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Characteristics, Costs, and Issues for Organic Dairy Farming

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Abstract

Organic milk production has been one of the fastest growing segments of organic agriculture in the United States in recent years. Despite the growing number of organic dairy operations, the characteristics of organic dairy operations and the relative costs of organic and conventional milk production have been difficult to analyze. This study, using 2005 ARMS data for U.S. dairy operations, which include a targeted sample of organic milk producers, examines the structure, costs, and challenges of organic milk production. The analysis addresses economies of size, regional differences, and pasture use in organic milk production and compares organic and conventional milk production costs. The findings suggest that economic forces have made organic operations more like conventional operations and that the future structure of the industry may depend on the interpretation and implementation of new organic pasture rules.

Keywords: dairy, organic, milk production, costs of production, pasture, Agricultural Resource Management Survey (ARMS)

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Contents

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Summary

Spurred by increased demand for organic milk, organic milk production has been one of the fastest growing segments of organic agriculture in the United States. Between 2000 and 2005, the number of certified organic milk cows on U.S. farms increased by an annual average of 25 percent, from 38,000 to more than 86,000. To meet the growing demand, the organic production sector has evolved much like the conventional sector. Along with primarily small, pasture-based organic operations located in the Northeast and Upper Midwest, larger organic operations, often located in the West, that use more conventional milk production technologies have increased in number. Economic incentives, driven largely by lower production costs, are behind much of this change. Proposed changes in USDA's National Organic Program (NOP), which develops, implements, and administers national production, handling, and labeling standards for organic agricultural products, seek to clarify and stiffen pasture requirements for organic certification and may determine how the organic production sector continues to evolve.

What Is the Issue?

Organic milk producers usually begin as conventional dairy operators who go through what can be a challenging and costly transition. To qualify for organic certification under the NOP, producers must make changes in animal husbandry, land and crop management, input sourcing, and certification paperwork, among others. In addition to these challenges, organic milk producers must now contend with the impact of a weaker U.S. economy on the demand for organic food products. By providing information about the characteristics, costs, and challenges faced by organic milk producers, this report provides a context for producers considering the organic approach, processors trying to supply an expanding organic milk market, and policymakers evaluating the economic implications of organic livestock production.

What Did the Study Find?

Economic forces may have pushed organic dairies to adapt their operations to be more like conventional dairies in terms of size, location, and the types of technologies used. The relative production costs for large and small organic dairies, organic dairies in the East and West, and organic dairies using pasture-based and conventional technologies are similar to those for conventional dairies.

Size and Costs of Organic Dairies. Farms producing organic milk most often have small dairy operations; 45 percent of organic dairies milk fewer than 50 cows, and 87 percent milk fewer than 100 cows. Large organic dairies with 200 cows or more are a small portion of the organic dairy population, but account for more than a third of organic milk production. Average operating costs are highest on the largest organic dairies, but total economic costs are nearly $14 per hundredweight (cwt) less on the largest than on the smallest organic dairies because of lower capital and unpaid labor costs. The smallest operations use much more unpaid labor, accounting for most of this cost difference. Large organic dairies are much more likely to generate returns above capital and labor costs, suggesting that organic milk

production will migrate toward larger operations, as has conventional production. Additional costs to comply with organic pasture requirements and for securing organic inputs in large volume may limit the cost advantages for larger organic dairies.

Region and Costs of Organic Dairies. More than 80 percent of U.S. organic dairies are located in the Northeast and Upper Midwest, but these operations are small and less productive than those in the West. Organic dairies in the Northeast (averaging 53 cows) and Upper Midwest (64 cows) have far fewer cows on average than those in the West (381 cows), which produce more milk per cow on average (2,700 pounds more than in the Upper Midwest and 4,000 pounds more than in the Northeast). Average feed costs per cow are significantly less on organic dairies in the Northeast and Upper Midwest due to greater use of homegrown feed and pasture. Despite higher feed costs per cow and greater labor and capital use, organic dairies in the West have lower total economic costs per cwt of milk produced. This cost advantage is the result of economies of size and much higher productivity per cow that may be attributed to the technologies used on these operations.

Pasture Use and Costs of Organic Dairies. Almost two-thirds of organic dairies report that 50 percent of dairy forage comes from pasture, and a third indicate that 75 percent or more comes from pasture. Using pasture for dairy feed costs less than higher energy feed sources, and average feed costs per cow decline as more pasture is used for dairy forage. Organic dairies using the least pasture for dairy forage, however, have lower feed costs per cwt of milk than other organic dairies because average production per cow is more than 30 percent higher. Organic dairies that use conventional feeding methods, such as confining cows and feeding harvested forages, may generate higher returns to capital and labor than those using pasture-based feeding because of higher production and economies of size, and because pasture-based feeding requires more labor.

Comparing Organic and Conventional Dairies

- Organic dairies are smaller than conventional dairies (82 cows compared with 156 cows).
- Organic dairies produce about 30 percent less milk per cow than conventional dairies (13,601 pounds per organic cow compared with 18,983 pounds per conventional cow).
- Organic dairies are more often located in the Northeast and Upper Midwest than are conventional dairies (86 percent compared with 65 percent).
- Organic dairies use more pasture-based feeding, where more than 50 percent of dairy forage fed is from pasture during grazing months, than conventional dairies (63 percent compared with 18 percent).
- Organic dairies paid $6.37 per cwt more than conventional dairies in operating and capital costs, including transition costs, in 2005; the average price premium for organic milk was $6.69 per cwt.

- Total economic costs of organic dairies in 2005 were $7.65 per cwt higher than for conventional dairies, nearly $1 per cwt higher than the average price premium for organic milk.
- Pasture-based organic dairies' total economic costs were about $4 per cwt higher than conventional pasture-based dairies, much lower than the average price premium for organic milk in 2005.

Challenges of Organic Milk Production. Certification paperwork and compliance costs were reported by 40 percent of producers as the most challenging aspect of organic milk production, followed by finding new organic input sources (dairy replacement and feed), higher costs of production, and maintaining animal health. By contrast, the chief concern for large organic dairies seem to be finding organic input sources, and the chief concern for dairies in the Northeast seemed to be production costs; certification paperwork was a lesser concern for pasture-based dairies and more educated operators.

How Was the Study Conducted?

This study used information from a 2005 survey of U.S. milk producers as part of USDA's annual Agricultural Resource Management Survey (ARMS) administered by its National Agricultural Statistics Service (NASS) and Economic Research Service (ERS). The survey targeted dairy operations in 24 States that accounted for more than 90 percent of national milk production and covered all major production areas. A subsample of the survey targeted organic dairies identified by major organic milk processors and certifiers. Surveyed organic milk producers were divided by size, region, and pasture use, and differences in characteristics and production costs of the groups were evaluated. Regression analysis, with a treatment-effect model, was used to measure the difference in production costs between organic and conventional dairies. Differences in production costs, along with estimates of organic transition costs, indicated the milk price premiums that make organic competitive with conventional milk production.

Introduction

Organic milk production has been one of the fastest growing segments of organic agriculture in the United States. Between 2000 and 2005, the number of certified organic milk cows on U.S. farms increased by an annual average of about 25 percent, from 38,000 to more than 86,000 (USDA, Economic Research Service, 2007a; fig. 1). Many of these cows were on small dairy operations that had switched to organic production to improve farm profitability (Barham, Brock, and Foltz, 2006).[1] While organic milk cows accounted for about 1 percent of all U.S. milk cows in 2005, the sector continues to grow. USDA estimates indicate that organic milk increased from 2 percent of U.S. fluid milk product sales in 2006 to 3 percent in 2008 (computed from information reported at USDA, Agricultural Marketing Service, 2009c).[2]

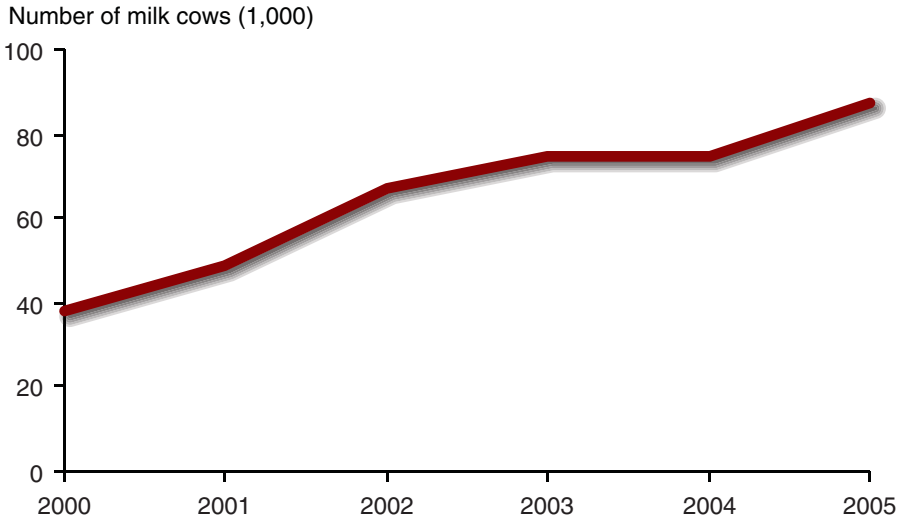
Certified organic milk production systems rely on ecologically based standards that prohibit the use of antibiotics and hormones in the cow herd and the use of synthetic chemicals in dairy feed production. Certified organic milk production systems also attempt to accommodate the animals' natural nutritional and behavioral requirements, such as ensuring that cows have access to pasture (Greene and Kremen, 2003). These requirements add to production costs and create challenges for widespread adoption, such as higher managerial costs and risks of shifting to a new way of farming, and significant time and costs associated with the transition to organic production.

This report describes organic dairy farms in the United States, including information about farm size, location, production costs, and the types of technologies used, and discusses the challenges of organic milk production. Although the analysis focuses on organic dairy farms, a comparison with conventional dairy farms adds value to the discussion.

Figure 1

Number of organic milk cows on U.S. farms

Between 2000 and 2005, the number of organic milk cows increased by an annual average of about 25 percent



Source: USDA, Economic Research Service, 2007a.

[1]The 2007 Census of Agriculture reports 1,617 farms with organic product sales among those classified as dairy cattle and milk production according to the North American Industry Classification System (NAICS). This is up from 516 farms in 2002.

[2]One percent of organic milk cows can account for 2-3 percent of U.S. fluid milk consumption because most organic milk production is sold as fluid milk. In contrast, only about 36 percent of conventional milk is sold as fluid milk. The rest is sold for cheese and other manufactured products (Miller and Blayney, 2006).

Background

Organic milk producers usually begin as conventional dairy operators who then go through what can be a challenging and costly transition process. During the transition, organic dairies must change their animal husbandry, land, and crop management, source new and different inputs, and initiate the certification process. To become a certified organic dairy under current standards of USDA's National Organic Program (USDA, Agricultural Marketing Service, 2008a), the pasture and cropland providing feed for organic dairies must be managed organically for a minimum of 36 months. Current standards also require the dairy herd to be fed 100 percent organic feed and to receive organic health care for 12 months before being certified.[3] Organic dairy animals may not be given hormones, such as rBST,[4] or antibiotics for any reason. Grazing is required for all animals over 6 months of age.

These requirements mean that products and feeds that meet organic standards must be found, and organic feeds can be priced significantly higher than conventional feeds. Also, the approach to management must be adjusted on most farms as many conventional inputs, such as antibiotics, are no longer available (Arnold, 2007). The certification process can also be time consuming and tedious as farmers must develop an organic systems plan that describes practices and substances used in production. In addition, detailed production records must be kept for 5 years post-certification for a farm to be in compliance with the regulations, and access to these records must be provided to USDA and its certifying agents (USDA, Agricultural Marketing Service, 2008b).

USDA's National Organic Program (NOP) rules state that access to pasture must be provided for ruminant animals, but do not indicate how much pasture should be allocated or how much dairy feed should be provided by pasture.[5] The most common technology used on conventional dairy operations confines milk cows in large barns and limits access to pasture. Therefore, interpretation of the pasture rule, largely left to individual certifiers, has important implications for land requirements and costs of organic milk production for farmers considering the transition. Partly in response to comments, complaints, and noncompliance regarding pasture use on organic dairy operations, USDA proposed a rule in October 2008 to clarify and strengthen the NOP pasture requirement. This proposed rule would amend livestock and related provisions of the NOP, providing better consumer assurances that the USDA organic label on dairy products means that cattle graze on pasture during the pasture-growing season[6] (U.S. Office of the Federal Register, 2008).

Milk prices paid to U.S. producers are determined by a complex system. A minimum, or base price, is determined by a combination of the dairy price support program and Federal milk marketing orders (Manchester and Blayney, 2001). Quality adjustments are made to the minimum price based on the content of fats and other milk solids and the volume of milk sold, among other factors. Organic milk pricing is subject to the same minimum as all other milk, but processors pay a premium for the value added by the organic brand. Also, organic producers with cows using pasture as their primary forage may receive higher prices because the milk tends to have higher fat and other solids content (Butler, 2007). Organic milk producers are paid a fixed price per hundredweight (cwt) for organic milk, according

[3]Dairy farms that transitioned prior to June 2006 were allowed to feed a diet consisting of as much as 20 percent conventional feed, but must have fed at least 80 percent organic feed for 9 months and then 100 percent organic feed for 3 additional months before they were able to sell certified organic milk (Dimitri and Greene, 2002).

[4]Recombinant bovine somatotropin (rBST) is a synthetic version of a naturally occurring bovine growth hormone given to cows to increase milk production.

[5]Pasture is defined by the NOP as land used for livestock grazing that provides feed value and maintains or improves soil, water, and vegetative resources.

[6]The pasture-growing season is defined as from last frost to first frost, and can be from 120 to 365 days depending on climate and region of the United States.

to annual contracts with organic creameries that purchase the milk. In contrast, conventional milk producers are paid a blend price determined by spot markets for butter, cheese, nonfat dry milk, and whey, which may vary dramatically each month.[7] The relative price stability of organic milk, compared with conventional milk, is a benefit for producers who transition to organic.

