soil nitrogen test	40	68	69	77	81
Soil phosphate test	46	75	83	80	82
Plant tissue test	9	16	15	14	18
Nitrogen applications					
Less than recommended	10	25	13	23	26
More than recommended	72	47	52	40	41
Equal to recommended	18	28	35	37	33
Basis for nitrogen decision					
Routine practice	53	56	41	47	48
Soil/tissue test	30	62	62	61	71
Crop consultant	15	22	19	23	35
Fertilizer dealer	39	37	32	20	10
Extension services	*	*	*	5	10
Nitrogen/crop prices	*	11	5	5	5
Factory recommendation	10	17	20	19	24
Pest management practices					
Scouting weeds	89	97	99	97	99
Scouting insects	81	94	92	91	94
Scouting diseases	85	93	93	95	98
Scouting records	8	21	26	36	51
Pre-emergence herbicides					
Routine practice	50	39	32	26	40
Field mapping	*	5	7	5	*
Dealer recommendation	17	11	9	*	6
Consultant recommendation	*	6	*	*	6
Post-emergence herbicides					
Routine practice	50	62	69	64	57
Field mapping	49	58	59	62	66
Dealer recommendation	28	36	30	19	22
Consultant recommendation	13	19	26	26	31
Reasons for insecticide applications					
Preventive schedule	32	47	52	52	48
Scouting data	6	9	9	14	18
History of problem	19	36	33	31	31
Local information	6	7	10	8	12
Operator determination of infestation	77	88	91	91	91

* = 0.1 to less than 5 percent. Totals may not add due to rounding or omission of possible categories.

Source: 2000 USDA Agricultural Resource Management Survey.

Characteristics and Costs of Sugarbeet Production Varied by Farm Typology

Half of the sugarbeet farms were large family farms that accounted for three-fourths of total sugarbeet 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 sugarbeet version of the 2000 ARMS survey did not have adequate sample size to use all the classes in the typology.

Therefore, limited-resource, retirement, residential/lifestyle, and non-family farms are not reported in this section. These farms accounted for 7 percent of all sugarbeet farms and 6 percent of the total sugarbeet crop (fig. 8). Small family farms, those with annual sales of \$250,000 and under, accounted for 40 percent of all sugarbeet farms but contributed only 16 percent of the total sugarbeet production. Small family farms are further divided into low- and high-sales farms and these accounted for 13 and 27 percent of all sugarbeet farms, respectively.

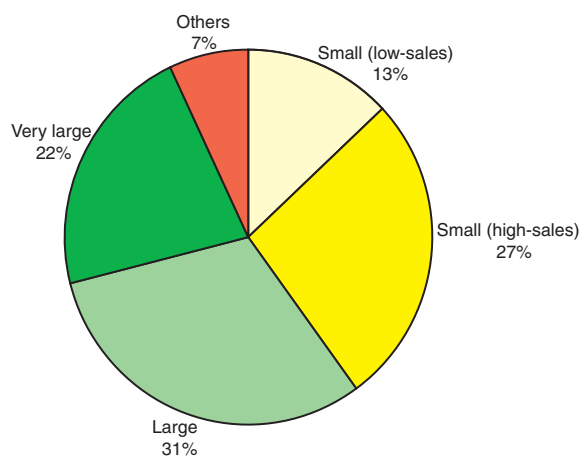
Low-sales farms were concentrated more in the Great Lakes region and accounted for less than 5 percent of the total sugarbeet production. On the other hand, large family farms (annual sales more than \$250,000)

accounted for 53 percent of all sugarbeet farms and just over three-fourths of the sugarbeet production. Large and very large farms accounted for 22 and 31 percent of all sugarbeet farms, respectively. The largest share of sugarbeet production came from the very large farms (48 percent). Most of these farms were located in the Red River Valley and the Great Plains regions (fig. 9).

