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Characteristics and Production Costs of U.S. Dairy Operations

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In this report. . . Total costs of producing milk in 2000 ranged from an average of \$11.58 per hundredweight (cwt) of milk sold in the Fruitful Rim-West region to \$18.23 per cwt in the Eastern Uplands. Milk producers in the West had a significant cost advantage over producers in other regions in 2000 because their operations were much larger. Operations with 500 or more milk cows had significantly lower total operating and ownership costs, indicative of the economies of size experienced by larger operations. Also, differences in animal performance, feed efficiency, and labor efficiency were critical in determining whether producers were in the low- or high-cost group for producing milk. These findings were based on the 2000 Agricultural Resource Management Survey (ARMS), the most recent national survey of milk producers.

Keywords: Milk, operation characteristics, production practices, costs of production, cost variation.

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Overview

Milk is produced in all 50 States. The top five milk-producing States in 2000 were California, Wisconsin, New York, Pennsylvania, and Minnesota (NASS, April 2002), accounting for 53 percent of all milk produced. The same five States topped production in 1975, but in different order. Wisconsin, California, New York, Minnesota, and Pennsylvania together produced 48 percent of the Nation's milk that year. The percentage increase for these five States between 1975 and 2000 may seem slight, but their total milk production increased from 55.8 billion pounds in 1975 to 88.1 billion pounds in 2000.

The top 10 milk-producing States in 2000 and 1975 accounted for 70 and 65 percent, respectively, of total milk production. Differences in State rankings each year highlight one key change in milk production—growth in nontraditional dairy areas. Idaho, New Mexico, and Washington State replaced Iowa, Ohio, and Missouri—States in a traditional dairy area, the Midwest—in the top 10. Coupled with long-term growth of milk production in California, large quantities of milk production in southern Idaho, eastern New Mexico, eastern Washington State, and southwestern Kansas have contributed to the changing national landscape of milk production. Growth in the importance of western regions as major sources of milk supplies is a significant feature of the U.S. dairy industry.

Beginning in 1993, the National Agricultural Statistics Service (NASS) began publishing data on the distribution of milk production by herd-size categories. In 2000, about 65 percent of production came from operations with 100 or more cows, up from 51 percent in 1993. Production from the smallest herds (less than 50 cows) fell by about 60 percent. Recent NASS data, which include a category of 500 or more cows, indicate how concentrated milk production has become—more than 35 percent of the herd inventory was on these largest operations in 2000 (NASS, February 2002).

In 1993, farms with 100 or more cows comprised about 14 percent of all operations, housed just over half of the cows, and provided over 55 percent of the milk produced. By 2000, farms with 100 or more cows accounted for 20 percent of operations, had almost 66 percent of the cows, and produced more than 70 percent of the milk production. Information about operations with 500 or more milk cows further highlights this dimension of the dairy industry. Such operations are about 3 percent of all operations, house over 35 percent of the cows, and provide over 31 percent of U.S. milk production.

Dairy farming is much more industrialized today than in the past in terms of resources, technology, and organizational structure. Technological innovations have increased opportunities for expansion and specialization, processes that tend to change the functions of the farmer. Even on smaller operations, dairy farm managers are doing more than just making the production decisions directly related to the animals; they are managing labor and other inputs, and possibly making marketing decisions.

Technology has also changed the way milk is produced. The switch to more technologically oriented production has coincided with expansion to take advantage of economies of size. However, not all technologies are capital intensive—rotational grazing, for example, is a production system that does not necessarily require large capital investments, though it does require a relatively large investment in human capital because animals are moved on a daily basis to and from designated grazing areas. In fact, capital-intensive, confinement dairies also need high-quality labor for efficient operation.

Prospects for continued expansion of milk production clearly exist, but they are not limitless. Environmental concerns about large numbers of animals on small acreages are increasing, as are concerns about the waste management associated with those animals. Such environmental issues are not limited to large farms; small farms face similar concerns.

Objective and Data

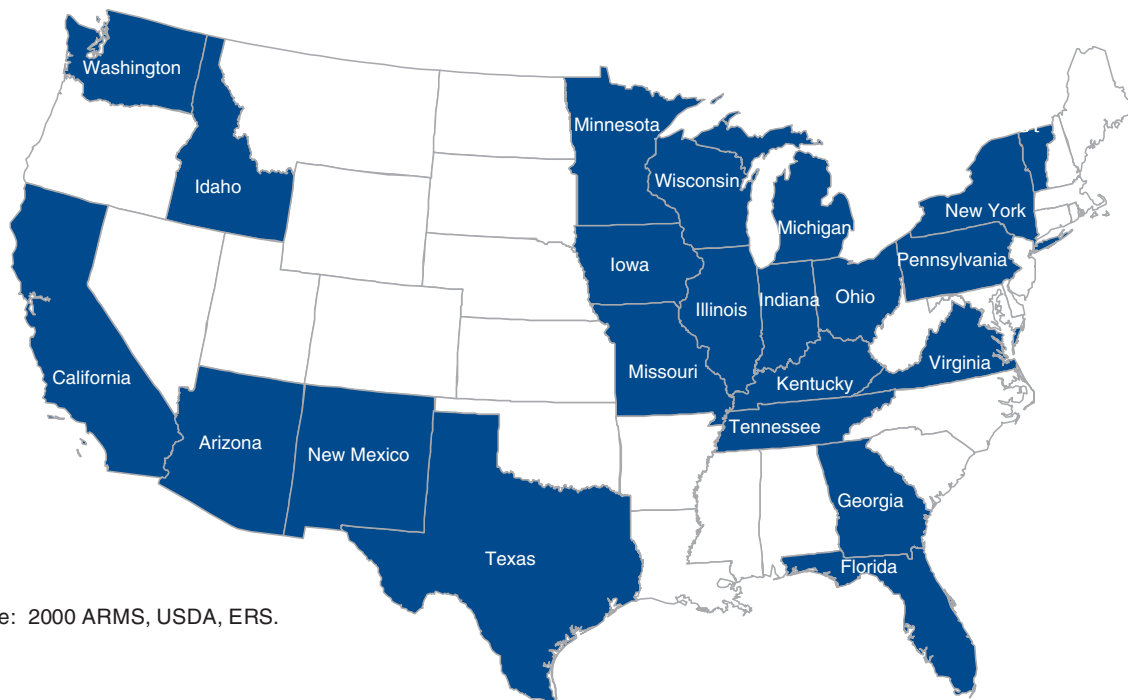
The objective of this report is to examine how milk production costs vary among U.S. producers. Characteristics and production costs of operations are compared and grouped according to selected regions, enterprise size, and production costs. A national overview of operating and ownership costs is available at www.ers.usda.gov/Data/CostsandReturns. Operating plus ownership costs are used in the analysis of production costs (see box "Cost-of-Production Components"). These costs describe the dairy operation's ability to meet short-term obligations and to replace capital assets as needed, and thus stay in business.