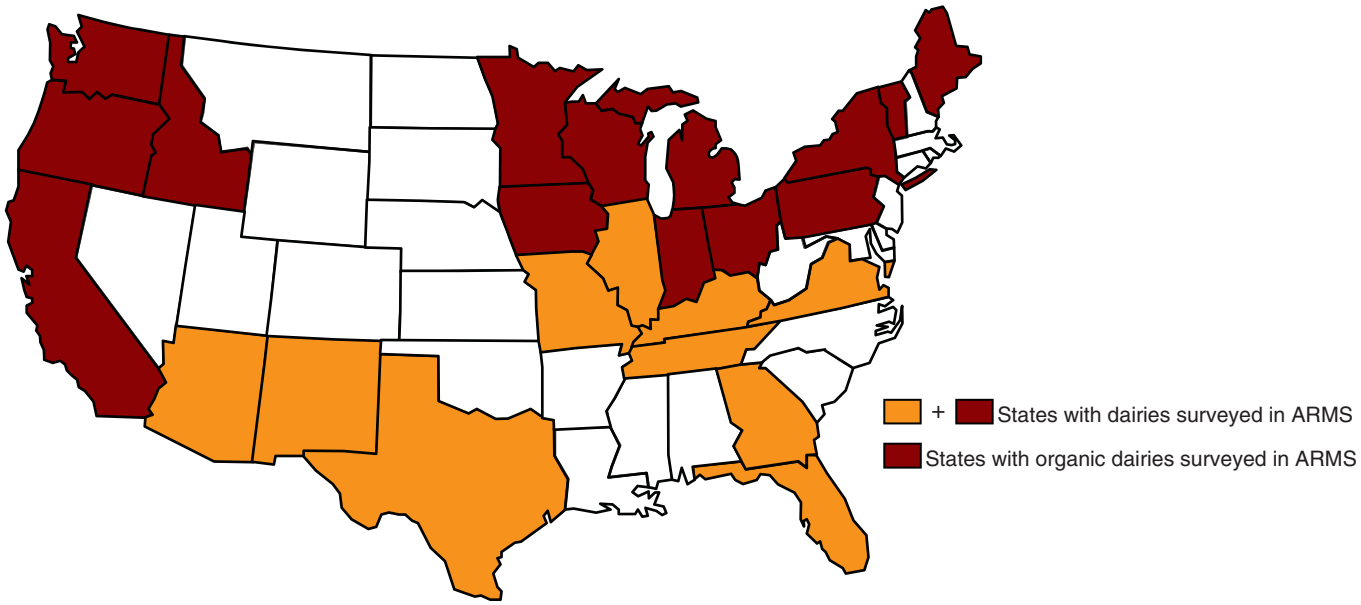
Dairy Farm Data

Dairy farm data used in this study came from USDA's 2005 Agricultural Resource Management Survey (ARMS) of U.S. milk producers. The ARMS, conducted annually by the National Agricultural Statistics Service (NASS) and Economic Research Service (ERS), provides detailed farm information on income, expenses, assets, and debt, as well as farm and operator characteristics. The 2005 ARMS included a version that highlights milk production practices and costs. This version targets dairy operations in 24 States that accounted for more than 90 percent of national milk production and covered all major production areas (fig. 2).

The surveyed dairy farms were chosen from a list of farm operations maintained by USDA's National Agricultural Statistics Service (NASS). The target population of the dairy version included farms that were in the dairy business for all 12 months of 2005 and milked at least 10 cows at any time during the year. The dairy survey collected information to estimate average milk production costs. Screening out farms that milked fewer than 10 cows excluded farms with dairy cows for onfarm consumption and other noncommercial activities, such as youth projects.

[7]The blend price is a minimum weighted average price in Federal milk marketing orders based on the proportion of Grade A Milk allocated to each use class. Producers receive the blend price with adjustments for butterfat content and plant location if so specified (Manchester and Blayney, 2001).

Figure 2
States surveyed in 2005 ARMS dairy version
Milk producers in 24 States were surveyed in the 2005 ARMS dairy version, including 14 States with data from organic dairies



Source: USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

A subsample that targeted organic operations was also part of the 2005 ARMS dairy version. Of the total 2,987 dairy farms sampled, 737 samples were targeted at organic operations in 19 States as identified by the major organic milk processors and certifiers. After accounting for nonresponse and missing data, information on 1,787 farms, including 352 certified organic milk operations in 14 States, were available from the ARMS[8] (fig. 2). Among the organic dairies, 325 sold more than 90 percent of milk production as certified organic, 18 were transitioning to organic production, and 9 were mixed operations.

Each surveyed farm represented a number of similar farms in the population as indicated by the surveyed farm's expansion factor. The expansion factor, or survey weight, was determined from the farm's selection probability, expanding the sample to represent the target population. Farm survey weights ensured that the sample expanded to represent dairy operations in the 24 States and that organic operations represented an appropriate share of the population despite a disproportionate representation in the sample. Organic farms accounted for 18 percent of the sample, but only 2 percent of the weighted number of farms.

[8]The response rate of the organic dairy sample was 48 percent, compared with 64 percent for the conventional dairy sample. This response difference was due to the challenges of building the list of organic dairies; in addition, some dairies on the organic dairy list were not actually organic operations.

Economies of Size in Organic Milk Production

The emergence of large conventional dairy farms and the continued shift of production toward such farms suggest that economies of size play a major role in the structure of dairy farming. Economies of size and the role it takes in the structural changes observed in conventional milk production were documented by MacDonald et al. This section reports on the relationship between operation size and production costs in organic milk production, including what size and costs might mean for the structure of the industry.

To evaluate the relationship between organic milk production costs and operation size, surveyed producers were divided into groups by size, and differences in farm characteristics and practices, production costs and net returns, and labor use were compared among the groups. The size groups were defined by the largest number of cows milked on the operation during 2005: (1) fewer than 50 cows; (2) 50-99 cows; (3) 100-199 cows; and (4) 200 cows or more.

Characteristics and Practices by Size

Data for 2005 indicated that about 45 percent of organic dairies milked fewer than 50 cows, while 87 percent had fewer than 100 cows (table 1). These small operations accounted for a disproportionately small share of organic milk cows and production. In contrast, about 13 percent of organic dairies had 100 cows or more, but they accounted for 44 percent of milk cows and nearly half of production. The largest organic dairies—those with 200 cows or more—had an average herd size of almost 500 cows per farm and included nearly a third of organic milk cows. These large dairies had a higher average milk yield per cow than smaller dairies and produced 37 percent of organic milk.

The most striking difference among organic dairies in each size group was their location. Northeast and Upper Midwest farms accounted for 96 percent of dairies with fewer than 50 cows. Farms in the West accounted for 80 percent of dairies with 200 cows or more. Within each region, 97 percent of organic dairies in the Northeast, 88 percent of organic dairies in the Upper Midwest, and 85 percent of organic dairies in the Corn Belt had fewer than 100 cows. In contrast, 83 percent of organic dairies in the West had 100 cows or more and 63 percent had 200 cows or more (fig. 3).

The use of several milk production technologies and practices tended to increase with size of organic operation, but most of the differences were between the smallest and other organic farms. For example, use of a milking parlor increased from 22 percent for the smallest dairies to nearly all dairies with 100 cows or more (table 1). Thirty-eight percent of the smallest farms and over 50 percent of other farms participated in the Dairy Herd Improvement program. Use of regular veterinary and nutritionist services was also much lower on the smallest farms. Likewise, the use of business management tools, such as computer records, the Internet, and forward-purchasing inputs, was less. Pasture-based feeding was used by 70 percent of the smallest dairies and was also used by more than half of the largest dairies.[9]

[9]Producers surveyed in the ARMS were asked what percentage of the total forage ration milk cows obtained from pasture during the grazing months. With pasture-based feeding, pasture provides at least half of the forage fed to milk cows during the grazing months.

Table 1

Dairy farm characteristics and production practices, by size of organic operation, 2005

Item	Size of organic dairy			
	Fewer than 50 cows	50-99 cows	100-199 cows	200 cows or more
Percent of farms	45	42	8	5
Percent of milk cows	21	35	13	31
Percent of milk production	18	33	12	37
Milk cows *(number per farm)*	37	68	132	490
Milk production *(pounds per cow)*	11,884	12,796	12,008	16,133
		Percent of farms		
Region:				
Northeast (ME, NY, PA, VT)	51	46	17	0
Upper Midwest (MI, MN, WI)	45	39	52	20
Corn Belt (IL, IN, IA, MO, OH)	4	12	15	0
West (CA, ID, OR, WA)	0	3	16	80
Production practices:				
DHI program participation[1]	38	51	53	60
Pasture-based feeding[2]	70	60	49	54
Artificial insemination	70	76	71	87
Embryo transplants or sexed semen	3	3	6	2
Controlled breeding/calving season	38	35	36	20
Regular veterinary services	28	41	72	55
Nutritionist services	30	53	66	70
Computerized milking system	1	4	4	7
Computerized feeding system	id	3	5	31
Milking parlor	22	45	88	100
Kept individual cow records	59	64	62	70
Johne's disease program participation	18	28	44	45
Onfarm computer records	13	25	34	41
Dairy information from Internet	30	46	56	64
Forward-purchased inputs	4	10	22	16
Negotiate input price discounts	18	21	33	36

id=Insufficient data for disclosure.

[1]Dairy Herd Improvement.

[2]Pasture-based feeding is defined as providing at least half of the forage fed to milk cows during the grazing months from pasture. Organic dairies reported an average grazing period for milk cows of 6.5 months in 2005.

Source: USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

Production Costs and Net Returns by Size

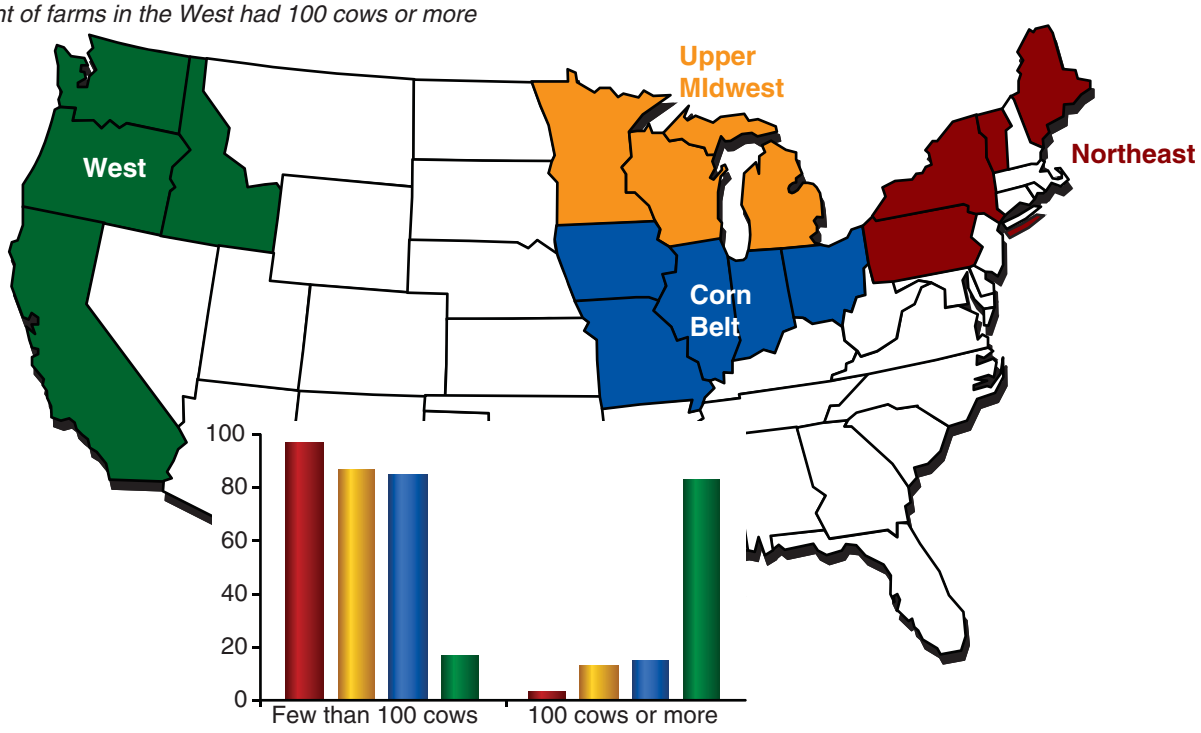
Average feed costs differed little among the dairies in each size group,[10] but average operating costs for organic dairies increased from the smallest to largest size group due to the additional costs of hired labor on the largest farms. Total operating costs were about $2 per cwt higher on the largest organic dairies than on the smallest (table 2). Once capital costs were added, cost differences among the size groups were negligible, as lower capital costs on the larger operations offset the additional hired labor costs. The smallest farms, however, used significantly more unpaid labor, mainly from farm operators and other family members, than did larger farms. After adding an opportunity cost for this unpaid labor, total economic costs for organic dairies declined with

[10]Feed costs made up the largest share of milk production costs, accounting for 65-75 percent of operating costs and 33-50 percent of total economic costs.

Figure 3

Share of organic dairy farms, by size group in each region

Most organic dairy farms in the Northeast, Upper Midwest, and Corn Belt had fewer than 100 cows, but 83 percent of farms in the West had 100 cows or more



Source: ERS calculations based on data from USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

Table 2

Production costs and returns, by size of organic dairy operation, 2005

Item	Size of organic dairy			
	Fewer than 50 cows	50-99 cows	100-199 cows	200 cows or more
	Dollars per cwt sold			
Feed:	12.96	12.67	11.93	13.06
Purchased feed	5.16	4.94	5.29	8.99
Homegrown harvested feed	6.96	7.00	6.06	3.51
Grazed feed	0.83	0.73	0.58	0.56
Hired labor	0.79	1.75	2.25	3.21
Capital costs	6.02	6.20	5.04	3.58
Opportunity cost of unpaid labor	13.42	7.45	4.84	1.15
Cost summary:				
Operating costs	17.65	18.25	18.10	19.66
Operating and capital costs	23.67	24.44	23.13	23.25
Total economic costs	38.50	33.36	29.13	24.84
Gross value of production	25.57	24.88	23.46	23.59
Returns above total economic costs	-12.93	-8.48	-5.67	-1.26

Notes: Costs are defined in Appendix A: Measuring Milk Production Costs. The gross value of production includes milk sales, cull and breeding animal sales, revenue from leasing dairy animals or space to other operations, co-op patronage dividends, dairy assessment rebates or refunds, and the value of manure. The value of milk sales was determined from prices reported by the survey respondents.

Source: USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

size and were nearly $14 per cwt less on the largest farms than on the smallest (see Appendix A: Measuring Milk Production Costs).