For sugarbeet farms, farm typology and the size of the sugarbeet acres are positively related. As the value of a farm's gross sales increases, the total acreage per farm and sugarbeet acres per farm increases as well.

Producers on very large farms planted an average of 551 acres of sugarbeets out of 2,907 operated acres, in contrast to producers on low-sales farms, who planted sugarbeets on 77 acres out of 316 operated acres. As farm size increased, rented land accounted for a larger portion of total operated acreage, with cash-rental arrangements most common. However, more sugarbeets

Figure 8
Distribution of sugarbeet farms by farm typology group, 2000



Source: 2000 USDA Agricultural Resource Management Survey.

were planted on owned land as farm size increased. Operators of the larger sugarbeet farms were more diversified, less specialized in cash grains, and more likely to specialize in livestock commodities than were smaller farms (table 11).

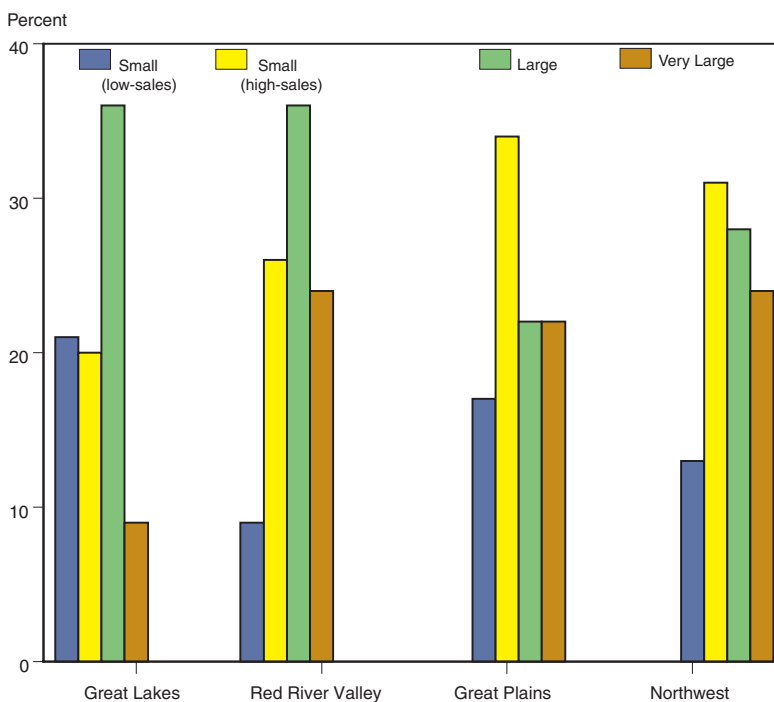
Production costs varied among the typology groups, but most of the significant differences were between small and large family farms, particularly for fuel and labor expenses. On a per-acre basis, the very large farms had the highest operating and ownership costs, \$593 per acre, compared with \$498 per acre for the low-sales small farms (table 12). Very large family farms had the highest per-acre production costs, due primarily to irrigation-related expenses, but they also had higher yields. As a result, these farms had the lowest per-ton cost, averaging \$34.71, compared with \$45.11 per ton for the low-sales small farms.

Small family farms differ from larger family farms in many characteristics other than size of the farm enterprise or the enterprise size. A large percentage of small farm operators used conventional tillage with a moldboard plow and were less likely than operators of larger farms to use conservation tillage (such as reduced or mulch tillage) (table 13). Also, operators of small family farms reported less use of precision technologies, such as remote sensing and GPS. Low-sales farmers reported less soil testing for nitrogen and generally applied nitrogen fertilizer at a higher rate and more than the recommended amount. Labor use was also higher on small farms. Average farm asset, debt, and equity values increased as farm size increased, with low-sales small farms having the lowest debt-to-asset ratio (14 percent), while very large farms had the highest ratio (30 percent). Farm income averaged \$24,434 for low-sales farms compared with \$203,588 for very large farms. Operators of small family farms were generally older and had less formal education.