Data for the analysis came from a detailed survey of U.S. dairy producers conducted for 2000 as part of the USDA's annual Agricultural Resource Management Survey (ARMS). The survey collected information from

a cross section of U.S. dairy operations, including measures of size, production costs, business arrangements, production facilities and practices, and farm operator and financial characteristics. The sampling resulted in 872 responses from 22 States (fig. 1).

Each surveyed (sample) farm represents a number of similar farms in the target population, as indicated by its expansion factor. The expansion factor, or survey weight, is determined from the selection probability of that farm. The survey weights allow the sample farms to represent the target population. The ARMS target population was farms with 10 or more milk cows during 2000. The sample represents about 90 percent of U.S. milk production that year (NASS, April 2002).

Figure 1
States surveyed in the 2000 ARMS of milk producers



Source: 2000 ARMS, USDA, ERS.

Cost-of-Production Components

Operating costs include major inputs such as feed, veterinary services and medicine, bedding and litter, marketing, custom services, fuel, lube, electricity, repairs, and interest on operating inputs. *Ownership costs* include the annualized cost of maintaining the capital investment (depreciation and interest) in dairy facilities and equipment and costs for non-real-estate property taxes and insurance.

Most operating costs are developed by summarizing survey responses about the total amount paid for these inputs. Surveyed quantities of homegrown feed fed to milk cows are valued at market prices. Surveyed acres of grazed pasture and cropland are valued at market rental cost. The interest on operating inputs is the *opportunity cost* of the investment in total operating inputs during the year.

Capital recovery cost is an estimate of the annual capital expenditure necessary to replace machinery, buildings, and equipment over their assumed ownership period and includes an interest charge on unrecovered capital. Detailed information is collected regarding the machinery, buildings, and equipment used in production. The data include age, type, and size of machinery, buildings, and equipment items. Non-real-estate taxes and insurance for the whole operation are allocated to the milk enterprise according to the gross margin of milk production relative to other farm enterprises. All costs are computed using methods recommended by the American Agricultural Economics Association (AAEA) Task Force on Commodity Costs and Returns (AAEA Handbook).

Capital Recovery Costs Are Significantly Lower on Operations in the West

Milk producers in the West had a significant cost advantage over producers in other regions because their operations were appreciably larger. Larger dairy operations benefit from economies of size that spread capital costs over more units of production.

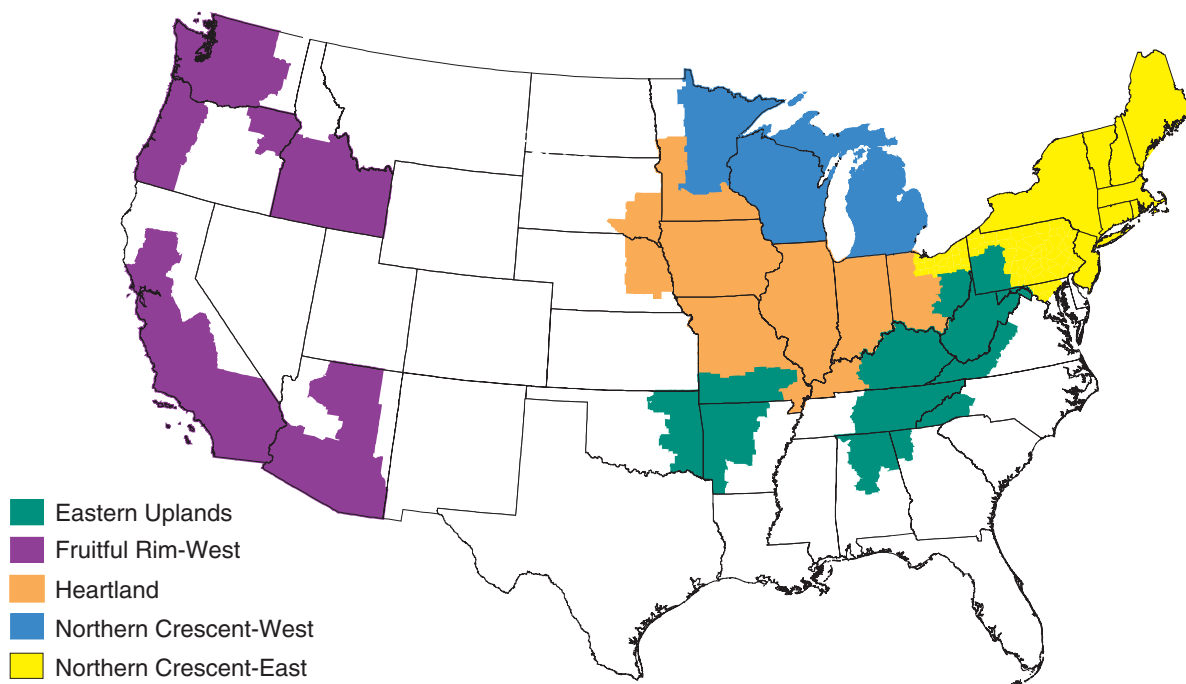
This report explores regional diversity in milk production using the ERS Farm Resource Regions as the basis for regional delineation (Heimlich). The Fruitful Rim region is modified (Fruitful Rim-West) to include only States in the Western United States because of this area's importance as a source of milk (fig. 2). The Northern Crescent is divided into two separate regions (Northern Crescent-East and Northern Crescent-West) to enable the comparison of two traditional milk production areas (fig. 2). The Heartland and Eastern Uplands are also used in the analysis. The Southern Seaboard and Prairie Gateway regions were not included because the survey provided too few observations for a detailed breakdown of farm and operator characteristics in these regions. The Northern Great Plains and Basin and Range regions were excluded for similar reasons.

Only 7 percent of dairy operations were located in the Fruitful Rim-West. However, these operations accounted

for 28 percent of milk sales (table 1). Sixty-six percent of the operations were located in the two Northern Crescent regions combined and accounted for 46 percent of milk sales. The remaining 23 percent of dairy operations were in the Heartland and Eastern Uplands regions and accounted for 12 percent of milk sales.

Structural differences in milk production were apparent among the five regions. For example, producers in the Fruitful Rim-West had significantly larger dairy operations that are more labor-efficient, tend to be more specialized in milk production, and purchase most, if not all, of the feed fed. Operations in the Fruitful Rim-West had an average of 469 milk cows, compared with fewer than 100 milk cows in each of the other four regions. Concentration of the cows on the cropland base of dairy farms in the Fruitful Rim-West (4.61 milk cows per cropland acre) was significantly higher than in the other four regions. The concentration of cows on the land

Figure 2
ERS farm resource regions modified to examine dairy operations



Source: 2000 ARMS, USDA, ERS.