The relationship between average production costs and operation size for organic dairies was similar to that for conventional dairies among the size groups that characterize the organic industry (fig. 4). Average production costs for conventional milk production declined from about $30 per cwt on operations with fewer than 50 cows to about $18 per cwt on operations with 200-499 cows (MacDonald et al., 2007). Average costs dropped to less than $14 per cwt on conventional operations with more than 1,000 cows. Lower costs among the largest conventional producers suggest that similar economies of size may be available to organic producers if they increase the size of their operation above the industry norm. However, the additional costs of complying with pasture requirements and securing organic inputs in large volume may limit the cost advantages for larger organic operations.

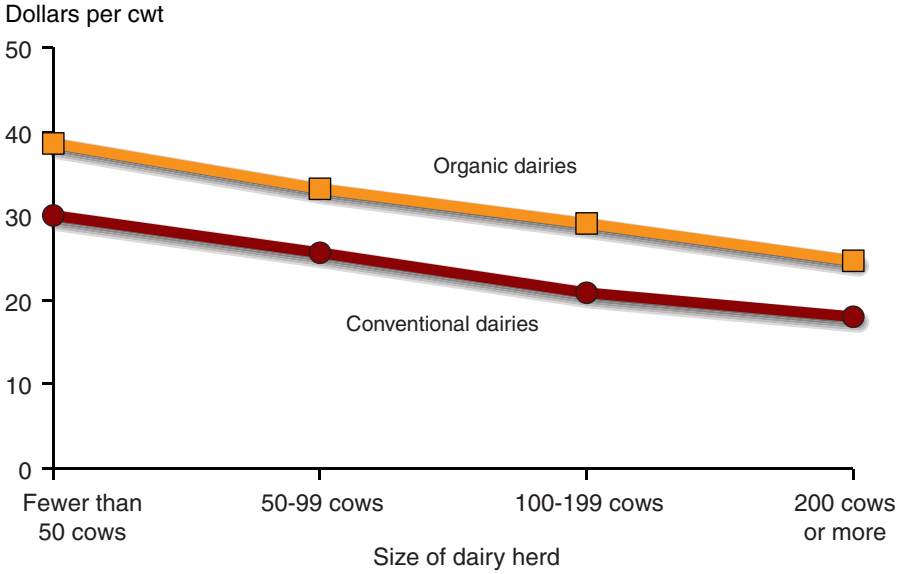
Net returns to the organic dairy enterprise were computed as the difference between the gross value of production and total economic costs. Average net returns in 2005 were negative for all organic dairy size groups (from -$12.93 per cwt among dairies with fewer than 50 cows to -$1.26 per cwt among dairies with 200 cows or more) (table 2).[11] These averages, however, mask the variation in net returns among dairies. Some operations may be more productive because they are well managed, while others may pay less than average for inputs or receive above-average milk prices, and thus these farms may be profitable while their group, on average, is not. For example, 10 percent of organic dairies with fewer than

[11]These estimates of net returns include charges for unpaid farm labor and homegrown feed. Charges for these items were determined by estimates of their opportunity costs, which may or may not reflect the costs perceived by some farm operators (see Appendix A: Measuring Milk Production Costs).

Figure 4

Total economic costs for each type of dairy producer, by farm size

The relationship between production costs and operation size for organic dairies was similar to conventional dairies, only at higher costs



Notes: Costs shown for conventional dairies of 200 cows or more are reported for 200-499 cows by MacDonald et al., with an average size of 295 cows.The average size of organic dairies in the 200 cows or more group is 490 cows.

Source: ERS calculations based on data from USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

50 cows and almost half of those with 200 cows or more generated positive returns above total economic costs (fig. 5).

Farmers are unlikely to start or expand a dairy operation if they are unable to recover their investment in capital and labor. Farmers who have already made substantial capital investments in dairy facilities and equipment, however, see these costs as sunk (unrecoverable), with little or no opportunity for use outside the dairy operation. These costs, therefore, have no bearing on the decision to operate in the short term, only becoming important when these capital assets must be replaced.[12] To better measure costs relevant to short-term operating decisions, the share of farms with gross returns exceeding all costs except for capital costs was computed. About a fourth of organic dairies with fewer than 50 cows covered these costs, compared with almost three-fourths of those with 200 cows or more (fig. 5).

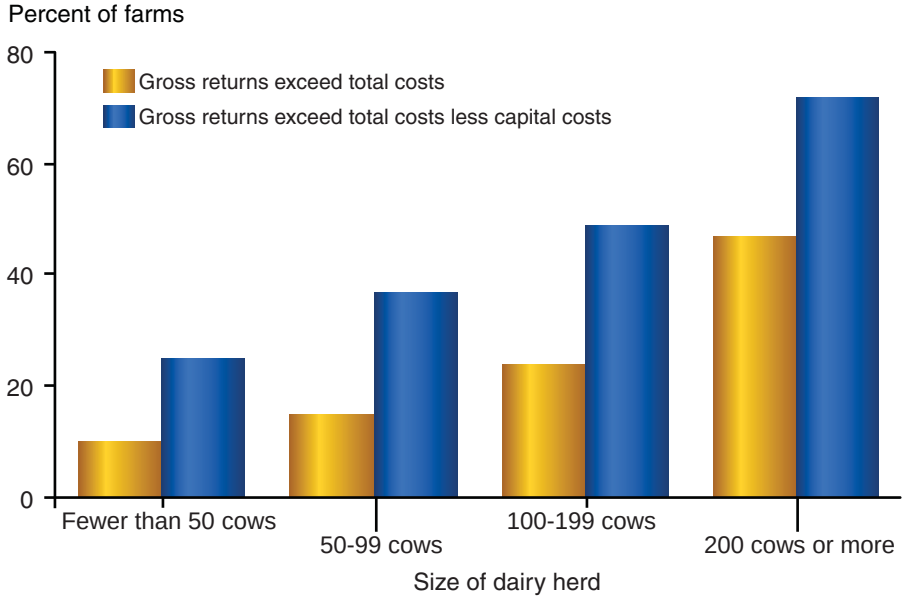
Some small organic dairy farms appeared to be earning enough to keep operating, but on average, farms in the smaller size groups were not covering the opportunity costs of their investments in capital and the operator's time. In contrast, larger organic dairies were much more likely to generate returns above capital and labor costs. These conditions suggest that organic milk production may migrate toward larger operations, as has conventional production. This production change will likely occur over an extended period as existing smaller operations use up their production facilities and equipment, ultimately facing decisions about replacing capital assets or exiting the industry. Also, in the short term, some small operators may continue

[12]If not replaced, the costs of maintaining dairy facilities and equipment are likely to increase over time, leading to higher repair and other operating costs.

Figure 5

Organic dairy operations with positive returns, by size of operation

Ten percent of the smallest and 47 percent of the largest organic dairies have positive returns above total costs, but many more have positive returns when capital costs are excluded



Source: ERS calculations based on data from USDA's 2005 Agricultural Resource Management Survey conducted by the National Agricultural Statistics Service and the Economic Research Service.

producing organic milk as a lifestyle choice despite returns that fail to cover the opportunity cost of their time.

Labor Use by Size

Small organic dairies are at a cost disadvantage relative to larger dairies due to the opportunity cost assigned to the unpaid labor provided by operators, partners, and family members. Unpaid labor costs for organic dairies with fewer than 50 cows were $13.42 per cwt, compared with only $1.15 per cwt on dairies with 200 cows or more. If this opportunity cost is ignored, the net returns to organic milk production were more similar among the size groups.

Labor use by size group for organic dairies is shown in table 3. The largest dairies used substantially more hired labor than the smallest (11,530 hours versus 557 hours), but the hired labor hours per unit of production differed little among the size groups because of much higher production on the largest dairies. The difference in unpaid labor use among the farm size groups was much less. Organic dairy operations with 200 cows or more used about 700 more hours of unpaid labor, about 20 percent more than those with fewer than 50 cows. The largest dairies, however, produced about 1,700 percent more milk as a result of having more cows and an average productivity per cow that was 36 percent higher than the smallest dairies. Enhanced productivity for these larger dairies means that unpaid labor hours per unit of production fell dramatically across the size groups from 0.82 hour per cwt on the smallest organic dairies to only 0.05 hour on the largest.

Unpaid labor is an opportunity cost defined as the time spent working on a dairy operation charged at a wage rate that represents what unpaid workers could earn in off-farm employment (see Appendix A: Measuring Milk Production Costs).[13] Opportunity costs of labor may vary significantly among producers, and some producers may be willing to accept returns lower than they could earn in nonfarm employment because of lifestyle preferences and costs of switching occupations, among other reasons. The incentive to earn a competitive return for the time spent on the dairy operation, however, may be a motivating force for increasingly larger organic dairies.

[13]Wage rates used to estimate unpaid labor costs averaged from $16.36 per hour among the smallest dairies to $23.00 per hour among the largest. Differences in the age, education, and location of farm operators in each group determined the wage rates.

Table 3
Labor use, by size of organic dairy operation, 2005

Item	Size of organic dairy			
	Fewer than 50 cows	50-99 cows	100-199 cows	200 cows or more
	Per farm			
Hired labor hours	557	1,648	3,051	11,530
Unpaid labor hours	3,612	3,759	4,265	4,322
Total labor hours	4,169	5,407	7,316	15,852
Milk production (cwt)	4,367	8,748	15,825	78,977
	Per cwt			
Hired labor hours	0.13	0.19	0.19	0.15
Unpaid labor hours	0.82	0.43	0.27	0.05
Total labor hours	0.95	0.62	0.46	0.20

Source: USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

Regional Differences in Organic Milk Production

Conventional milk production has historically been concentrated in the Upper Midwest and Northeast, mostly in Wisconsin, Minnesota, New York, and Pennsylvania. In the past three decades, however, milk production has expanded rapidly on large operations located in nontraditional areas of the South and West. Most prominently, California surpassed Wisconsin during the early 1990s as the number one milk-producing State. The continued growth of dairies in these nontraditional areas is the result of a favorable climate, an abundance of alternative crops that can be used for dairy feed (e.g., citrus pulp, cottonseed, or almond hulls), their relative geographic isolation, and population growth (Butler, 2002).

Although more recent in nature, regional development of organic milk production has followed a path similar to that of conventional milk production. Small organic dairy farmers and milk cooperatives in the Northeast and Upper Midwest, along with a major organic milk processor with its own large dairy farm in the West, pioneered organic milk production during the 1990s. Organic milk production was a good fit for the small, pasture-oriented operations in the Northeast, in Wisconsin, and in other parts of the Midwest. Expansion in the West, where California and Oregon have become leading organic milk-producing States, was motivated by many of the same factors that spurred expansion of conventional milk production in this area. Figure 6 illustrates the dramatic growth of organic milk production in the West, where the number of organic milk cows more than tripled between 2000 and 2005.

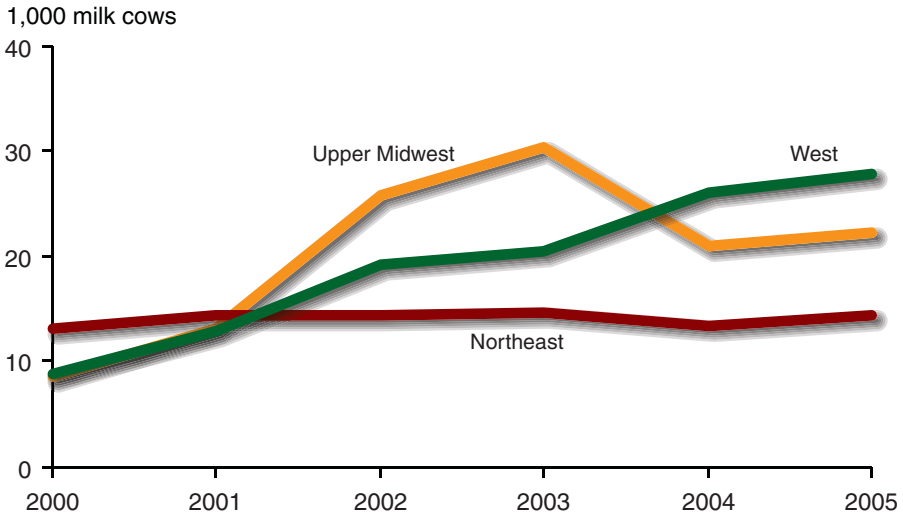
Characteristics and Practices by Region

More than 40 percent of organic dairies were located in both the Northeast and Upper Midwest, but these operations were small and less productive than

Figure 6

Number of organic milk cows, by region

Between 2000 and 2005, the number of organic milk cows more than tripled in the West



Source: Economic Research Service, 2007a.

those in the West (table 4). The Northeast includes organic dairies surveyed in New York, Pennsylvania, Maine, and Vermont; the Upper Midwest includes dairies in Wisconsin, Minnesota, and Michigan; and the West includes those in California, Oregon, Washington, and Idaho. Despite their large number, Northeast and Upper Midwest dairies accounted for a disproportionately small share of organic milk cows, 29 and 33 percent, respectively (fig. 7). Operations in the Northeast averaged 53 cows; the Upper Midwest, 64 cows; and the West, 381 cows. Organic dairy cows in the West averaged nearly 16,000 pounds of annual milk production per cow, 2,700 pounds more than in the Upper Midwest and 4,000 pounds more than in the Northeast.[14]

Organic dairies in the Northeast and Upper Midwest were more likely than dairies in the West to produce crops used for dairy cattle feed. Nearly all farms in these regions produced hay for cattle feed, and nearly 80 percent of

[14]Information about the Corn Belt is not presented in this section due to the small sample of Corn Belt farms available in the ARMS data.

Table 4
Characteristics and production practices of organic dairies, by region, 2005

Item	Northeast	Upper Midwest	West
Percent of farms	44	42	7
Percent of milk cows	29	33	31
Percent of milk production	25	32	37
Milk cows *(number per farm)*	53	64	381
Milk production *(pounds per cow)*	11,831	13,195	15,902
		Percent of farms	
Feed crops produced:			
Corn (grain and silage)	27	79	16
Hay (alfalfa and other)	96	93	55
Operator education:			
Less than high school	37	14	5
Completed high school	43	69	48
Some college	20	17	47
Production practices:			
DHI program participation[1]	40	60	66
Pasture-based feeding[2]	71	57	65
Artificial insemination	67	77	82
Embryo transplants or sexed semen	3	2	2
Controlled breeding/calving season	31	39	19
Regular veterinary services	36	38	46
Nutritionist services	42	44	54
Computerized milking system	2	2	6
Computerized feeding system	3	1	27
Milking parlor	28	39	100
Kept individual cow records	59	65	63
Johne's disease program participation	14	32	35
Onfarm computer records	18	24	34
Dairy information from Internet	30	48	72
Forward-purchased inputs	9	7	21
Negotiate input price discounts	30	13	31

[1]Dairy Herd Improvement.