Figure 9

Distribution of sugarbeet farms by typology in each region, 2000

Large farms were most common in the Great Lakes and Red River Valley, while small farms were most common in the Great Plains and Northwest.



Note: The Southwest region has been excluded because of insufficient data for disclosure.

Source: 2000 USDA Agricultural Resource Management Survey.

Table 11—Selected characteristics of sugarbeet farms, by farm typology, 2000

Item	Small family farms		Large family farms	
	Low-sales	High-sales	Large	Very Large
ARMS share (percent)				
Sugarbeet farms	13	27	31	22
Sugarbeet acres	*	17	30	44
Sugarbeet production	*	14	30	48
Size (acres)				
Operated	316	808	1,410	2,907
Cropland	257	714	1,344	2,625
Sugarbeet	77	175	259	551
Sugarbeet land tenure (percent of acres)				
Owned	46	37	35	38
Cash-rented	33	50	56	51
Share-rented	20	13	9	11
Production specialty (percent of farms)				
Cash grains	35	35	52	29
Other crops	60	61	44	62
Livestock	5	*	*	10
Livestock (percent of farms)				
Beef cattle	22	20	14	21
Hogs	*	*	*	5
Dairy				
Other livestock	18	11	10	7
Farm finances (dollars/farm)				
Farm production value	81,721	230,675	453,965	1,356,073
Sugarbeet production value	37,357	104,063	192,856	457,112
Net farm income	24,434	28,300	84,664	203,588
Assets	585,303	912,810	1,618,015	3,852,934
Debt	81,110	224,046	297,722	1,162,837
Farm equity	504,193	688,764	1,320,293	2,690,096
Debt-to-asset ratio (percent)	14	25	18	30
Income solvency group (percent of farms):				
Favorable (percent of farms)	64	50	60	50
Marginal income	9	15	19	19
Marginal solvency	24	24	16	19
Vulnerable	*	11	6	13
Sugarbeet Payment-In-Kind Program				
Participated (percent of farms)	57	72	73	82
PIK acres (percent of planted acres)	14.3	8.8	6.9	4.7
Co-op share (percent of farms)	41	53	61	62
Marketing contracts (percent of farms)	86	95	94	91
Operator occupation (percentage)				
Farming	100	100	100	98
Operator age (percentage)				
Less than 50 years	56	64	60	58
50-64 years	29	29	38	35
65 years or older	15	7	*	6
Operator education (percentage)				
High school or less	53	39	38	29
Some college	33	43	39	41
Completed college	14	18	23	30

* = 0.1 to less than 5 percent. Totals may not add due to rounding or omission of possible categories.