Table 1—Performance and production practices of dairy farms by region, 2000

Item	Heartland (a)	Northern Crescent-East (b)	Northern Crescent- West (c)	Eastern Uplands (d)	Fruitful Rim- West (e)
			<i>Percent</i>		
Dairy farms	13 b c e	28 a c d e	38 a b d e	10 b c e	7 a b c d
Milk sales	7 b c d e	22 a d e	24 a d	5 a b c e	28 a b d
			<i>Average number per farm</i>		
Milk cows	67 e	78 e	80 e	64 e	469 a b c d
			<i>Pounds</i>		
Output per cow	15,399 b e	17,302 a d	15,391	14,013 b e	18,001 a d
			<i>Milk cows per cropland acre</i>		
Concentration	0.49 c e	0.42 c e	0.31 a b d e	0.58 c e	*4.61 a b c d
			<i>Hours per cwt of milk sold</i>		
Labor efficiency					
Paid	0.06 b c d	0.14 a e	0.15 a e	0.12 a e	*0.07 b c d
Unpaid	0.39 e	0.35 e	0.31 e	0.38 e	0.05 a b c d
Total	0.45 e	0.49 e	0.46 e	0.50 e	0.12 a b c d
			<i>Pounds per cwt of milk sold</i>		
Feed efficiency					
Purchased	41 e	#142	33 e	67	*185 a c
Homegrown	217 b d e	145 a c e	180 b e	133 a e	56 a b c d
Total	258	*287	213	200	*241
			<i>Percent of milk cows</i>		
bST use	*12	20 d	13 d	*5 b c e	*16 c
Hours milking system operational	5 e	5 c e	4 b e	5 e	12 a b c d
			<i>Percent of farms</i>		
Milking units with automatic takeoffs	16 e	20 e	18 e	*27 e	71 a b c d
Management practices					
<i>Production</i>					
Genetic selection/ breeding programs	62	74 c d	60 a	54 b	64
Breeding/calving season control	58 b c	32 a c e	41 a b	44	49 b
Preventive medicine/ practices	88 c	89	94 a	90	93
<i>Input acquisition</i>					
Forward purchases of feed	23 e	25 e	21 e	*19 e	52 a b c d
Nutritionist to purchase feed	61 b	77 a d	67 d	51 b c e	66 d
Dealers/suppliers to purchase feed	46	39 e	39 e	*36 e	58 b c d
Farmer-owned coop to purchase feed	47 c	46 c	79 a b d e	*39 c	45 c
Monitor forage quality	50	63	51	47	60
Purchase used farm machinery or equipment	53 e	64 d e	59 e	50 b	38 a b c

Coefficient of Variation = (Standard Error/Estimate) x 100. * indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is greater than 50 and less than or equal to 75.

a, b, c, d, e indicate that estimates are significantly different from the indicated region above the 90-percent-or-better level using the t-statistic.

Source: 2000 ARMS of milk producers, USDA, ERS.

indicates the amount of land potentially available for feed production, as well as for manure disposal.

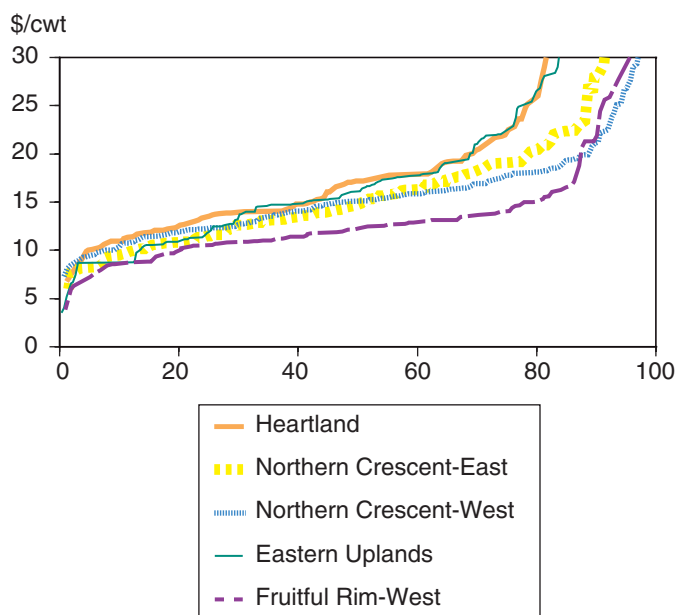
Concentration was significantly less in the Northern Crescent-West than in the Northern Crescent-East even though the average number of milk cows per farm in the two regions is similar. The Northern Crescent-West has a much larger cropland base than the Northern Crescent-East. Northern Crescent-West producers fed significantly more homegrown feed per hundredweight (cwt) of milk sold. However, total feed efficiency was similar in both regions.

Management practices used by dairy farmers in the five regions suggest that most milk producers take steps to improve the performance of the dairy enterprise. In managing dairy herds, a relatively large proportion of farmers used genetic selection and breeding programs to improve the herd quality and used preventive medicine and practices to maintain herd health. To manage input purchases, a significantly larger percent of farmers in the Fruitful Rim-West locked in input prices before delivery to take advantage of favorable prices and thereby control input costs; negotiated input price discounts with dealers or suppliers; and purchased used farm machinery or equipment. Such practices may have contributed to operating costs that were significantly lower in the Fruitful Rim-West than in most other regions (table 2).

Producers in the Fruitful Rim-West operated their milking systems significantly more hours per day, thus using more of the available milking capacity than producers in the other four regions (table 1). Because milking facilities were used much more efficiently in the Fruitful Rim-West, asset ownership costs were lower as fixed costs were spread over more units of production. Consequently, dairy operations in this region had a significant competitive advantage over those in the other regions, due in part to lower asset ownership costs.

A comparison of the regional cost distributions of milk producers illustrates the cost competitiveness of producers in each region (fig. 3). The Heartland and Eastern Uplands were the high-cost regions, as their distributions are above those of the other regions. Cost distributions were similar in both areas of the Northern

Figure 3
Regional cumulative distribution of milk operating plus ownership costs, 2000



Source: 2000 ARMS, USDA, ERS.

Crescent, but were much lower for producers in the Fruitful Rim-West. At \$12.40 per cwt, the average U.S. all-milk price in 2000, 50 percent of dairy producers in the Fruitful Rim-West were able to cover total operating and ownership costs compared with 30 percent of producers in the two Northern Crescent regions, 25 percent in the Eastern Uplands, and 20 percent in the Heartland.