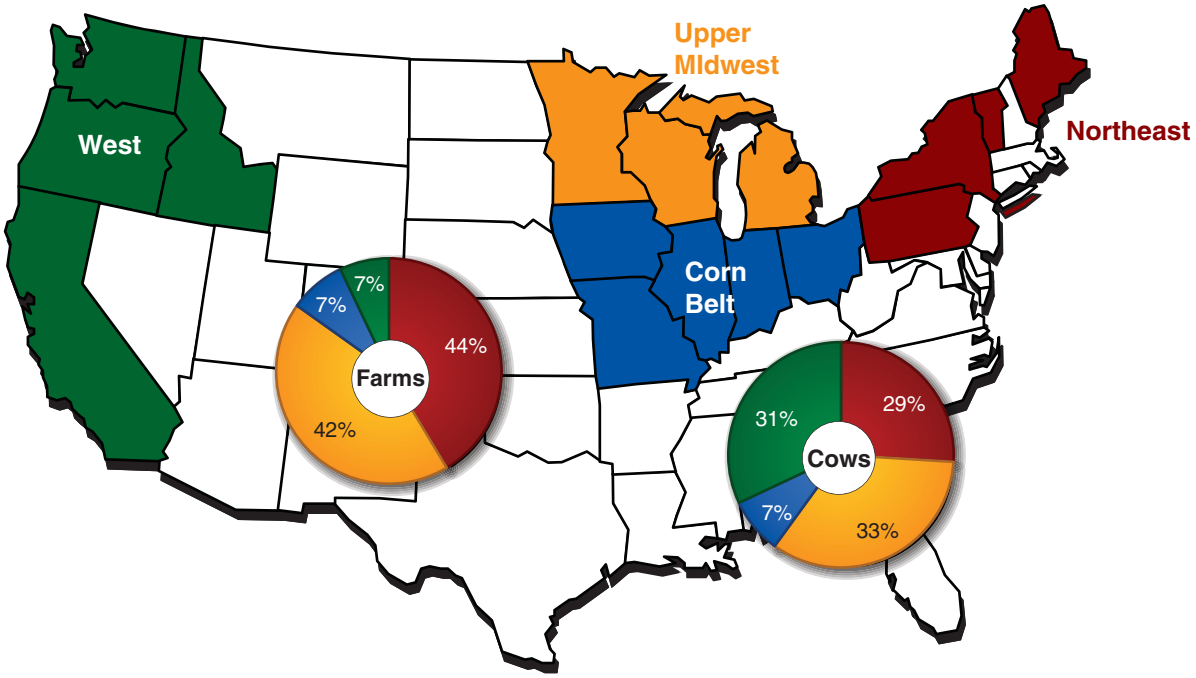
[2]Pasture-based feeding is defined as providing at least half of the forage fed to milk cows during the grazing months from pasture. Organic dairies reported an average grazing period for milk cows of 6.5 months in 2005.

Source: USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

Figure 7

Share of organic dairy farms and milk cows in each region

Only 7 percent of organic dairy farms were in the West region, but these farms held 31percent of organic milk cows



Source: ERS calculations based on data from USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

farms in the Upper Midwest produced corn. Only 16 percent of operations in the West grew corn, and just over half produced hay. As a result, the large organic dairies in the West purchased more dairy feed items than those in other regions. The percentage of farms using pasture-based feeding for dairy cattle varied little among the regions.

Operators of organic dairies in the West were, on average, more educated than those in other regions. Nearly half of farm operators in the West attended college, compared with 20 percent or less in the other regions. More education may explain why the use of some production practices was more common on dairies in the West. Operators of organic dairies in the West were more likely to participate in the Dairy Herd Improvement program, use artificial insemination, use regular veterinary and nutritionist services, use computerized milking and feeding systems, access dairy information from the Internet, and forward-purchase inputs. Higher education may contribute to a greater awareness of these practices and ease the adoption process. Also, the larger dairies in the West were able to spread the fixed costs of the investments required by some of these practices over more units of production.

Production Costs and Net Returns by Region

Average operating costs were lowest for dairies in the Upper Midwest by more than $1 per cwt than in the other regions (table 5). Lower operating costs in the Upper Midwest resulted from feed costs that were about $1 per cwt less than in the Northeast and hired labor costs that were nearly $1.70 per cwt less than in the West. Once capital costs are added, the cost difference between the Upper

Table 5

Production costs and returns of organic dairies, by region, 2005

Item	Northeast	Upper Midwest	West
		Dollars per cwt sold	
Feed:	13.48	12.52	12.80
Purchased feed	6.66	3.36	9.69
Homegrown harvested feed	5.92	8.62	2.47
Grazed feed	0.90	0.55	0.64
Hired labor	1.60	1.61	3.28
Capital costs	6.31	5.44	3.67
Opportunity cost of unpaid labor	10.75	6.76	1.64
Cost summary:			
Operating costs	19.03	17.92	19.46
Operating and capital costs	25.34	23.36	23.13
Total economic costs	37.59	31.47	25.13
Gross value of production	26.83	23.56	23.47
Returns above total economic costs	-10.76	-7.91	-1.66

Notes: Costs are defined in Appendix A: Measuring Milk Production Costs. The gross value of production includes milk sales, cull and breeding animal sales, revenue from leasing dairy animals or space to other operations, co-op patronage dividends, dairy assessment rebates or refunds, and the value of manure. The value of milk sales was determined from prices reported by the survey respondents.

Source: USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

Midwest and West were minimal due to the impact of size economies for the larger operations in the West. Size economies were the predominant factor in the difference between total economic costs in each region, ranging from $37.59 per cwt on the small Northeast operations to $25.13 per cwt on the large operations in the West. Most of the difference in total economic costs in the West came from unpaid labor charges that were more than $9 per cwt less than in the Northeast and about $5 per cwt less than in the Upper Midwest.

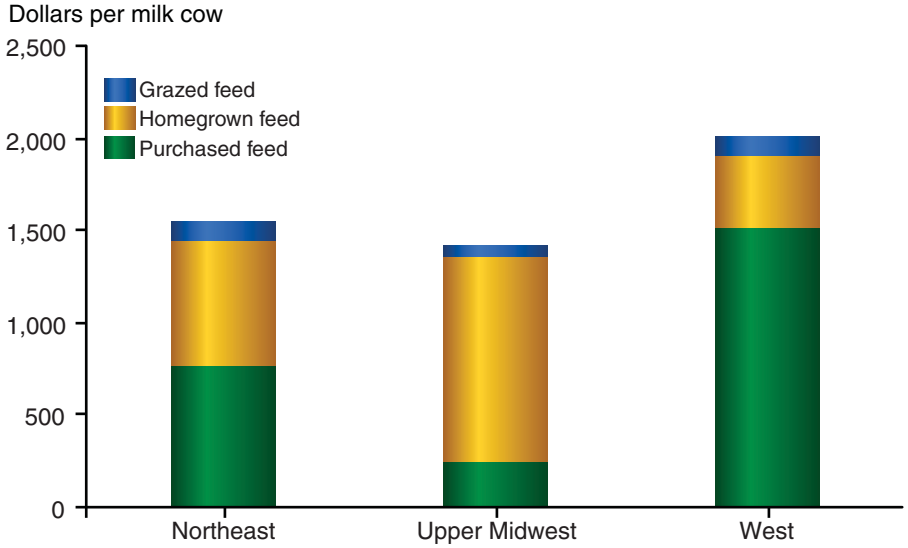
A breakdown of annual feed costs per cow in each region reveals costs that were significantly less in the Northeast ($400 per cow less) and Upper Midwest ($500 per cow less) than in the West (fig. 8). More than half of total feed costs on organic dairies in the Northeast stemmed from homegrown feed and grazed forages, while these sources accounted for more than 70 percent of feed costs in the Upper Midwest. Organic dairies in these regions may have incurred lower feed costs than those shown here if their production costs were lower than the market prices charged for these inputs. In contrast, more than three-fourths of the total feed cost on organic dairies in the West was from purchased feed items.

Despite higher feed costs per cow on organic dairies in the West, feed costs per cwt were competitive with organic dairies in other regions. Total labor and capital usage were also much higher on dairies in the West, but total costs per cwt were significantly less. The cost advantage of organic dairies in the West resulted from economies of size on larger dairies and higher productivity. Almost 50 percent of organic dairies in the West had an average milk production per cow of 15,000 pounds or more, and only 12 percent of organic dairies were producing less than 10,000 pounds (fig. 9). In the Northeast and

Figure 8

Organic dairy feed costs per cow, by region

Total feed costs per cow were highest for organic dairies in the West, where a much higher proportion of dairy feed was purchased than in the other regions



Source: ERS calculations based on data from USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

Upper Midwest, only a quarter of producers were producing 15,000 pounds or more, and 25 percent of Upper Midwest producers and more than a third of producers in the Northeast had average production less than 10,000 pounds. This difference in milk yield may be due to productivity-enhancing technologies and practices more common on organic dairies in the West. Due to this cost advantage, net returns for dairies in the West were significantly greater than in the other regions.

Labor Use by Region

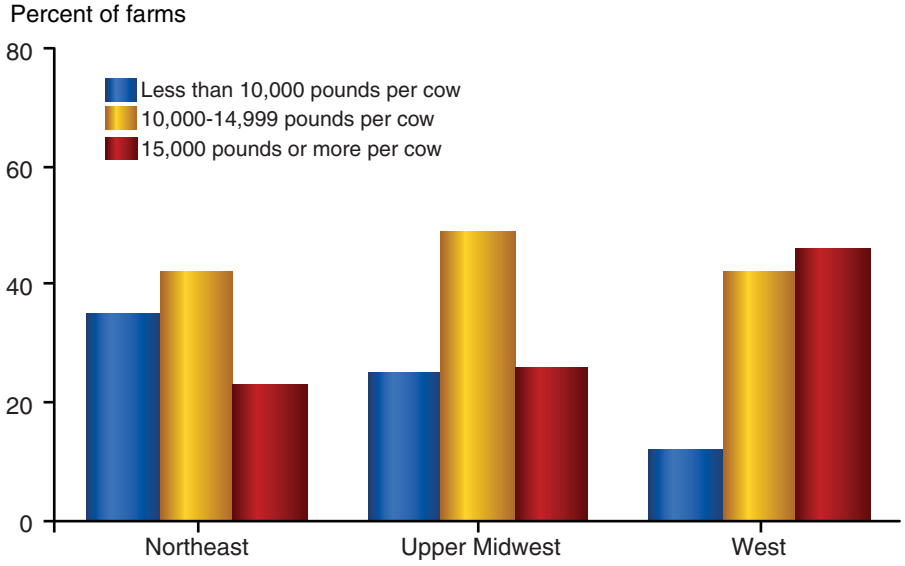
Charges for unpaid labor accounted for most of the differences in total costs for organic dairies in each region. Unpaid labor costs were nearly $11 per cwt in the Northeast, nearly $7 per cwt in the Upper Midwest, but only about $2 per cwt in the West (table 5). Without these charges, the difference in total economic costs among the regions would be less than $3.50 per cwt.

Total labor use for organic milk production was significantly higher in the West due to the larger operations, but labor use per cwt was much less (table 6). Total labor use per cwt in the West (0.23 hour) was less than half that in the Upper Midwest (0.53 hour) and less than a third of that in the Northeast (0.84 hour). Part of this difference in labor use per cwt was due to higher productivity in the West, but labor use per cow was also significantly less. Organic dairies in the West used 38 hours of labor per cow, compared with 100 hours in the Northeast and 70 hours in the Upper Midwest. Less labor use per cow was due, in part, to the labor-saving practices more often used on dairies in the West and to economies of size.

Figure 9

Milk production, by region

Nearly half of organic dairies in the West had milk cows that produced more than 15,000 pounds per year, compared with less than 30 percent in the other regions



Source: ERS calculations based on data from USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

Table 6

Labor use of organic dairies, by region, 2005

Item	Northeast	Upper Midwest	West
		Per cow	
Hired labor hours	24	17	26
Unpaid labor hours	76	53	12
Total labor hours	100	70	38
		Per cwt	
Hired labor hours	0.20	0.13	0.16
Unpaid labor hours	0.64	0.40	0.07
Total labor hours	0.84	0.53	0.23

Source: USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

Pasture Use in Organic Milk Production

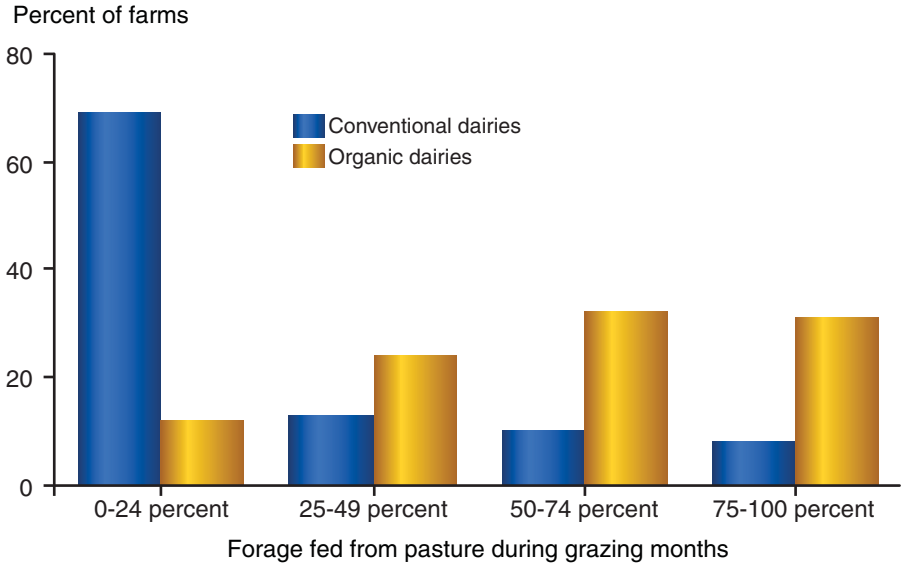
The most common technology used on conventional dairy operations confines milk cows in large barns and limits access to pasture. This means that forage from grazing comprises very little of the forage fed to dairy cows on most conventional dairies. Access to pasture is a requirement for the organic certification of dairy operations. Forage from grazing is also an important element of the feeding program on many organic dairies. Milk producers may find it easier and less expensive to maintain organic pastures for grazing dairy cows than to either purchase or produce and harvest organic crops and forage for dairy feed. Also, grazing systems may be less stressful for dairy cattle and contribute to lower veterinary expenses. Pasture-based production may also have environmental benefits, such as improved soil quality and reduced soil erosion (Boody et al., 2005; Weil and Gilker, 2003).