Source: 2000 USDA Agricultural Resource Management Survey

Table 12—Sugarbeet production costs and returns, by farm typology, 2000

Item	Small family farms		Large family farms	
	Low-sales	High-sales	Large	Very Large
	<i>Dollars per planted acre</i>			
Gross return				
Sugarbeets	593.61	655.38	741.31	844.90
Beet tops/grazing	0.41	0.30	0.21	0.05
Value of PIK sugar ¹	185.39	114.15	66.81	41.36
Total gross return	779.41	769.83	808.33	886.31
Operating costs				
Seed	42.06	42.49	43.98	44.09
Fertilizer	55.23	46.18	48.27	45.26
Chemicals	80.53	87.38	90.03	98.47
Custom operations	37.46	27.17	24.71	37.40
Fuel, lube, and electricity	30.25	35.10	49.49	58.17
Repairs	36.57	39.58	47.63	42.12
Purchased irrigation water	7.22	6.54	5.42	3.95
Freight and dirt hauling	6.95	12.56	16.72	15.55
Miscellaneous	10.64	17.08	14.20	15.64
Hauling allowance (-)	2.50	4.14	6.94	7.98
Interest on operating capital	8.85	9.08	9.83	10.50
Hired labor	44.50	51.16	48.13	69.14
Total operating costs	357.76	370.18	391.47	432.31
Return over total operating costs	421.65	399.65	416.86	454.00
Ownership costs				
Capital recovery (machinery & equipment)	124.93	135.75	160.07	145.07
Taxes and insurance	15.45	17.88	15.12	16.05
Total operating and ownership costs	498.14	523.81	566.66	593.43
Return over total operating and ownership costs	281.27	246.02	241.67	292.88
Other costs				
General farm overhead	35.56	32.64	30.87	33.88
Opportunity cost of land	111.28	112.05	119.62	122.74
Opportunity cost of unpaid labor	126.19	101.44	103.21	62.73
Opportunity cost of coop share	17.82	22.56	20.96	25.10
Total (economic) costs	788.99	792.50	841.32	837.88
Return over total (economic) costs	-9.58	-22.67	-32.99	48.43
	<i>Tons per planted acre</i>			
Yield	17.5	19.2	21.6	24.1
	<i>Dollars per ton</i>			
Cost of production				
Total operating costs	20.46	19.30	18.12	17.91
Total operating and ownership costs	28.48	27.31	26.23	24.58
Total (economic) costs	45.11	41.32	38.95	34.71
Season-average price	33.94	34.17	34.32	35.00

¹Payments on acres diverted from production by the Payment-In-Kind (PIK) program.
Source: 2000 USDA Agricultural Resource Management Survey.

Table 13—Inputs and management practices of sugarbeet production, by farm typology, 2000

Item	Small family farms		Large family farms	
	Low-sales	High-sales	Large	Very Large
Previous crop (percent of farms)				
Wheat	37	35	40	37
Corn	17	25	14	23
Soybeans	*	*	0	0
Other crops	31	24	20	30
Irrigation (percent of beet acres)	39	41	27	45
Expected yield (tons/acre)	22.8	23.2	24.4	24.1
Seed (pounds/acre)	1.47	1.42	1.61	1.55
Fertilizer use (percent of farms)				
Any fertilizer	98	99	96	97
Nitrogen	98	99	96	97
Phosphorus	89	92	94	88
Potassium	53	50	55	53
Fertilizer application rate (pounds/acre)				
Nitrogen	112	105	102	101
Phosphorus	53	60	65	64
Potassium	51	32	63	30
Chemical use (percent of farms)				
Any chemicals	99	99	99	100
Herbicides	99	99	99	99
Insecticides	89	85	94	89
Tillage system (percent of farms)				
Conventional with moldboard plow	70	62	38	44
Conventional without moldboard plow	22	24	31	37
Reduced tillage	*	6	9	10
Mulch tillage	5	8	20	9
Soil surface covered (percent)	*	6	13	7
Custom operations (percent of farms)				
Any custom operation	89	93	84	97
Cultivation/planting	11	5	8	2
Fertilizer application	73	71	74	79
Chemical application	47	43	54	48
Harvest/hauling	30	23	25	31
Fuel use (units/acre)				
Diesel (gallons)	17.1	16.1	14.7	17.5
Gasoline (gallons)	6.3	7.0	16.7	7.7
Electricity (kilowatt hours)	6.9	130.9	206.3	632.9
Labor use (hours/acre)				
Unpaid labor	6.8	5.7	6.2	3.6
Paid labor	3.1	3.8	3.9	5.3

—Continued

Table 13—Inputs and management practices of sugarbeet production, by farm typology, 2000 (con't)