A significantly larger proportion of producers in the Fruitful Rim-West attended college compared with producers in the other regions (table 3). The smaller proportion of Fruitful Rim-West producers over 55 years of age and the higher average debt-to-asset ratio suggest that the investment in milk production in this region has been more recent than in the other four regions. Also, a smaller proportion of dairy farmers in the Fruitful Rim-West reported plans to exit milk production within the next 10 years compared with farmers in the other regions, indicating that the Fruitful Rim-West will likely continue to be a major source of milk supplies. Most of the dairy farms in the Fruitful Rim-West were highly specialized commercial farms with sales of \$250,000 or more (see glossary).

Table 2—Milk production costs and returns, dollars per cwt milk sold, by region, 2000

Item	Heartland (a)	Northern Crescent-East (b)	Northern Crescent- West (c)	Eastern Uplands (d)	Fruitful Rim- West (e)
<i>Dollars</i>					
Operating costs					
Feed					
Feed grains	*2.16	0.97 c	1.33 b	*1.23	1.16
Hay and straw	3.11 b d	1.31 a	0.86 d e	1.76 a c	1.83 c
Complete feed mixes	1.09 d	1.48 c d	*0.68 b d	2.86 a b c e	*1.48 d
Liquid whey and milk replacer	*0.07 c	0.05 c	0.15 a b e	#0.13	#0.05 c
Silage	1.02	1.22 d e	1.18 d e	0.74 b c	0.81 b c
Grazed pasture and cropland	*0.18 e	0.08 d e	0.07 d e	0.26 b c e	0.03 a b c d
Other feed ¹	1.46 b d	0.87 a	1.31	#2.38	*0.80 a
Total feed cost	9.07 b c e	5.98 a d	5.57 a d	9.36 b c	6.15 a
Veterinary and medicine	0.80 d e	0.79 d e	0.74 d e	0.55 a b c	0.50 a b c
Bedding and litter	0.18 b d e	0.26 a d e	0.22 d e	0.10 a b c	*0.08 a b c
Marketing	0.24 b	0.42 a c e	0.20 b d	0.36 c e	0.22 b d
Custom services	0.57 c d	0.62 c d e	0.36 a b d	0.82 a b c e	0.41 b d
Fuel, lube, and electricity	0.59 e	0.54 e	0.56 e	0.56 e	0.36 a b c d
Repairs	0.66 e	0.63 e	0.55 e	0.66 e	0.42 a b c d
Hired labor	*0.72	1.03	1.20	0.96	1.12
Other ²	#0.00	*0.00	#0.00	#0.00	#0.02
Interest on operating capital	0.35 b c e	0.27 a c e	0.24 a b d	0.36 c e	0.24 a b d
Total operating costs	13.18 b c e	10.53 a c e	9.65 a b d	13.73 c e	9.52 a b d
Ownership costs					
Capital recovery	4.73 b e	3.71 a c e	4.52 b e	4.31 e	1.92 a b c d
Housing facilities	1.72 b e	1.28 a e	1.39 e	*1.15	0.63 a b c
Milking facilities	0.53 b c e	0.70 a b e	0.79 a d e	0.51 b c e	0.07 a b c d
Feed storage facilities	0.30 e	0.30 e	0.30 e	0.24 e	*0.13 a b c d
Manure handling facilities	0.28 b e	0.17 a d e	#0.56	0.32 b e	0.55 a b d
Machinery	1.76 b e	1.18 a d e	1.38 d e	1.82 b c e	0.36 a b c d
Breeding herd	*0.14	*0.08 d	0.10	*0.27 b	*0.18
Non-real-estate property taxes and insurance	0.18	0.20 c e	0.23 b e	0.19 e	0.13 b c d
Total ownership costs	4.91 b e	3.91 a c e	4.75 b e	4.50 e	2.06 a b c d
Total operating and ownership costs	18.09 b c e	14.44 a d e	14.40 a d e	18.23 b c e	11.58 a b c d
Returns above					
Operating costs	@1.22 b c	4.75 a e	4.62 a e	@1.92	3.33 b c
Operating and ownership costs	*-3.69 b c e	*0.84 a c	@-0.13 a b e	@-2.58 e	*1.28 a c d

¹Cotton seed meal, protein supplements, protein byproducts, vitamin or mineral supplements, nonprotein byproducts, alfalfa cubes or pellets, green chop, corn stalks, and antibiotics and other medicated additives.

²Manure disposal fees, permits and licenses, and odor control costs.

Coefficient of Variation = (Standard Error/Estimate) x 100. * indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is greater than 50 and less than or equal to 75. @ indicates that CV is above 75.

a, b, c, d, e indicate that estimates are significantly different from the indicated region above the 90-percent-or-better level using the t-statistic.

Source: 2000 ARMS of milk producers, USDA, ERS.

Table 3—Dairy operator and operation characteristics, by region, 2000

Item	Heartland (a)	Northern Crescent-East (b)	Northern Crescent- West (c)	Eastern Uplands (d)	Fruitful Rim- West (e)
Age distribution (percent)					
Less than 55 years	70	73	69	72	63
55 years or more	*30	27	31	28	37
Operator education (percent)					
High school or less	82 d e	81 d e	69 e	77 a b e	46 a b c d
Attended college	18 d e	19 d e	31 e	23 a b e	54 a b c d
Major occupation (percent)					
Farming	97	98	98	95	97
Sales class (percent of farms)					
\$250,000 or more	26 e	24 e	23 e	*16 e	75 a b c d
\$100,000-\$249,999	31 b	46 a	41	43	na
\$99,999 or less	43	29	36	*41	na
Production specialty (percent of farms)					
Dairy	79 e	92 e	90 e	83 e	98 a b c d
Farm debt/asset ratio (average)					
	2.58 e	2.77 d	2.74 d e	2.49 b e	2.96 a c d
Typology (percent of farms)					
Rural residence farms	9	7	1	13	na
Intermediate farms	65	68	75	71	na
Commercial farms	26 e	25 e	24 e	*16 e	76 a b c d
Exiting industry (percent of farms)					
10 years or less	50	53	66	49	38
More than 10 years	50	47	34	51	62
Years in business (percent of farms)					
10 years or less	na	26 c	16 b e	na	29 c
More than 10 years	na	74 c	84 b e	na	71 c

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

* indicates that CV is greater than 25 and less than or equal to 50.

na indicates value is not available due to no observations, an undefined statistic, or reliability concerns.

a, b, c, d, e indicate that estimates are significantly different from the indicated region above the 90-percent-or-better level using the t-statistic.

Source: 2000 ARMS of milk producers, USDA, ERS.