Pasture use for dairy feed on organic dairies, relative to conventional dairies, is illustrated in figure 10. More than 60 percent of organic milk producers reported that at least half of their total forage ration came from pasture during the grazing months (an average of 6.5 months per year), compared with 18 percent of conventional dairies. Nearly 90 percent of organic dairies sourced at least 25 percent of their total forage ration from pasture. In contrast, 70 percent of conventional dairies reported that less than 25 percent of their total forage ration fed to dairy cows came from pasture, while 40 percent obtained none from pasture.

Figure 10

Producer type, by share of dairy forage fed from pasture

More than 60 percent of organic dairies obtained at least 50 percent of the forage fed to dairy cows from pasture, while nearly 70 percent of conventional dairies obtained less than 25 percent



Source: ERS calculations based on data from USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

To evaluate the role of pasture grazing in organic milk production, surveyed producers were divided into groups that indicate the level of pasture grazing as a source of dairy cow forage during the grazing months: (1) 0-24 percent; (2) 25-49 percent; (3) 50-74 percent; and (4) 75-100 percent.

Characteristics and Practices by Level of Pasture Use

Almost two-thirds of organic milk producers reported that at least 50 percent of the forage fed to dairy cattle during the grazing months came from pasture, and a third reported that 75 percent or more came from pasture (table 7). Only 12 percent of organic milk producers reported that less than 25 percent of forage fed came from pasture. Differences between organic dairies where pasture use was highest (75-100 percent of forage fed) and lowest (0-24 percent of forage fed) were significant and are emphasized in this section. Farm characteristics among organic dairies in the middle groups (25-49 percent and 50-74 percent of forage fed from pasture) showed little difference.

Operations that relied on pasture use the most were the smallest in size and produced the least milk per cow. Organic dairies with 75-100 percent of forage fed from pasture had an average of 64 milk cows that averaged 11,289 pounds of milk per cow. In contrast, dairies with 0-24 percent of forage from

Table 7

Characteristics and production practices, by level of pasture use on organic dairy operations, 2005

Item	Forage fed from pasture during grazing months			
	0-24 percent	25-49 percent	50-74 percent	75-100 percent
Percent of farms	12	24	32	31
Percent of milk cows	21	23	31	25
Percent of milk production	25	23	31	21
Milk cows *(number per farm)*	135	79	78	64
Milk production *(pounds per cow)*	16,560	13,594	13,319	11,289
Region:		*Percent of farms*		
Northeast (ME, NY, PA, VT)	21	42	43	55
Upper Midwest (MI, MN, WI)	58	44	40	35
Corn Belt (IL, IN, IA, MO, OH)	13	8	5	9
West (CA, ID, OR, WA)	8	6	12	2
Region:		*Percent of cows*		
Northeast (ME, NY, PA, VT)	9	29	28	45
Upper Midwest (MI, MN, WI)	30	46	28	29
Corn Belt (IL, IN, IA, MO, OH)	10	9	4	8
West (CA, ID, OR, WA)	51	16	40	18
In dairy business:		*Percent of farms*		
Less than 10 years	11	18	19	27
10 years or more	89	82	81	73
Pasture rotation:				
At least once a day	39	48	58	72
Every 2-7 days	30	33	38	26
Less than weekly	4	1	id	1
Never	24	18	3	1
Pasture not used for feed	4	0	0	0

id=Insufficient data for disclosure.

Source: USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

pasture averaged more than twice the number of milk cows (135) and more than 5,000 pounds more milk production per cow (16,560 pounds). Thus, operations that relied less on pasture use (12 percent) had a disproportionately large share of milk cows (21 percent) and milk production (25 percent), while a third of operations that relied most on pasture use accounted for only 25 percent of milk cows and 21 percent of production.

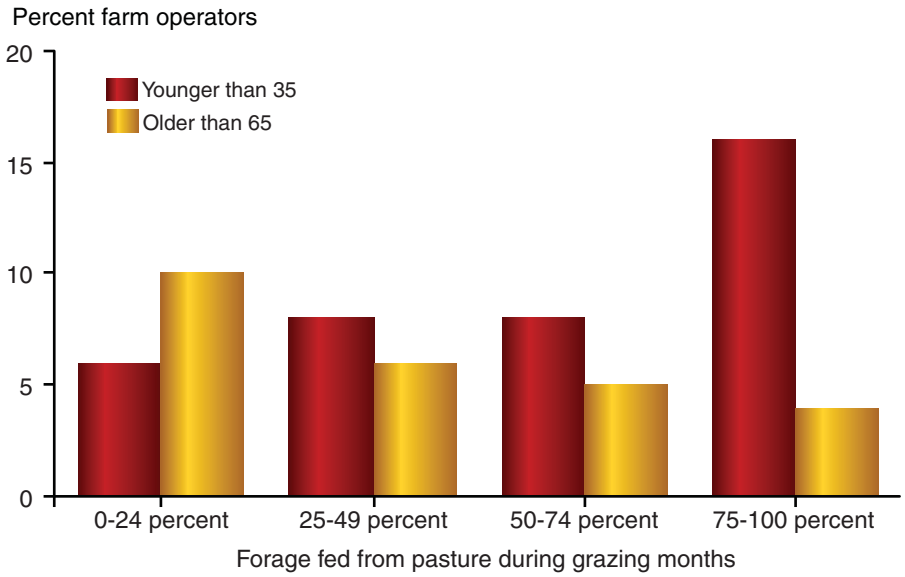
Organic dairies with the highest pasture use for feed were located in the Northeast. More than half of these farms were in the Northeast and operated with 45 percent of the organic milk cows in this group. Operations in the Upper Midwest accounted for the majority of farms using the least pasture (0-24 percent) and 35 percent of farms using the most (75-100 percent). Organic dairies in the West accounted for only 8 percent of the farms using the least pasture, but these large operations held 51 percent of the milk cows in this group. Large operations relied less on pasture as a forage source because of the significant land requirements necessary to supply pasture for large herds. However, some large operations in the West used pasture as an important dairy feed source. Among the farms with the highest pasture use, the West (at 2 percent) included 18 percent of the milk cows.

Organic dairies that relied the most on pasture use were in business relatively less time than other organic dairies. Twenty-seven percent of dairies that relied on pasture for 75-100 percent of their forage feed had been in business less than 10 years, compared with only 11 percent that relied on pasture for 0-24 percent of their forage feed (table 7). Also, farm operators who relied the most on pasture forage were younger than other farm operators. Sixteen percent of these farm operators were younger than 35 and only 4 percent were older than 65, compared with 6 and 10 percent, respectively, of the operators who used the least pasture (fig. 11). Younger farm operators

Figure 11

Farm operator age, by the share of dairy forage fed from pasture

Among organic farm operators that used the most pasture for dairy feed, 16 percent were younger than 35 and only 4 percent were older than 65



Source: ERS calculations based on data from USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

on relatively new dairies were more likely to use pasture-based feeding for organic milk production.

Pasture as a source of forage on organic dairies was closely related to the intensity of pasture management. Rotating pastures is a management strategy that can increase the total volume and quality of dry matter produced on pastures by allowing cows to graze for specified periods before moving them to new pastures. Seventy-two percent of organic dairies that reported the highest use of pasture forage rotated pastures at least once a day, compared with less than 40 percent of dairies that used pasture forage the least. Among dairies that used pasture the least, 24 percent reported that pastures were never rotated and 4 percent indicated that pasture was not a source of dairy feed.

Production Costs and Net Returns by Level of Pasture Use

Substituting pasture for more expensive feed sources may appear to be an efficient way to lower dairy feed costs. Average feed costs per cwt of milk, however, were lowest on the organic operations using the least pasture for dairy forage (0-24 percent), between $1 and $2 per cwt less than on the operations using more pasture (table 8). This relationship changes little even if charges for pasture resources are excluded from the feed costs.

Average feed costs per cow declined as pasture use for dairy forage increased (fig. 12). Total feed costs were $1,902 per cow on organic dairies that relied on pasture for 0-24 percent of forage fed, compared with only $1,409 on

Table 8
Production costs and net returns on organic dairy operations, by level of pasture use, 2005

Item	Forage fed from pasture during grazing months			
	0-24 percent	25-49 percent	50-74 percent	75-100 percent
	Dollars per cwt sold			
Feed:	11.61	13.14	13.42	12.90
Purchased feed	7.43	5.15	7.19	6.09
Homegrown harvested feed	3.89	7.51	5.41	5.69
Grazed feed	0.29	0.48	0.82	1.13
Hired labor	2.44	1.85	2.17	2.27
Capital costs	4.11	5.36	4.48	6.70
Opportunity cost of unpaid labor	2.82	6.47	6.24	8.36
Cost summary:				
Operating costs	17.74	18.55	18.99	19.44
Operating and capital costs	21.85	23.91	23.47	26.14
Total economic costs	25.33	31.53	30.64	35.99
Gross value of production	24.10	24.49	23.59	25.63
Returns above total economic costs	-1.22	-7.04	-7.05	-10.36

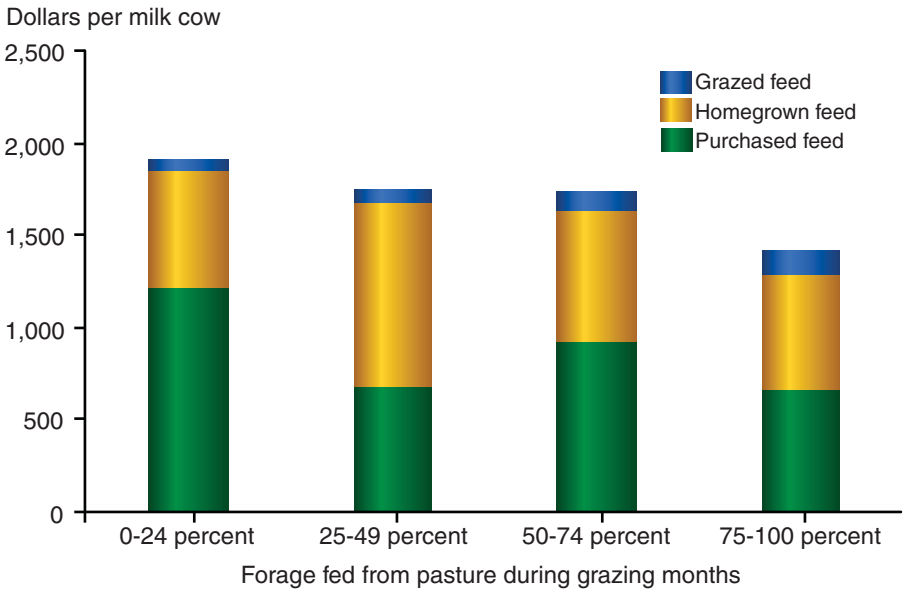
Notes: Costs are defined in Appendix A: Measuring Milk Production Costs. The gross value of production includes milk sales, cull and breeding animal sales, revenue from leasing dairy animals or space to other operations, co-op patronage dividends, dairy assessment rebates or refunds, and the value of manure. The value of milk sales was determined from prices reported by the survey respondents.

Source: USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

Figure 12

Feed costs, by share of dairy forage fed from pasture

Average feed costs per cow on organic dairies were about 25 percent less on operations using the most pasture



Source: ERS calculations based on data from USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

organic dairies that relied on pasture for 75-100 percent of forage fed, a savings of about 25 percent. As shown previously, however, average production per cow was more than 30 percent lower on the organic dairies that used the most pasture, thus total costs per cwt were higher.

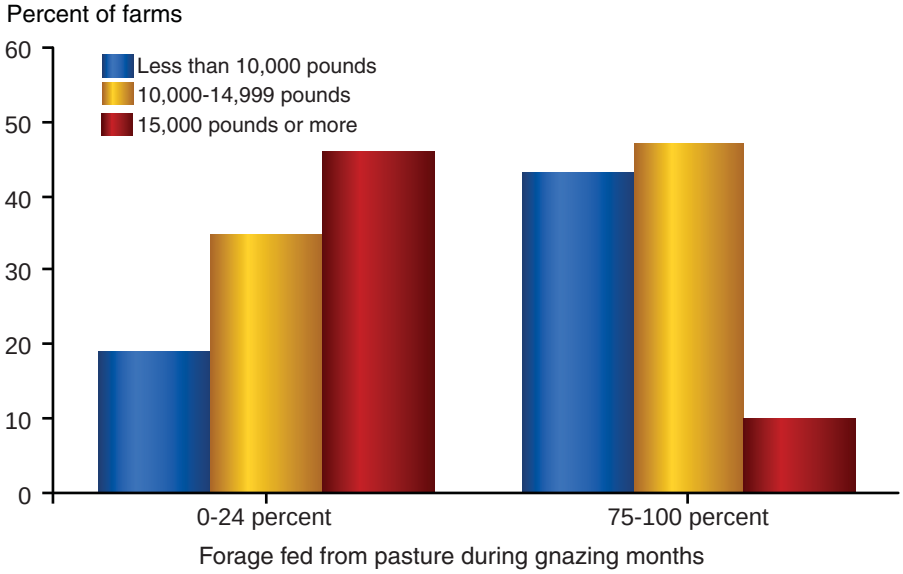
Breaking down the distribution of milk production per cow for each group provides an indication of how milk yields declined as pasture was substituted for higher energy feed in the dairy ration. Nearly half of organic dairies feeding 0-24 percent of forage from pasture had annual milk yields at 15,000 pounds per cow or more, compared with just 10 percent of dairies feeding 75-100 percent (fig. 13). In contrast, more than 40 percent of dairies using the most pasture had an annual milk yield of less than 10,000 pounds per cow, compared with 19 percent of those using the least pasture. This suggests that improving pasture quality to achieve higher milk production can contribute to the success of organic dairies using pasture-based feeding.