Item	Small family farms		Large family farms	
	Low-sales	High-sales	Large	Very Large
Precision technology (percent of farms)				
Any technology	21	29	36	47
GPS	12	20	21	29
Remote sensing	14	21	22	26
VRT fertilizer	0	7	6	9
Fertilizer management practices				
Soil nitrogen test	50	77	70	79
Soil phosphate test	63	83	82	82
Plant tissue test	13	12	11	19
Nitrogen applications				
Less than recommended	20	21	17	26
More than recommended	56	43	46	45
Equal to recommended	24	37	37	29
Basis for nitrogen decision				
Routine practice	63	47	47	47
Soil/tissue test	49	67	60	66
Crop consultant	24	20	23	38
Fertilizer dealer	30	29	34	15
Extension services	*	6	5	7
Nitrogen/crop prices	9	8	6	7
Factory recommendation	24	19	18	29
Pest management practices				
Scouting weeds	95	97	98	100
Scouting insects	87	91	93	96
Scouting diseases	87	91	96	96
Scouting records	20	25	35	47
Pre-emergence herbicides				
Routine practice	48	40	27	29
Field mapping	6	6	5	5
Dealer recommendation	14	9	6	*
Consultant recommendation	*	*	*	*
Post-emergence herbicides				
Routine practice	74	64	71	71
Field mapping	66	56	67	65
Dealer recommendation	28	22	32	25
Consultant recommendation	30	21	20	32
Reasons for insecticide applications				
Preventive schedule	50	55	50	54
Scouting data	6	10	14	13
History of problem	39	39	34	31
Local information	8	6	12	14
Operator determination of infestation	89	85	94	89

* = 0.1 to less than 5 percent. Totals may not add due to rounding or omission of possible categories.

Source: 2000 USDA Agricultural Resource Management Survey.

Glossary

Agricultural Resource Management Survey (ARMS).

The 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 information for individual crop and livestock commodities and is the primary source of data used in this report. Sugarbeet cost and return estimates in this report are derived from the responses of 895 sugarbeet growers in 11 States (CA, CO, ID, MN, MT, NE, ND, MI, OR, WA, and WY). The survey included information on sugarbeet production practices, input use, and costs of production for the 2000 sugarbeet crop.

Cost group:

- **Low-cost** producers represent the 25 percent of U.S. sugarbeet producers with the lowest per-ton operating plus ownership costs. These sugarbeet producers had operating plus ownership costs of \$20.40 per ton or less.
- **High-cost** producers represent the 25 percent of U.S. sugarbeet producers with the highest per-ton operating plus ownership costs. These sugarbeet producers had operating plus ownership costs of \$33.01 per ton 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 sugarbeet acres, 50-149 sugarbeet acres, 150-249 sugarbeet acres, 250-499 sugarbeet acres, and 500 or more sugarbeet acres.

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

Sugarbeet production regions are groups of States with common production practices in sugarbeet production. These regions defined as: Great Lakes (Michigan and Ohio); Red River Valley (Minnesota and eastern North Dakota); Great Plains (Wyoming, Montana, western North Dakota, Colorado, and Nebraska); Northwest (Idaho, Oregon, and Washington); and Southwest (California).

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 small 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 small 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.

Financial condition describes the financial health of a farm from a combination of net farm income and solvency (debt/asset ratio). Farms are categorized into one of four classes:

- **Favorable** means a positive income and debt/asset ratio less than 0.40. These farms are generally considered financially stable.
- **Marginal** means negative income and a debt/asset ratio less than 0.40. Periods of negative income may not post financial difficulties if these farms are carrying a low debt load and can either borrow against equity or obtain income from off-farm sources.
- **Marginal solvency** means positive income and a debt/asset ratio above 0.40. A high debt/asset ratio may be acceptable if these farms can generate enough income to service their debt and meet other financial obligations.
- **Vulnerable** means negative income and a debt/asset ratio above 0.40. These farms are generally considered financially unstable.

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; freight and dirt hauling, miscellaneous; 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 (machinery and equipment) used in production, including asset depreciation and interest (capital recovery) taxes, and insurance.
- **Total (economic) 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. In addition to operating and ownership costs, these costs include opportunity costs for unpaid labor, land, coop shares, 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 planting another crop.
- **Conventional tillage systems with moldboard plow** include any tillage system uses a moldboard plow.
- **Conventional tillage without moldboard plow** includes 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 planting other crop.
- **Reduced tillage** leaves 15-30 percent of the previous crop residue covering the soil when planting another crop.
- **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.