Operation Performance, Input Use, and Costs Varied by Enterprise Size

Operations with 500 or more milk cows had significantly lower total operating and ownership costs, indicative of the economies of size experienced by larger operations.

To analyze the relationship between enterprise size and production costs, dairy operations were divided into four groups; small (fewer than 50 cows), medium (50-199 cows), large (200-499 cows), and industrial scale (500 or more cows). Small- and medium-sized dairy operations far outnumbered large and industrial-scale operations in 2000 (table 4). Thirty-nine percent of dairy operations were small, but they accounted for only 10 percent of total milk sales. Although only 4 percent of dairy operations were industrial scale, they accounted for more than a third of milk sales. Industrial-scale operations had an average of 955 milk cows, compared with 313 in large operations, 88 in medium operations, and 33 in small operations. Concentration of the cows on the cropland base was significantly higher on industrial-scale operations (3.63 milk cows per cropland acre) than on any others. Consequently, these producers had much less acreage for producing feed or spreading manure.

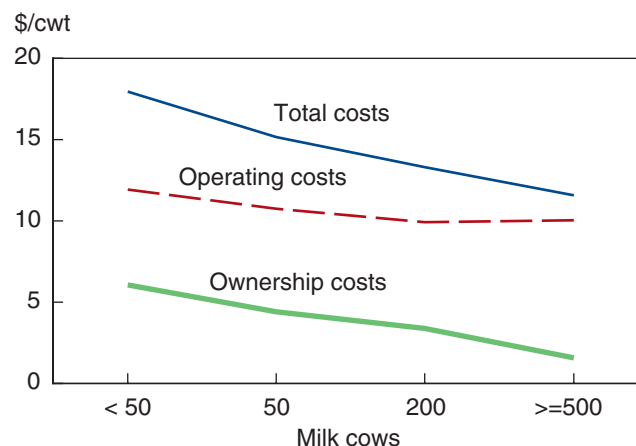
Most indicators of performance improved as size of operation increased. Feed, labor, and capital, the three major inputs in milk production, were all used more efficiently on larger operations. Industrial-scale operations were more labor-efficient, using only 0.11 total labor hours per cwt of milk sold (table 4); small dairy operations used nearly eight times as much labor per cwt of milk sold. Feed efficiency was significantly higher on industrial-scale dairy operations than on small and medium operations. Industrial-scale operations fed 162 pounds of feed per cwt of milk sold, compared with 243 and 253 pounds on small and medium operations, respectively. Industrial-scale operations more often used genetic selection and breeding programs to improve herd quality and a nutritionist to determine feed rations than did producers in other size groups. A large number of industrial-scale operations also used preventive medicine and practices to maintain herd health. Differences in capital efficiency by size, as indicated by the hours that milking systems were operational, were also significant: industrial scale enterprises operated their milking systems 8 to 15 more hours per day than the other three enterprise sizes.

Industrial-scale dairy operations had significantly lower operating and ownership costs than other operations, averaging \$11.60 per cwt. of milk sold (table 5). Nearly all of the cost difference is due to the decline in asset ownership costs with size. This is indicative of the economies of size experienced as the size of the enterprise increases and fixed facility costs are spread over more units of production.

Improvements in performance from the small to the industrial-scale operations were not linear, but rather incrementally less between the small, medium, and large groups (fig. 4). The largest efficiency gains were made between the small and medium groups. Average costs on medium-sized operations were more than 15 percent less than on small operations, while they fell 12 percent between the medium and large groups. However, average costs fell almost 13 percent between large and industrial-scale operations. These data suggest that production costs are reduced significantly by enlarging operations beyond relatively small sizes, and that there are cost-reducing incentives for operations to grow to the industrial scale.

Seventy percent of small operations had sales of \$99,999 or less (table 6). Milk production was a more

Figure 4
Operating and ownership costs by dairy enterprise size, 2000



Source: 2000 ARMS, USDA, ERS.

important component of the overall business of industrial-scale operations than of small and medium ones. All the industrial-scale operations were highly specialized commercial farms with sales of \$250,000 or more (see glossary). A significant proportion of operators of large and industrial-scale operations attended college, in con-

trast with operators of small and medium-size operations. Only 16 percent of industrial-scale operators reported intentions to exit milk production within the next 10 years, compared with 65 percent of small operators, indicating that industrial-scale operations will likely continue to be the major source of milk supplies.

Table 4—Performance and production practices of dairy farms, by enterprise size, 2000

Item	Enterprise size (number of milk cows)			
	Small (a) Fewer than 50	Medium (b) 50-199	Large (c) 200-499	Industrial scale (d) 500 or more
Share of ARMS (percent)				
Dairy farms	39 b c d	52 a c d	5 a b	4 a b
Milk sales	10 b d	41 a c	14 b d	35 a c
Milk cows (average number per farm)				
Output per cow (pounds)	33 b c d	88 a c d	313 a b d	955 a b c
Concentration (milk cows per cropland acre)	14,932 b c	16,157 a	17,420 a	17,326
Labor efficiency (hours per cwt of milk sold)				
Paid	0.39 c d	0.60 c d	*2.07 a b	3.63 a b
Unpaid	0.07 b c	0.13 a	0.12 a	*0.09
Total	0.77 b c d	0.31 a c d	0.07 a b d	0.02 a b c
Feed efficiency (pounds per cwt of milk sold)				
Purchased	0.84 b c d	0.44 a c d	0.19 a b d	0.11 a b c
Homegrown	38 d	*93	#230	102 a
Total	205 c d	159 c d	87 a b	*60 a b
bST use (percent of milk cows)				
Hours milking system operational	243 d	252 d	#317	162 a b
Milking units with automatic takeoffs (percent of farms)	*8	10	*17	22
Management practices (percent of farms)				
Production				
Genetic selection/breeding programs	3 b c d	5 a c d	10 a b d	18 a b c
Breeding/calving season control	3 b c d	30 a c d	85 a b	87 a b
Preventive medicine/practices	56 b c d	68 a d	70 b d	89 a b c
Input acquisition				
Forward purchases of feed	38 b	46 a	39	51
Nutritionist to purchase feed	86 b d	94 a	93	97 a
Dealers/suppliers to purchase feed	*12 b c d	27 a c d	58 a b d	89 a b c
Farmer-owned co-op to purchase feed	51 b c d	76 a d	76 a	90 a b
Monitor forage quality	32 b c d	44 a d	56 a d	90 a b c
Purchase used farm machinery or equipment	55	62 d	68 d	48 b c
Regional distribution (percent of farms)				
Heartland	42 b c d	63 a	72 a	65 a
Northern Crescent-East	51 b	63 a d	52	45 b
Northern Crescent-West	18 b	12 a	na	na
Eastern Uplands	28	32	na	na
Fruitful Rim-West	41	42	na	na
	*12	11	na	na
	na	4 d	na	77 a

Coefficient of Variation = (Standard Error/Estimate) x 100. * indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is greater than 50 and less than or equal to 75.

na indicates value is not available due to no observations, an undefined statistic, or reliability concerns.

a, b, c, d indicate that estimates are significantly different from the indicated enterprise size above the 90-percent-or-better level using the t-statistic.