The relationship between pasture use and total production costs follows much the same pattern as seen for size and production costs on organic dairies. That is, the operations using less pasture were much larger and had lower average costs per cwt than the smaller operations using more pasture. Capital costs were more than $2 per cwt higher and the charge for unpaid labor was more than $5 per cwt higher on the operations where pasture forage accounted for 75-100 percent of forage fed than on those where pasture forage accounted for 0-24 percent of forage fed (table 8). Larger operations were able to spread the fixed costs for capital and labor over production from more cows, and each cow was more productive on the larger operations using the least pasture for dairy forage.

Figure 13

Milk production, by share of dairy forage fed from pasture

Nearly half of organic dairies feeding the least pasture forage had milk yields above 15,000 pounds per cow, compared with only 10 percent of those feeding the most pasture



Source: ERS calculations based on data from USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

Average returns net of total economic costs were negative for dairies in each of the pasture use groups, but were significantly higher among the dairies using the least pasture. This disparity suggests that organic operations using conventional dairy feeding methods, such as confining cows and feeding higher energy feed, were more likely to generate higher returns to capital and labor resources than those relying more on pasture-based feeding. Thus, the technologies and production methods used on organic dairies could become more like those used on conventional dairies. Changing technologies and production methods may depend on the extent to which pasture requirements for organic dairies must include pasture as part of the dairy feeding program.

Labor Use by Level of Pasture Use

The biggest difference in organic dairy costs between those using the most and the least pasture for dairy forage was the unpaid labor charge. The labor charge on organic dairies feeding 75-100 percent of forage from pasture was more than $8 per cwt, compared with less than $3 per cwt on dairies feeding 0-24 percent of forage from pasture (table 8). The labor charge contributed about half the difference in total costs that were more than $10 per cwt higher for dairies using the most pasture.

Table 9 includes labor use per cow and per cwt for each level of pasture feeding. Unpaid labor use per cwt on organic dairies feeding 75-100 percent of forage from pasture was about three times that for those feeding 0-24 percent of forage from pasture. Part of this difference came from fixed amounts of labor being spread over more output on the larger operations that used the least amount of pasture. Some of the labor difference, however, may be due to the pasture feeding system's being more labor intensive than handling dairy cows

in confinement. Among farms with fewer than 100 cows, the unpaid labor use on dairies feeding the least forage from pasture was still about a third less than on those feeding the most forage from pasture (0.45 hour versus 0.65 hour). In addition, total labor use among these small dairies increased steadily as more pasture was used for dairy feed. This increase suggests that pasture-based feeding systems are inherently more labor intensive than the conventional practice of handling dairy cows in confinement, possibly due to the labor required for moving cows to, from, and between pastures.

Table 9

Organic dairy labor use, by level of pasture use, 2005

Item	Forage fed from pasture during grazing months			
	0-24 percent	25-49 percent	50-74 percent	75-100 percent
			Per cow	
Hired labor hours	30	20	22	17
Unpaid labor hours	27	52	48	56
Total labor hours	57	72	70	73
			Per cwt	
Hired labor hours	0.18	0.15	0.17	0.15
Unpaid labor hours	0.16	0.39	0.36	0.49
Total labor hours	0.34	0.53	0.52	0.65
			Per cwt—dairies with fewer than 100 cows	
Hired labor hours	0.15	0.18	0.17	0.16
Unpaid labor hours	0.45	0.52	0.59	0.65
Total labor hours	0.60	0.70	0.76	0.81

Note: Totals may not equal the sum of items due to rounding.

Source: USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

Comparing Organic and Conventional Dairies

Organic dairy operations usually begin as conventional dairies that undergo the transition to become certified organic operations. Differences in farm and operator characteristics and production practices of organic and conventional dairies were identified and used to measure differences in milk production costs. These cost differences, along with estimates of organic transition costs, indicate milk price premiums that organic dairies need to be competitive with conventional milk production (see box, "What Other Studies Indicate").

Research models were specified to describe farms that use organic production and the difference in costs between organic and conventional farms. The models accounted for the myriad of factors that influence milk production costs, such as size of operation, region, and production practices, to isolate the cost difference attributed to an organic operation. The models also accounted for the fact that organic producers are not randomly assigned among the dairy population, but instead self-select. Self-selection could bias the cost comparison if unmeasured factors, such as the level or type of management, were correlated with both organic participation and milk production costs (see Appendix B: Modeling the Impact of Organic Participation on Milk Production Costs or McBride and Greene, 2009).

This research was also designed to examine whether organic systems are more or less competitive in different segments of the U.S. dairy sector. The models were used to evaluate the competitiveness of organic and conventional milk production for farms located in the Northeast and Upper Midwest, those using pasture-based feeding, and among small dairies, segments of the U.S. dairy sector where organic production is most common. The results provide an indication of when organic milk production was most economical compared with conventional production.

Characteristics and Practices of Organic and Conventional Dairies

Organic dairies were smaller than conventional dairies, averaging 82 cows per organic farm compared with 156 cows per conventional farm (table 10). The average milk production per cow was also lower on organic operations, nearly 30 percent less. Organic operations averaged about 13,600 pounds of milk per cow, compared with nearly 19,000 pounds per cow on conventional operations.

More than 80 percent of organic dairy operations were located in the Northeast or Upper Midwest, compared with 65 percent of conventional operations. These regions also included 62 percent of all organic milk cows, compared with 42 percent of conventional milk cows. In contrast, only 7 percent of organic dairies were located in the West, but these operations held about a third of total U.S. organic milk cows, the same as conventional operations. Organic dairies in the West (381 cows) were much larger than those in other regions and similar in average size to conventional operations (431 cows). The average size of organic dairies in the Northeast was half that of conventional dairies (52 cows versus 104 cows), and those in the Upper Midwest were about two-thirds the size of conven-

What Other Studies Indicate	
Butler (2002)	Measured the differences between organic and conventional dairy production costs in California based on 1999 data. The primary cost differences between organic and conventional operations included: reduced milk production, slightly higher feed and labor costs, and significantly higher herd replacement and transition costs. Net returns from organic production in 1999 appeared to be more than twice those from conventional production on similar dairies, but less than for the State average of conventional production.
Dalton et al. (2005)	Reported average production costs and returns from a 2004 sample of 30 organic dairy farms in Vermont and Maine. Total costs for organic milk production came in at $22.58 per cwt, before a deduction for unpaid operator labor and management. Organic milk production did not generate any return to unpaid labor and management nor did it produce a positive return to farm assets or equity. To do so, an organic milk price of at least $25.00 per cwt would have been needed in 2004 to break even on returns to assets, and $28.05 per cwt would have been needed to earn a 5 percent return—9 and 24 percent, respectively above the average 2004 organic milk price.
Dalton et al. (2008)	Reported the financial performance of Maine and Vermont organic dairies over 3 years, 2004 through 2006. Financial performance improved in each year (2005 and 2006), following low returns reported for 2004. Higher returns to organic milk production were primarily due to increasing milk prices during this period. Compared with a similar sample of small conventional farms, organic milk revenues were similar to those for conventional farms in 2004 and 2005, but 36 percent higher on organic farms in 2006. The cost structures of organic and conventional dairies were found to be similar, differing only in items that contributed 7 percent or less to the total cost of production.
Barham, Brock, and Foltz (2006)	Described organic dairy farming in Wisconsin using 2003 and 2004 survey data from organic, management intensive grazing, and conventional milk operations. Few differences existed between organic and other dairies in terms of farm operator characteristics, but organic operators expressed greater satisfaction and optimism about the dairy business. Organic operations were generally smaller than conventional operations, but larger than grazing operations, and were more similar to conventional operations in terms of their technology use. Organic operations seemed to be modernizing more rapidly than other dairies.
Rotz et al. (2007)	Examined the environmental and economic performance of organic grass and organic crop dairies in Pennsylvania. Results showed an economic advantage for organic over conventional milk production that depended on relative organic and conventional milk prices and levels of milk production. Based on the relative milk prices for 2006, organic production seemed to provide an option for improving the economic viability of dairy operations of a similar scale.

Table 10
Characteristics of organic and conventional dairy operations, 2005

Item	Type of dairy	
	Conventional	Organic
Milk cows (number per farm)	156	82
Milk production (pounds per cow)	18,983	13,601
	Percent of farms/cows	
Region:		
Northeast (ME, NY, PA, VT)	26/17	44/29
Upper Midwest (MI, MN, WI)	39/25	42/33
Corn Belt (IL, IN, IA, MO, OH)	15/10	7/7
Southeast (FL, GA, KY, TN, VA)[1]	6/6	0/0
Southwest (AZ, NM, TX)[1]	2/10	0/0
West (CA, ID, OR, WA)	11/32	7/31
	Milk cows per farm	
Region:		
Northeast (ME, NY, PA, VT)	104	52
Upper Midwest (MI, MN, WI)	98	64
Corn Belt (IL, IN, IA, MO, OH)	108	75
Southeast (FL, GA, KY, TN, VA)[1]	152	0
Southwest (AZ, NM, TX)[1]	781	0
West (CA, ID, OR, WA)	431	381
	Percent of farms	
Farm operator:		
Off-farm occupation	2	4
Education:		
Less than high school	18	26
Completed high school/some college	66	54
Graduated from college	16	20
Age (years)	51	49
In dairy business (years)	23	21
Selling certified organic milk (years)	na	5
Exit dairy business:		
5 years or less	25	16
10 years or less	51	33
20 or more years	30	47

na=Not applicable.

[1]Organic dairies were not surveyed in the Southeast and Southwest regions.

Source: USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

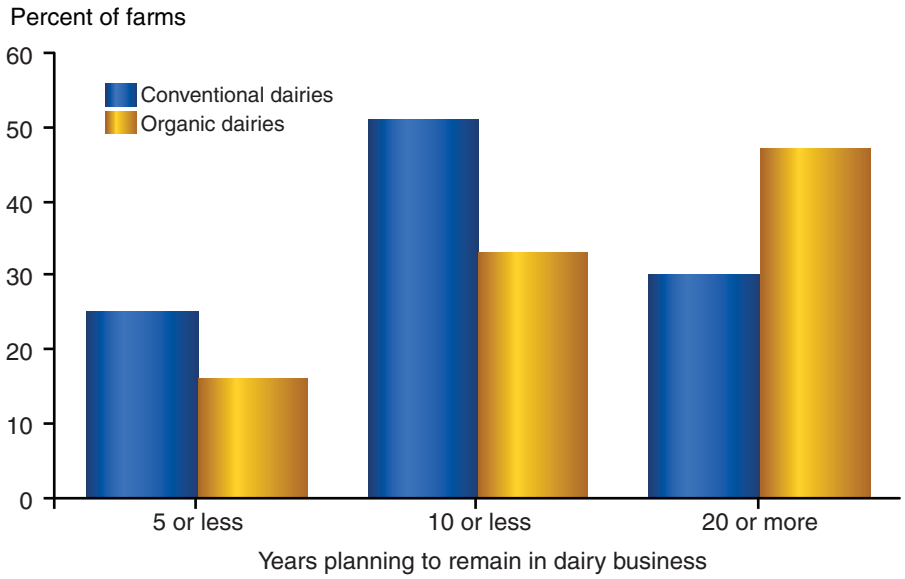
tional dairies (64 cows versus 98 cows). The ARMS includes no data for organic dairy operations in the Southeast or Southwest.

Most farm operator characteristics were similar among conventional and organic dairies. Nearly all farm operators in both groups reported farming as their primary occupation, common for dairy operations due to their substantial onfarm labor requirements. The distribution of operator education suggests that those in the organic group were neither more nor less educated than operators of conventional dairies. The average age of farm operators on conventional and organic dairies was similar. Most organic operations converted to organic production after years of conventional production. Of the 21 years that organic operators reported being in business, organic milk was produced for only 5 years. Organic producers were more optimistic about

Figure 14

Plans to exit the dairy business, by type of producer

Operators of organic dairies were more optimistic about their future



Source: ERS calculations based on data from USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

their future, as significantly fewer planned to exit in the next 10 years and significantly more planned to be in business for 20 or more years (fig. 14).

The primary difference in the production practices used by organic and conventional dairies was found in their feeding systems. More then 60 percent of organic operations reported using pasture-based feeding that provided more than 50 percent of seasonal forage from pasture (during the grazing months), compared with just 18 percent of other operations (table 11). Although not available to organic producers, rBST was used by 17 percent of conventional operations that were also more likely to utilize regular veterinary services and a nutritionist to formulate dairy rations (fig. 15). Differences in production practices may have contributed to the higher production per cow on conventional versus organic operations.

Labor use also distinguished conventional from organic dairies. Organic operations used nearly twice the hours of total labor per cwt, on average, than did conventional operations (0.50 hour versus 0.26 hour). Most of the labor difference came from significantly more unpaid labor hours worked on organic dairies and was influenced by the smaller average size and lower productivity of organic dairies. Fixed labor inputs were spread over fewer units of production on the smaller organic dairies.

Factors Affecting the Use of Organic Milk Production

Several operator and farm characteristics were statistically associated with the organic approach to milk production. Among operator characteristics, education and planning horizon were important. Dairy farmers graduating from college were more likely to be organic producers. Dairy operations planning to

Table 11

Production practices and labor use on organic and conventional dairy operations, 2005

Item	Type of dairy	
	Conventional	Organic
	Percent of farms	
Production practices		
DHI program participation[1]	45	46
Pasture-based feeding[2]	18	63
Milking three times or more daily	7	1
rBST (recombinant bovine somatotropin)	17	0
Artificial insemination	82	73
Embryo transplants or sexed semen	10	3
Controlled breeding/calving season	25	35
Regular veterinary services	69	38
Nutritionist services	72	45
Computerized milking system	5	2
Computerized feeding system	7	3
Milking parlor	50	41
Keep individual cow records	61	62
Johne's disease program participation	20	26
Onfarm computer records	26	21
Dairy information from Internet	38	41
Forward-purchased inputs	20	8
Negotiate input price discounts	35	21
	Hours per cwt	
Labor use:		
Paid labor	0.12	0.16
Unpaid labor	0.13	0.34
Total labor	0.26	0.50

[1]Dairy Herd Improvement.