Sugarbeet farms represent those operations selected in the 2000 ARMS. Sugarbeet farms are defined as farm operations that planted 1 or more acres of sugarbeet.

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Appendix: 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 (CV). In general, the smaller the CV, the greater the reliability of the estimate (appendix tables 1-3).

The average operating and ownership costs of production for all surveyed sugarbeet farms, \$569.41 per acre, has a CV of 1.7 percent (appendix table 1). Therefore, the confidence interval for operating costs per acre of producing sugarbeets in the United States is estimated to be between \$550.44 and \$588.38 per planted acre based on a 95-percent probability (appendix table 2).

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 ton 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

(SE²) of the two groups. This is estimated as follows:

$$\begin{aligned} t &= \frac{(\text{OPOWC}_{\text{Low-cost}} - \text{OPOWC}_{\text{High-cost}})}{(\text{SE}^2_{\text{Low-cost}} + \text{SE}^2_{\text{High-cost}})^{0.5}} \\ &= (16.88 - 41.20)/(0.0410^2 + 1.3184^2)^{0.5} \\ &= -18.23 \end{aligned}$$

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

Differences among means of sugarbeet production characteristics and costs items for the various groupings presented in this report were statistically tested (Dubman, 2000). 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—Coefficient of variation of sugarbeet production costs, 2000

Item	Operating costs		Operating and ownership costs		Total costs	
	Per acre	Per ton	Per acre	Per ton	Per acre	Per ton
			<i>Percent</i>			
All ARMS sugarbeet farms	1.9	2.4	1.7	2.0	2.0	2.3
Region						
Great Lakes	3.0	6.9	8.4	5.4	12.4	8.9
Red River Valley	1.9	3.4	1.8	3.5	1.4	3.3
Great Plains	2.5	3.3	2.4	3.1	2.2	3.5
Northwest	3.1	3.2	3.3	2.8	2.5	2.3
Costs group						
Low-cost	4.0	1.6	3.3	1.2	3.6	1.5
Mid-cost	2.9	2.4	1.7	1.2	2.2	2.0
High-cost	3.5	4.1	3.6	3.2	4.4	4.3
Enterprise size group						
Fewer than 50 acres	4.8	9.2	4.9	8.7	4.9	8.9
50-149 acres	9.2	7.4	6.8	5.9	7.7	7.6
150-249 acres	3.0	4.5	4.5	3.2	5.4	3.7
250-499 acres	1.8	2.7	1.8	3.1	1.6	2.9
500 acres or more	2.5	2.4	2.7	2.0	2.6	2.3
Farm typology						
Low-sales small farms	8.1	11.2	8.2	11.8	8.2	12.1
High-sales small farms	3.4	7.8	3.1	7.4	3.2	8.0
Large farms	2.4	3.4	3.3	2.8	4.3	3.7
Very large farms	3.1	3.5	3.1	3.3	2.6	2.7

Source: 2000 USDA Agricultural Resource Management Survey.