Source: 2000 ARMS of milk producers, USDA, ERS.

Table 5—Milk production costs and returns, dollar per cwt milk sold, by enterprise size, 2000

Item	Enterprise size (number of milk cows)			
	Small (a) Fewer than 50	Medium (b) 50-199	Large (c) 200-499	Industrial scale (d) 500 or more
<i>Dollars</i>				
Operating costs				
Feed				
Feed grains	*1.88	1.13	1.13	1.17
Hay and straw	2.93 b c d	1.43 a	1.17 a	1.31 a
Complete feed mixes	1.04 c	1.34	1.69 a	1.54
Liquid whey and milk replacer	0.08 c	0.10 c	*0.04 a b	*0.07
Silage	0.90 b	1.11 a	0.90	*1.20
Grazed pasture and cropland	0.25 b c d	0.10 a c d	*0.04 a b d	*0.01 a b c
Other feed ¹	1.08	1.33 c	0.86 b	0.88
Total purchased feed cost	8.16 c d	6.54	5.83 a	6.17 a
Veterinary and medicine	0.66	0.71	0.58	0.60
Bedding and litter	0.25 b d	0.20 a d	0.17 d	0.07 a b c
Marketing	0.32	0.29	0.25	0.24
Custom services	0.61 b	0.52 a	0.52	0.51
Fuel, lube, and electricity	0.65 c d	0.58 c d	0.41 a b	0.35 a b
Repairs	0.62 c d	0.64 c d	0.47 a b	0.41 a b
Hired labor	0.32 b c d	1.01 a c d	1.45 a b	1.41 a b
Other ²	*0.00	0.00	*0.00	#0.02
Interest on operating capital	0.33 c d	0.27 c d	0.24 a b	0.24 a b
Total operating costs	11.92	10.76	9.94	10.03
Ownership cost				
Capital recovery	5.85 b c d	4.17 a d	3.24 a d	1.44 a b c
Housing facilities	1.57 b d	1.31 a d	*1.14 d	*0.48 a b c
Milking facilities	1.33 b c d	0.66 a c d	0.10 a b d	*0.06 a b c
Feed storage facilities	0.30 c d	0.32 c d	0.13 a b	*0.12 a b
Manure handling facilities	0.15 b d	0.34 a	#1.06	0.37 a
Machinery	2.26 b c d	1.43 a c d	0.54 a b d	0.26 a b c
Breeding herd	0.24 b	0.11 a	*0.26	*0.14
Non-real-estate property taxes and insurance	0.21 c d	0.23 c d	0.15 a b d	0.12 a b c
Total ownership costs	6.06 b c d	4.40 a d	3.38 a d	1.57 a b c
Total operating and ownership costs	17.98 b c d	15.16 a c d	13.32 a b d	11.60 a b c
Returns above				
Operating costs	*3.82	3.92	4.12	3.38
Operating and ownership costs	*-2.24 c d	@-0.48 d	@0.73 a	*1.81 a b

¹Cotton seed meal, protein supplements, protein byproducts, vitamin or mineral supplements, nonprotein byproducts, alfalfa cubes or pellets, green chop, corn stalks, and antibiotics and other medicated additives.

²Manure disposal fees, permits, and licenses, and odor control costs.

Coefficient of Variation = (Standard Error/Estimate) x 100. * indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is greater than 50 and less than or equal to 75. @ indicates that CV is above 75.

a, b, c, d indicate that estimates are significantly different from the indicated enterprise size above the 90-percent-or-better level using the t-statistic.

Source: 2000 ARMS of milk producers, USDA, ERS.

Table 6—Dairy operator and operation characteristics, by enterprise size, 2000

Item	Enterprise size (number of milk cows)			
	Small (a) Fewer than 50	Medium (b) 50-199	Large (c) 200-499	Industrial scale (d) 500 or more
Age distribution (percent)				
Less than 55 years	74	68	61	71
55 years or more	26	32	*39	29
Operator education (percent)				
High school or less	84 b c d	70 a c d	48 a b	*36 a b
Attended college	16 b c d	30 a c d	52 a b	64 a b
Major occupation (percent)				
Farming	97	97	90	94
Sales class (percent of farms)				
\$250,000 or more	2 b c d	36 a c d	98 a b	100 a b
\$100,000-\$249,999	28 b d	55 a d	na	0 a b
\$99,999 or less	70 b d	10 a d	na	0 a b
Production specialty (percent of farms)				
Dairy	81 b d	94 a d	93	100 a b
Debt/asset ratio (average)				
	2.65 c d	2.72 d	2.92 a d	3.32 a b c
Typology (percent of farms)				
Rural residence farms	na	1 d	na	0 b
Intermediate farms	86 b d	62 a d	na	0 a b
Commercial farms	na	37 c d	98 d	100 b
Exiting industry (percent of farms)				
10 years or less	65 b c d	54 a d	39 a d	16 a b c
More than 10 years	35 b c d	46 a d	61 a d	84 a b c
Years in business (percent of farms)				
10 years or less	24 d	20 d	20 d	44 a b c
More than 10 years	76 d	80 d	80 d	56 a b c

Coefficient of Variation = (Standard Error/Estimate) x 100. * indicates that CV is greater than 25 and less than or equal to 50.

na indicates value is not available due to no observations, an undefined statistic, or reliability concerns.

a, b, c, d indicate that estimates are significantly different from the indicated enterprise size above the 90-percent-or-better level using the t-statistic.

Source: 2000 ARMS of milk producers, USDA, ERS.

Enterprise Size and Physical and Economic Performance Distinguished Low-Cost from High-Cost Operations

Low-cost operations showed the advantages of economies of size, as the average operation size was more than three times that of high-cost operations.