[2]Pasture-based feeding is defined as providing at least half of the forage fed to milk cows during the grazing months from pasture. Organic dairies reported an average grazing period for milk cows of 6.5 months in 2005.

Source: USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

exit the industry in the next 10 years were less likely to be organic, indicating that operations with a longer planning horizon were more likely to use the organic approach.[15] More educated dairy farmers with long-term plans to remain in business are probably more willing and able to make the necessary investments or take the additional risks associated with organic production.

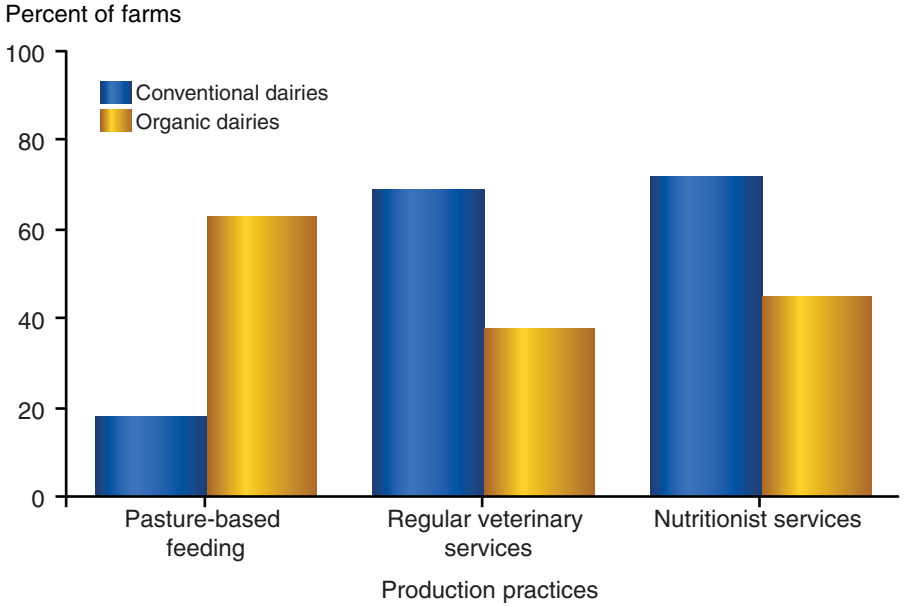
Size and location of dairy operations were also important factors influencing operators to go organic. The likelihood of being organic decreased as the number of milk cows on a farm increased. Larger operations had less incentive to go organic because of economies of size in milk production, pasture requirements for organic certification, and possible difficulties sourcing large quantities of organic inputs. The proximity and accessibility of grazing land to the operation may also have been important because barriers, such as highways and streams, may limit available pasture. Location in the Northeast or Upper Midwest was also associated with a higher probability of being organic. The organic dairy industry began in these areas and may offer a more developed infrastructure for handling organic milk.

[15]Some farm operators may have revised their planning horizon to be more optimistic after their experience as organic milk producers.

Figure 15

Production practices, by type of producer

Organic operations used pasture-based feeding more often, while conventional operations used regular veterinary and nutritionist services more often



Source: ERS calculations based on data from USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

Operations with a pasture-based feeding program were more likely to be organic, possibly because the land base enabled them to meet organic pasture requirements and pasture was more easily managed organically than field crops. Results suggest that using pasture as a significant source of dairy feed was one of the best predictors of being an organic dairy. Location in counties with a greater concentration of farms with milk cows included more organic production, potentially as a result of organic processors who chose to locate and recruit in areas with a large concentration of producers in order to reduce milk transportation and other transaction costs.

Factors Affecting Milk Production Costs

This section of the report examines the relationship between farm and operator characteristics and three levels of production costs—operating costs, operating and capital costs, and total economic costs (see Appendix A: Measuring Milk Production Costs). Older farm operators had higher costs than younger operators. Operating, operating and capital, and total economic costs all declined as farm size increased, consistent with economies of size. Costs declined as size increased, at a decreasing rate, as fixed capital and labor costs were spread over more units of output. Significant economies of size with respect to capital and labor were expected, but operating costs also declined with size, possibly due to greater feed efficiency or lower prices paid for feed items on larger farms.

Farm location influenced production costs as dairies in most other regions had lower costs than those in the Northeast. Technology use was also an important determinant of production costs. Farms using more technology had lower per unit capital and labor costs, possibly by increasing their

productivity. Pasture-based feeding had a negative, but insignificant, effect on operating costs. Feed costs were lower for organic dairies that substituted pasture for other feed items, but lower production from pasture-fed cows offset the cost savings. Pasture-based feeding was associated with higher total economic costs due to higher labor requirements.

After accounting for factors that influence production costs, operating costs for organic production were $4.78 per cwt higher, operating and capital costs were $5.65 per cwt higher, and total economic costs were $6.79 per cwt higher than for conventional production among all U.S. dairies (table 12). Results were similar for dairies in the Northeast and Upper Midwest and among small farms (less than 150 cows). The estimated difference in production costs between pasture-based organic and pasture-based conventional farms, however, was much less than among all dairies ($2.87 per cwt for operating costs, $3.00 per cwt for operating and capital costs, and $3.57 per cwt for total economic costs). Therefore, it is not surprising that many pasture-based dairies use organic production.

Organic Transition Costs

The estimated cost differences indicate the additional costs incurred by operations producing organic milk relative to conventional operations but do not include the costs associated with the transition period. Data from the ARMS did not indicate the actual costs incurred during transition, so the estimated cost differences between organic and conventional milk production were approximated for the transition period. Before an operation is certified to sell

Table 12
Estimated additional costs incurred by organic dairy farms compared with conventional dairy farms, 2005

	Operating costs	Operating and capital costs	Total economic costs
		Dollars per cwt sold	
All farms:			
Producing organic	4.78	5.65	6.79
Transitioning to organic	na	0.72	0.86
Total additional costs	4.78	6.37	7.65
Northeast and Upper Midwest farms:			
Producing organic	4.51	5.43	6.77
Transitioning to organic	na	0.69	0.86
Total additional costs	4.51	6.12	7.63
Pasture-based farms:			
Producing organic	2.87	3.00	3.57
Transitioning to organic	na	0.38	0.45
Total additional costs	2.87	3.38	4.02
Small farms (fewer than 150 cows):			
Producing organic	4.67	5.78	7.82
Transitioning to organic	na	0.73	0.99
Total additional costs	4.67	6.51	8.81

na=Not applicable.

Notes: Transition costs were treated as a capital investment necessary to return the higher organic milk price over the expected life of the operation and thus were not part of annual operating costs. Costs are defined in Appendix A: Measuring Milk Production Costs.

Source: ERS calculations based on data from USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

organic milk, pasture and cropland for dairy feed must be managed organically for a minimum of 36 months, and the dairy herd must be fed and managed organically during the last 12 months of that period. As a result, organic operations must undergo 3 years of higher costs before the higher organic milk prices are received.[16]

Higher costs for 3 years are a necessary investment to return higher milk prices over the expected life of the operation. This initial investment is determined by the estimated additional costs incurred by organic operations over the 3-year transition period. During year 3, when both the land and dairy herd must be managed organically, the total additional costs were charged. During years 1 and 2, when only the land is managed organically, 50 percent of the additional costs were charged. This corresponds with about half of the feed cost on organic dairies from homegrown supplies, which would be managed organically during the full 3 years. The annualized cost of this investment was computed by spreading it over an expected operating life of 20 years.

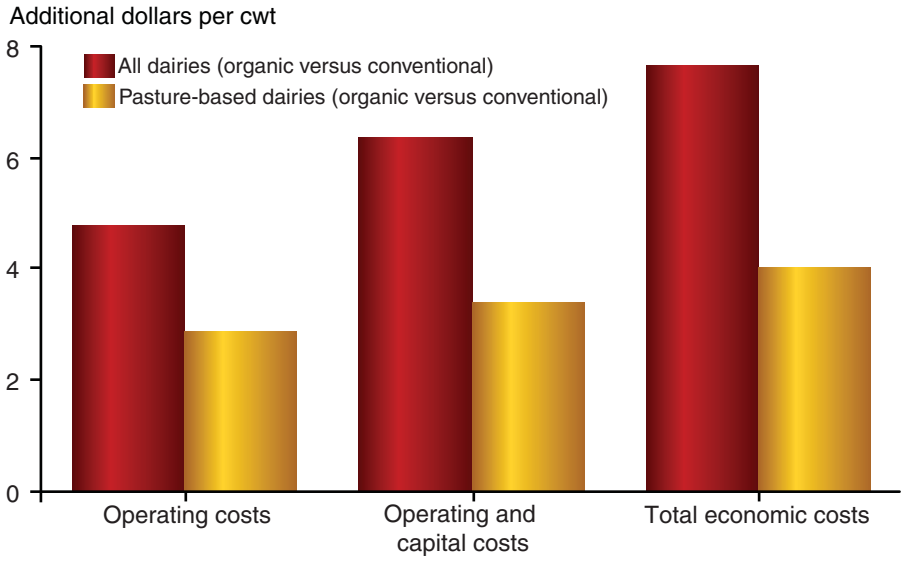
The estimated transition costs and total additional costs on organic operations are shown in table 12. Transition costs were $0.72 per cwt for operating and capital costs and $0.86 per cwt for total economic costs. Thus, the total estimated additional costs among U.S. dairy farms for producing organic relative to conventional milk were estimated at $4.78 per cwt for operating costs, $6.37 per cwt for operating and capital costs, and $7.65 per cwt for total economic costs. Among pasture-based dairies, the cost differences were much lower at an estimated $2.87 per cwt for operating costs, $3.38 per cwt for operating and capital costs, and $4.02 per cwt for total economic costs (fig. 16).

[16]Current NOP transition rules were used to estimate the transition costs even though many of the surveyed farms likely transitioned under the old rules. The current rules are used to reflect the costs faced by conventional farms considering the transition to organic production.

Figure 16

Additional costs of organic versus conventional milk production

The additional costs of organic compared with conventional milk production were much lower among pasture-based dairies than for all dairies



Source: ERS calculations based on data from USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

Challenges of Organic Milk Production

Organic milk producers were asked in the ARMS what they considered the most difficult aspect of organic milk production. Forty percent of producers reported that certification paperwork and compliance cost were the most challenging (fig. 17). Sourcing organic inputs, including grains and forages, feed supplements, and replacement heifers, was the most difficult aspect reported by 23 percent of organic producers. High costs of production and maintaining animal health were challenging aspects reported by 17 and 13 percent of producers, respectively.

In this section, the challenges of organic milk production are explored by examining how reported challenges to organic milk production varied across the sector. Producer reports were summarized by operation size, region, level of pasture use, and operator characteristics to see what factors may constrain the adoption and growth of organic milk production.

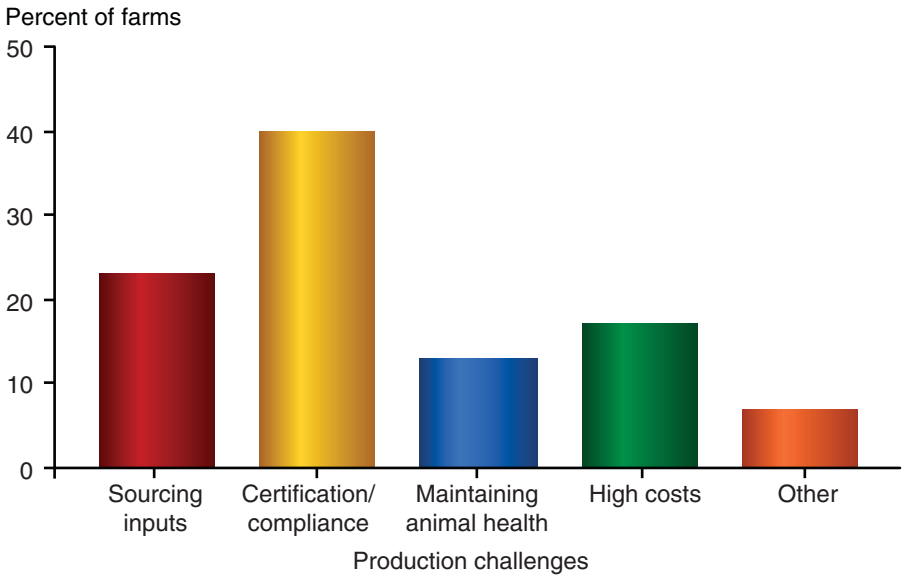
Farm Characteristics and Organic Production Challenges

The challenges reported for organic production varied little among dairy size groups, except for the largest dairies (table 13). About a third of the largest organic dairies, those with 200 cows or more and an average size of nearly 500 cows (see table 1), reported sourcing inputs as the most difficult aspect, compared with 20-25 percent of smaller dairies. This indicates that sourcing organic inputs in volume may be difficult for some large organic producers and may be a factor constraining the size of organic operations. Smaller

Figure 17

Challenges of organic milk production

40 percent of organic dairies cited certification paperwork and compliance costs as the most difficult aspect of organic production



Source: ERS calculations based on data from USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

Table 13

Most difficult aspect of organic milk production, by farm and operator characteristics, 2005

Item	Most difficult aspect				
	Sourcing inputs	Certification/ compliance	Maintaining animal health	High costs of production	Other
	Percent of farms reporting aspect				
Size:					
Fewer than 50 cows	25	44	10	13	8
50-99 cows	20	36	15	21	8
100-199 cows	20	41	19	20	0
200 cows or more	34	30	17	17	2
Region:					
Northeast	19	32	13	30	6
Upper Midwest	24	51	10	6	9
West	51	id	14	20	id
Pasture use:					
0-24 percent	13	43	15	16	13
25-49 percent	22	47	id	17	id
50-74 percent	26	42	14	13	5
75-100 percent	24	31	13	21	11
Operator age:					
Younger than 50 years	20	43	16	14	8
50 years or older	26	37	10	21	6
Operator education:					
Less than high school	17	54	4	18	8
Completed high school	22	40	17	15	7
Some college	33	22	16	21	8
Organic experience:[1]					
1 year	26	33	25	11	5
2-4 years	26	43	12	13	7
5 or more years	19	39	12	22	8

id = Insufficient data for disclosure.

[1]Number of years an operator has produced organic milk.

Source: USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

dairies reported certification/compliance as the most difficult aspect, and the smallest dairies, those with fewer than 50 cows, were the least likely to report animal health and production costs as most challenging.