Appendix table 2—Statistical reliability of sugarbeet production costs per acre

Item	95-percent confidence interval								
	Operating costs			Operating and ownership costs			Total costs		
	Lower	Mean	Upper	Lower	Mean	Upper	Lower	Mean	Upper
	<i>Dollars</i>								
All ARMS sugarbeet farms	396.14	411.46	426.78	550.44	569.41	588.38	802.83	835.58	868.33
Region									
Great Lakes	346.96	368.64	390.32	458.11	548.40	638.69	604.92	799.15	993.38
Red River Valley	327.65	340.32	352.99	452.96	469.53	486.10	651.76	670.15	688.54
Great Plains	386.66	406.58	426.50	553.07	580.37	607.67	851.03	889.38	927.73
Northwest	548.22	583.69	619.16	750.33	802.22	854.11	1,109.26	1,166.41	1,223.56
Costs group									
Low-cost	295.26	320.38	345.49	404.39	432.35	460.33	613.24	659.79	706.34
Mid-cost	407.51	432.06	456.62	578.41	598.34	618.29	843.86	881.88	919.92
High-cost	524.32	562.94	601.55	752.93	810.09	867.25	1,005.70	1,100.63	1,195.54
Enterprise size group									
Fewer than 50 acres	345.76	381.67	417.58	470.30	520.27	570.24	768.28	849.90	931.52
50-149 acres	366.25	446.82	527.39	527.26	608.34	689.42	824.97	971.60	1,118.23
150-249 acres	363.47	386.18	408.89	520.18	570.50	620.82	778.13	870.24	962.35
250-499 acres	375.01	388.72	402.43	518.88	537.86	556.84	748.83	773.07	797.31
500 acres or more	410.01	431.14	452.27	551.90	582.74	613.58	785.93	828.13	870.33
Farm typology									
Low-sales small farms	300.97	357.77	414.57	418.09	498.15	578.21	662.19	789.00	915.81
High-sales small farms	345.52	370.19	394.86	491.99	523.82	555.65	742.80	792.51	842.22
Large farms	373.06	391.47	409.88	530.01	566.66	603.31	770.41	841.32	912.23
Very large farms	406.05	432.32	458.59	557.37	593.43	629.49	795.19	837.89	880.59

Source: 2000 USDA Agricultural Resource Management Survey.

Appendix table 3—Statistical reliability of sugarbeet production costs per ton

Item	95-percent confidence interval								
	Operating costs			Operating and ownership costs			Total costs		
	Lower	Mean	Upper	Lower	Mean	Upper	Lower	Mean	Upper
	<i>Dollars</i>								
All ARMS sugarbeet farms	17.51	18.37	19.23	24.42	25.42	26.42	35.63	37.31	8.99
Region									
Great Lakes	15.53	17.96	20.39	23.88	26.71	29.54	32.13	38.92	45.71
Red River Valley	15.41	16.51	17.61	21.22	22.78	24.34	30.41	32.51	34.61
Great Plains	18.73	20.02	21.31	26.84	28.58	30.32	40.79	43.79	46.79
Northwest	19.45	20.75	22.05	26.95	28.52	30.09	39.60	41.47	43.34
Costs group									
Low-cost	12.12	12.51	12.90	16.48	16.88	17.28	25.00	25.76	26.52
Mid-cost	17.84	18.72	19.60	25.32	25.92	26.54	25.00	38.22	39.72
High-cost	26.33	28.63	30.93	38.62	41.20	43.78	51.25	55.98	60.69
Enterprise size group									
Fewer than 50 acres	19.33	23.58	27.83	26.67	32.15	37.63	43.35	52.51	61.67
50-149 acres	18.14	21.22	24.30	25.55	28.89	32.23	39.27	46.14	53.01
150-249 acres	16.10	17.66	19.22	24.45	26.09	27.73	36.91	39.80	42.69
250-499 acres	18.19	18.19	19.15	23.64	25.17	26.70	34.11	36.17	38.23
500 acres or more	17.18	18.03	18.88	23.41	24.37	25.33	33.07	34.63	36.19
Farm typology									
Low-sales small farms	15.97	20.46	24.95	21.89	28.48	35.07	34.40	45.11	55.82
High-sales small farms	16.35	19.30	22.25	23.35	27.31	31.27	34.83	41.31	47.79
Large farms	16.92	18.13	19.34	24.80	26.24	27.68	36.13	38.95	41.77
Very large farms	16.68	17.91	19.14	22.99	24.58	26.17	32.87	34.71	36.55

Source: 2000 USDA Agricultural Resource Management Survey.

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