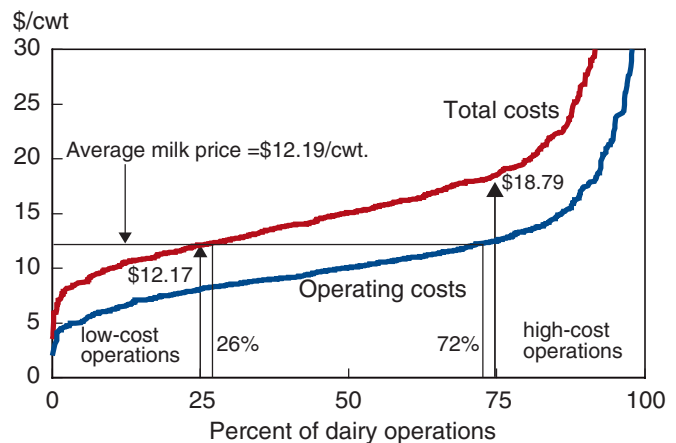
Estimated operating and ownership costs per cwt of milk sold were ranked from lowest to highest to form a weighted cumulative distribution of operations. A comparison of costs with prices received by milk producers gives a rough indication of the number of producers who covered costs. At the 2000 average milk price of \$12.19 per cwt, roughly 72 percent of milk producers were able to cover operating costs of production. Only about 26 percent of producers were able to cover both operating and asset ownership costs (fig. 5). Prices received by farmers for milk vary substantially, while production costs are relatively stable. Between 2000 and 2003, average monthly prices were as high as \$17 per cwt and as low as \$11. This means that the number of producers able to cover costs can vary widely at any point in time.

To analyze factors contributing to variation in production costs, dairy operations were divided into low-, mid-, and high-cost groups. Twenty-five percent of dairy operations had costs of \$12.17 or less per cwt of milk sold (fig. 5). These low-cost operations accounted for 43 percent of total milk sales (table 7). Low-cost operations had significantly larger herds than high-cost operations, 181 milk cows vs. 57. High-cost operations, with costs of \$18.79 or more per cwt of milk sold, accounted for 9 percent of milk sales.

Differences in animal performance were critical in determining whether producers were low or high cost. Output per cow on low-cost farms averaged 17,777 pounds, compared with 11,739 pounds on high-cost farms. As a result, low-cost producers averaged some \$750 more in cash receipts from the sale of milk for each cow in the milking herd. Feed represents a major expense in milk production. Low-cost producers fed 142 pounds of feed per cwt of milk sold, compared with 569 pounds fed by high-cost producers. Greater feed efficiency on the part of low-cost producers resulted from both more output per cow and less feed fed per cow.

Low-cost producers more often used innovative management practices and technologies than high-cost producers. For instance, low-cost producers made significantly greater use of genetic and breeding programs to improve herd quality, and they more often used a nutritionist to purchase feed and formulate dairy rations. Low-cost pro-

Figure 5
Cumulative distribution of operating and total costs for producing milk, 2000



Source: 2000 ARMS, USDA, ERS.

ducers were also more labor-efficient than high-cost producers, using 0.23 total labor hours per cwt of milk sold, compared with 0.75 total hours in high-cost operations. Low-cost dairy farms also used their milking facilities more efficiently than high-cost farms, keeping their milking systems operating 6 hours per day on average compared with 4 hours per day on high-cost farms.

Average total operating costs were \$8.74 per cwt of milk sold for low-cost producers, compared with more than \$23 for high-cost producers (table 8). High-cost operations had significantly higher feed costs than all other operations: an average of \$17.25 per cwt of milk sold vs. \$5.12 in low-cost operations. Low-cost farms made significantly more use of forward purchases to lock in feed prices (table 7). They also made significantly more use of nutritionists, dealers or suppliers, and farmer-owned cooperatives to purchase feed.

In general, dairy farms are highly specialized operations that derive most of their household income from milk production, as illustrated by the distribution by farm typology (see glossary). Ninety-eight percent of low-cost farms were intermediate and commercial farms, compared with 87 percent of high-cost farms (table 9). Low-cost producers were generally younger than high-cost producers and expected to stay in the dairy business beyond the year 2010.

Table 7—Performance and production practices of dairy farms, by production cost group, 2000

Item	Low-cost farms (a)	Mid-cost farms (b)	High-cost farms (c)
Dairy farms (percent)	25 b	50 a c	25 b
Milk sales	43 c	48 c	9 a b
Milk cows (average number per farm)	181 b c	104 a c	57 a b
Output per cow (pounds)	17,777 c	16,830 c	11,739 a b
Concentration (milk cows per cropland acre)	*1.27 b c	0.57 a c	0.32 a b
Labor efficiency (hours per cwt of milk sold)			
Paid	0.09 c	0.11 c	0.18 a b
Unpaid	0.14 b c	0.23 a c	0.57 a b
Total	0.23 b c	0.35 a c	0.75 a b
Feed efficiency (pounds per cwt of milk sold)			
Purchased	69	*116	#275
Homegrown	72 b c	129 a c	294 a b
Total	142 b c	245	*569 a b
bST use (percent of milk cows)	18 c	14	9 a
Hours milking system operational	6 b c	5 a c	4 a b
Milking units with automatic takeoffs (percent of farms)	30 c	26 c	17 a b
Management practices (percent of farms)			
Production			
Genetic selection/breeding programs	69 c	65	58 a
Breeding/calving season control	37	45	44
Preventive medicine/practices	90	94	88
Input acquisition			
Forward purchases of feed	29 c	28 c	14 a b
Nutritionist to purchase feed	70 c	74 c	48 a b
Dealers/suppliers to purchase feed	43 c	47 c	29 a b
Farmer-owned co-op to purchase feed	49 b	66 a	57
Monitor forage quality	54	58	51
Purchase used farm machinery or equipment	56	61	51
Regional distribution (percent of farms)			
Heartland	17	46	37
Northern Crescent-East	28	43	29
Northern Crescent-West	23	61	16
Eastern Uplands	26	38	36
Fruitful Rim-West	48	39	13

Coefficient of Variation = (Standard Error/Estimate) x 100. * indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is greater than 50 and less than or equal to 75.

a, b, c indicate that estimates are significantly different from the indicated production cost group above the 90-percent-or-better level using the t-statistic.

Source: 2000 USDA ARMS of milk producers, USDA, ERS.

Table 8—Milk production costs and returns, dollar per cwt milk sold, by production cost group, 2000

Item	Low-cost farms (a)	Mid-cost farms (b)	High-cost farms (c)
	<i>Dollars</i>		
Operating costs			
Feed			
Feed grains	1.06 c	1.10 c	*3.33 a b
Hay and straw	1.07 b c	1.49 a c	5.70 a b
Complete feed mixes	1.23 c	1.68	1.96 a
Liquid whey and milk replacer	*0.06	*0.09	*0.18
Silage	0.83 c	1.12	*3.34 a
Grazed pasture and cropland	0.04 b c	0.09 a c	*0.36 a b
Other feed ¹	0.82 c	1.29	#2.38 a
Total feed cost	5.12 b c	6.86 a c	17.25 a b
Veterinary and medicine	0.56 b c	0.78 a	0.79 a
Bedding and litter	0.12 b c	0.19 a c	0.31 a b
Marketing	0.25 c	0.29 c	0.41 a b
Custom services	0.44 b c	0.62 a c	0.85 a b
Fuel, lube, and electricity	0.38 b c	0.57 a c	1.00 a b
Repairs	0.39 b c	0.69 a c	1.05 a b
Hired Labor	1.25 b c	0.98 a	0.94 a
Other ²	#0.01	*0.00	*0.00
Interest on operating capital	0.21 b c	0.29 a c	0.62 a b
Total operating costs	8.74 b c	11.26 a c	23.23 a b
Ownership cost			
Capital recovery	2.01 b c	4.23 a c	9.62 a b
Housing facilities	0.62 b c	1.50 a c	2.26 a b
Milking facilities	0.25 b c	0.61 a c	1.28 a b
Feed storage facilities	0.16 b c	0.26 a c	0.58 a b
Manure handling facilities	0.30	0.29	#2.43
Machinery	0.55 b c	1.41 a c	2.77 a b
Breeding herd	*0.14 c	0.16 c	0.29 a b
Non-real-estate property taxes and insurance	0.14 b c	0.21 a c	0.33 a b
Total ownership costs	2.15 b c	4.44 c	9.95 a b
Total operating and ownership costs	10.89 b c	15.70 a c	33.18 a b
Returns above			
Operating costs	4.98 b c	3.56 a c	*-7.04 a b
Operating and ownership costs	2.84 b c	-0.89 a c	-16.99 a b

¹Cotton seed meal, protein supplements, protein byproducts, vitamin or mineral supplements, nonprotein byproducts, alfalfa cubes or pellets, green chop, corn stalks, and antibiotics and other medicated additives.

²Manure disposal fees, permits and licenses, and odor control costs.

Coefficient of Variation = (Standard Error/Estimate) x 100. * indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is greater than 50 and less than or equal to 75.

a, b, c indicate that estimates are significantly different from the indicated production cost group above the 90-percent-or-better level using the t-statistic.

Source: 2000 USDA ARMS of milk producers, USDA, ERS.

Table 9—Dairy operator and operation characteristics, by production cost group, 2000

Item	Low-cost farms (a)	Mid-cost farms (b)	High-cost farms (c)
Age distribution (percent)			
Less than 55 years	73	70	66
55 years or more	27	30	34
Operator education (percent)			
High school or less	68 c	75	79 a
Attended college	32	25	21
Major occupation (percent)			
Farming	97	97	96
Sales class (percent of farms)			
\$250,000 or more	46 b c	24 a c	*10 a b
\$100,000-\$249,999	35	44	36
\$99,999 or less	19 b c	32 a c	54 a b
Production specialty (percent of farms)			
Dairy	95 c	94 c	70 a b
Debt/asset ratio (average)			
	2.70	2.80 c	2.60 b
Typology (percent of farms)			
Rural residence farms	2	4	13
Intermediate farms	51 b c	72 a	77 a
Commercial farms	47 b c	24 a c	*10 a b
Exiting industry (percent of farms)			
10 years or less	48 c	55 c	70 a b
More than 10 years	52 c	45 c	30 a b
Years in business (percent of farms)			
10 years or less	25	20	*25
More than 10 years	75	80	75

Coefficient of Variation = (Standard Error/Estimate) x 100. * indicates that CV is greater than 25 and less than or equal to 50.

a, b, c indicate that estimates are significantly different from the indicated production cost group above the 90-percent-or-better level using the t-statistic.

Source: 2000 USDA ARMS of milk producers, USDA, ERS.

Glossary

Dairy farms represent those selected in USDA's 2000 ARMS, Dairy version, and include only operations that had 10 or more milk cows in 2000.

Enterprise size is a structural indicator of farm size based on the number of milk cows.

Farm operator is the person who makes most of the day-to-day decisions about the farm, regardless of whether or not others share management responsibility. Thus, for the ARMS as for the Census of Agriculture, the number of farm operators equals the number of farms.

Farm typology is a classification developed by the Economic Research Service (ERS) to divide U.S. farms into mutually exclusive and homogeneous groups. The farm typology focuses on "family farms," or farms organized as proprietorships, partnerships, or family corporations that are not operated by a hired manager. To be complete, however, the classification also considers nonfamily farms.

- **Rural residence farms**

Limited-resource—Any small farm with gross sales less than \$100,000, total farm assets less than \$150,000, and total operator household income less than \$20,000. Limited-resource farmers may report farming, a nonfarming occupation, or retirement as their major occupation.

Retirement farms—Small farms (sales less than \$250,000) whose operators report they are retired. (Excludes limited-resource farms operated by retired farmers.)

Residential/lifestyle farms—Small farms (sales less than \$250,000) whose operators report they had a major occupation other than farming. (Excludes limited-resource farms with operators reporting a nonfarm major occupation.)

- **Intermediate farms**

Farming occupation/lower sales—Small farms with sales less than \$100,000 whose operators report farming as their major occupation. (Excludes limited-resource farms whose operators report farming as their major occupation.)

Farming occupation/higher sales—Small farms with sales between \$100,000 and \$249,999 whose operators report farming as their major occupation.

- **Commercial farms**

Large family farms—Sales between \$250,000 and \$499,999.

Very large family farms—Sales of \$500,000 or more.

Nonfamily farms—Farms organized as nonfamily corporations or cooperatives, as well as farms operated by hired managers.

High-cost producers are the 25 percent of milk producers with the highest total operating and ownership costs per cwt of milk sold. Included are milk producers with costs of \$18.79 or more per cwt of milk sold.

Low-cost producers are the 25 percent of milk producers with the lowest total operating and ownership costs per cwt of milk sold. Included are milk producers with costs of less than \$12.17 per cwt of milk sold.

Major occupation is that occupation in which the operator reported spending the majority of his/her time during 2000.

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

Sales class is a structural indicator of farm size based on gross value of sales.

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. USDA's annual ARMS survey applies complex, stratified, multiple-frame, probability-weighted, and multiple-phase sampling methods to provide financial measures of the agricultural sector. These sampling methods lead to complications in estimating the efficiency of summary statistics. Software has been developed within USDA's ERS that addresses the intricacies of the ARMS. This software employs the delete-a-group jackknife variance estimator (Dubman), a universal all-purpose variance estimator that avoids problems in complex sample design. The delete-a-group jackknife is easy to apply to all weighted estimates, regardless of their complexity or statistical properties. In this report, ranges for coefficient of variation (CV) are given if the CV is greater than 25.

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

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

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