Organic milk production challenges were different in each region. The most difficult aspect for organic dairies in the Northeast was split between certification/compliance and production costs at a third each. Dairies in the Northeast were the least likely to report sourcing inputs as most challenging, possibly because these small dairies often produce organic dairy feed or can buy it locally. Half of Upper Midwest dairies reported certification/compliance, while half of organic dairies in the West indicated sourcing inputs as the most difficult aspect of organic milk production. The volume of organic inputs needed on large farms in the West may account for the level of concern with sourcing inputs.

The most difficult aspect of organic milk production did not differ much among the pasture use groups, except for those using the most pasture. Dairies that relied on pasture for 75-100 percent of forage during the grazing months were less likely to report certification/compliance as the most difficult aspect of organic production. Certification/compliance may be less difficult for these dairies because the feeding program satisfies the pasture requirement for organic certification. More than 40 percent of the dairies in each of the other pasture use groups reported certification/compliance as the most difficult aspect of organic milk production.

Operator Characteristics and Organic Production Challenges

Responses based on operator age varied by 6-7 percentage points (table 13). Operators younger than 50 years of age were more concerned with certification/compliance and maintaining animal health. Those older than 50 years of age reported sourcing inputs and production costs as the most difficult aspects of organic milk production.

Certification/compliance was reported as the most difficult aspect of organic milk production by more than half of farm operators with less than a high school education. As operator education increased, certification/compliance was less of a concern. Forty percent of operators with a high school education, compared with only 22 percent of those with some college, reported certification/compliance as the most difficult aspect. Results suggest that education may ease the certification process. In contrast, sourcing inputs was reported as most challenging with more frequency as operator education increased.

The relationship between organic experience and the challenge of organic production was examined by grouping farm operators by the number of years they had produced organic milk. Dairy farm operators in their first year of organic production were more likely to indicate that maintaining animal health was most challenging, reported by 25 percent of operators. Organic milk producers may have learned quickly to manage animal health as these concerns fell to 12 percent by year 2 and beyond. High production costs were an increasing concern as organic operators became more experienced, but certification/compliance issues were still the primary concern for organic dairy operators regardless of their experience.

Conclusions

Unique and detailed data from a 2005 survey of U.S. dairy operations were used to characterize organic dairies and to compare them with conventional dairies. The dataset is unique in that it includes a targeted sample of organic producers at a much higher rate than their occurrence in the population of all dairy farms. This targeted sample allows for an examination of the structure and costs associated with organic milk production and an analysis of differences between the conventional and organic sectors.

Operation size was a primary determining factor for a dairy operation being organic. Small farms may view the organic approach as an alternative by which to reorganize current resources to improve farm returns and the odds of economic survival. Small-scale production may also be more conducive to sourcing organic inputs, which may be limited in some areas. Large dairies have more invested in production technologies that typically confine milk cows to large barns and limit access to pasture and are able to take advantage of economies of size. Thus, large farms may have less incentive to consider production alternatives. Further, large farms may have greater difficultly sourcing sufficient quantities of organic inputs, and transitioning to organic production may require more adjustments due to pasture certification requirements. Large organic dairies more often reported sourcing inputs and organic certification/compliance requirements as the most challenging aspects of organic milk production.

Dairies were more likely to produce milk organically if they were located in the Northeast or Upper Midwest. These areas have a long history of small dairies and thus a successful infrastructure to provide inputs and manage output from several small operations. The largest U.S. organic milk cooperative pioneered organic milk production in the Northeast and Upper Midwest during the mid-1990s. Proximity to markets with highly affluent consumers also made these regions attractive to organic milk operations. Access to pasture for dairy feed also had a strong influence on whether a dairy becomes organic. Operations using pasture-based feeding satisfy the pasture requirements for organic certification, and organic pasture management is generally easier than organic crop management and less costly than purchasing organic dairy feed. Fewer small, pasture-based organic dairies were as concerned about certification/compliance requirements as other organic dairies.

Results from a statistical model comparing conventional and organic milk production costs indicated that average operating costs for organic dairies were $4.78 per cwt higher, and operating and capital costs were $5.65 per cwt higher after accounting for other factors that influence production costs. Including an estimate of the additional costs incurred during transition, average organic milk production costs were $4.78 and $6.37 per cwt higher, respectively. With an average price premium of $6.69 per cwt for organic milk, organic milk producers, on average, covered the additional operating and capital costs of organic production in 2005.

Most organic dairies were small operations that used primarily unpaid operator and family labor. Returns above operating and capital costs on these small organic operations compared favorably with those of small conventional operations, suggesting that there may be economic incentives for some small existing

dairies that have already committed much of the fixed investment to consider the transition to organic milk production. Additional economic costs for organic production averaged nearly $1 per cwt more than the organic milk price premium in 2005. Thus, low returns to unpaid labor and management may limit startup organic dairies unless they can enter the industry at a much larger scale of production than the current norm.

Even though most organic dairies were much smaller than conventional dairies, economic forces suggest that similar economies of size were available to organic producers. Some small organic dairies were earning enough to operate, but many were not able to cover the opportunity costs of investments in capital and the operator's time compared with larger operations. These economic conditions suggest that organic milk production may migrate toward larger operations, as has conventional production. This production shift will likely occur over an extended period as many existing small organic operations either choose to replace their capital assets with larger production units or exit the industry. In the short term, some small operators may continue producing organic milk as a lifestyle choice, despite generating returns that do not cover the opportunity cost of their time.

Organic milk farms able to use pasture resources for a significant portion of dairy feed were very competitive with pasture-based conventional producers. Average operating costs for pasture-based organic milk production were estimated to be about $3 per cwt higher than those for pasture-based conventional production, and total economic costs for organic pasture-based milk production were about $4 per cwt higher than for pasture-based conventional production, significantly less than the average organic milk price premium in 2005. Economic incentives appear to favor pasture-based dairies transitioning to organic production, and possibly startup organic dairies that can take advantage of pasture resources suitable for organic dairy feed.

While the economics of pasture-based organic milk production compared favorably with that of pasture-based conventional production, pasture-based organic dairies had lower average milk production per cow and higher per unit costs than other organic dairies. This suggests that organic operations using conventional dairy feeding methods, such as confining cows and feeding harvested forages, are more likely to generate higher returns to capital and labor than those using pasture-based feeding. Thus, the technologies and production methods used on organic dairies may become more like those used on conventional dairies. Interpretation and implementation of revised organic pasture rules may shape the future structure of the organic industry. If pasture rules become more stringent, the challenges of certification/compliance could have a major impact on the sizes and types of farms able to produce certified organic milk.

This report attempts to shed light on the structure of organic milk production, factors affecting whether a dairy becomes organic, and the relative costs and returns of conventional and organic milk production. Based on these findings, implications for the structure of organic milk production were developed. However, conclusions derived from the analysis were based on 2005 organic and conventional milk and feed price relationships and could change with adjustments in relative milk prices, markets for conventional and organic inputs, technological improvements in dairy farming, and new organic pasture regulations.

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Appendix A: Measuring Milk Production Costs

Milk production costs were computed according to standards recommended by the American Agricultural Economics Association (AAEA) and used by USDA in its annual commodity costs and returns report (USDA, Economic Research Service, 2008b). Costs were computed per cwt of milk sold and divided into three categories: operating costs, operating and capital costs, and total economic costs. Operating costs included costs for feed; veterinary and medical services; bedding and litter; marketing; custom services; fuel, lubrication, and electricity; repairs; hired labor; organic certification/compliance; and operating interest. Capital costs included the annualized cost of maintaining the capital investment (economic depreciation and interest) in the dairy operation, and costs for non-real-estate property taxes and insurance. Total economic costs were the sum of operating and capital costs, plus opportunity costs for unpaid labor and land and allocated costs for general farm overhead items.

Operating cost items, except those for farm-raised inputs, were taken directly from survey responses to questions about dairy expenditures for each item. Homegrown harvested and grazed feed costs were computed using market prices for each feed item to estimate the opportunity cost of feed for dairy cattle. State average market prices were used to value the harvested feed items fed to dairy cows on conventional dairies (USDA, National Agricultural Statistics Service, 2006). Because organic feed prices can be significantly higher than conventional feeds, premiums paid by organic producers for feed items were estimated from the ARMS data and added to the State average market prices to estimate the opportunity cost of homegrown organic feeds.[1] Pasture rental rates estimated from the ARMS data were used to approximate the opportunity costs of grazed feed items on conventional and organic operations. The average prices paid by conventional and organic dairy operations for purchased feed grain, forage, grazing, and other purchased feed items that set the homegrown feed costs are shown in Appendix A table.[2] Feed costs accounted for the largest share of milk production costs at 65 to 75 percent of operating costs and 33 to 50 percent of total economic costs.

Capital costs for milk production (economic depreciation and interest) were computed using the capital recovery approach (AAEA, pg. 6-19). Capital recovery is an estimate of the cost to replace the capital investment for cattle housing, milking facilities, feed storage structures, manure handling and storage structures, feed handling equipment, tractors, trucks, and purchased dairy herd replacements used in the annual production process, plus interest that the remaining capital could have earned in an alternative use. These costs were computed based on 2005 replacement cost estimates for the dairy assets reported by farmers in the ARMS. Farm expenditures on non-real-estate property taxes and insurance were allocated to the dairy enterprise based on an estimate of the dairy enterprise's gross margin relative to the whole farm. Capital costs on organic operations were not computed differently than those for conventional operations.

[1]These premiums reflect the difference in the production costs of organic and conventional feed items, but may also reflect additional transportation costs that could result from a scarcity of organic inputs in some areas. To the extent that these premiums reflect the scarcity of organic inputs in some areas, the opportunity costs for using these homegrown inputs may be overstated.

[2]Using the opportunity cost approach to estimate homegrown dairy feed costs might bias the results against farms that produce feed because their feed production costs could be lower than assumed feed prices. This bias could be problematic because organic and pasture-based operations produce a relatively larger share of their feed than other operations. However, means estimated for whole-farm variable and fixed costs per unit from the ARMS data are not significantly different from per unit enterprise costs estimated with the opportunity cost approach. Enterprise costs for producing milk are useful in this report because they can be directly compared with milk prices.

The largest component of other costs for milk production is unpaid labor. Unpaid labor was charged using the quantity of labor used for dairy production, as reported in the survey, times an imputed wage rate. The wage rate reflects the opportunity cost of farm operator labor employed off-farm, estimated from an econometric model of off-farm labor supply and wages (El-Osta and Ahearn, 1996). Unpaid labor hours worked by individuals less than 16 years of age were charged the State minimum wage rate. The differences between organic and conventional dairies were due to the amounts of labor reported for the dairy enterprise and, to a lesser extent, the characteristics of farm operators that influenced their opportunity wage (i.e., age, education, farm location).[3] General farm overhead costs were nonenterprise specific costs allocated to the enterprise based on dairy gross margins, while the land cost was an opportunity cost of the land used for building sites and animal holding areas.

[3]Opportunity costs of labor may vary significantly among producers, and some producers may be willing to accept returns less than they could earn in nonfarm employment because of lifestyle preferences and costs of switching occupations, among other reasons.

Appendix A table

Prices paid for purchased feed items, by producer type, 2005

Item	Unit	Type of dairy	
		Conventional	Organic
		Dollars per unit	
Feed grains:			
Corn	bushel	2.42	5.42
High-moisture corn	bushel	2.37	5.15
Barley	bushel	2.87	5.24
Oats	bushel	2.23	3.11
Forage:			
Alfalfa hay	ton	104.54	146.68
Other hay	ton	86.17	89.33
Silage	ton	35.88	40.74
Grazed feed:			
Improved pasture—irrigated	acre	115.81	152.14
Improved pasture—dry	acre	47.17	60.81
Other purchased feed:			
Complete feed mixes	ton	285.92	345.90
Protein supplements	cwt	15.62	23.52
Vitamin/mineral premix	cwt	35.69	59.35
Milk replacer/calf starter	pound	0.82	1.06

Source: USDA's 2005 Agricultural Resource Management Survey, conducted by the National Agricultural Statistics Service and the Economic Research Service.

Appendix B: Modeling the Impact of Organic Participation on Milk Production Costs

A treatment-effect sample selection model was employed to measure the impact of organic participation on milk production costs (Greene, 2003). The model assumes a joint normal distribution between the errors of a participation equation (use of the organic approach) and a treatment equation (measure of production costs). This technique accounts for the possible correlation of unmeasured variables with both organic participation and production costs, allowing for an unbiased estimate of the impact of organic production on milk production costs.

Applying the treatment-effect model, the organic approach can be expressed with the latent variable O_i^* indicating the net benefit from using this approach, so that:

$$O_i^* = Z_i \gamma + u_i \text{ ; where } O_i = 1 \text{ if } O_i^* > 0 \text{ , 0 otherwise,} \quad (1)$$

where Z_i is a vector of operator, farm, and regional characteristics. If the latent variable is positive, the variable indicating organic production O_i equals one, and equals zero otherwise. A measure of the impact of organic participation on production costs y_i can be expressed by:

$$y_i = X_i \ \beta + O_i \delta + \varepsilon_i \quad (2)$$

where X_i is a vector of operator, farm, and regional characteristics.

Equation 2 cannot be estimated directly because use of the organic approach may be determined by unmeasured variables, such as management factors, that may also affect production costs. If this were the case, the error terms in equations 1 and 2 would be correlated, leading to a biased estimate of δ. This selection bias was addressed by assuming a joint normal error distribution with the following form:

$$\begin{bmatrix} u \\ \varepsilon \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \rho \\ \rho & \sigma_\varepsilon^2 \end{bmatrix} \right)$$

and by recognizing that the expected costs of using the organic approach is given by:

$$E\left[y_i \middle| O_i = 1 \right] = X_i \beta + \delta + \rho \, \sigma_\varepsilon \lambda_i \quad (3)$$

where λ_i is the inverse Mills ratio. To derive an unbiased estimate of δ, a two-stage approach can be used, starting with a probit estimation of equation 1. In the second stage, estimates of γ are used to compute the inverse Mills ratio, which is included as an additional term in a least-squares estimation of equation 2. This two-stage Heckman procedure is consistent, albeit not efficient. Efficient maximum likelihood parameter estimates were obtained by maximizing:

$$L(\gamma, \beta, \sigma, \rho) = \prod_{O_i=0} \int_{-\infty}^{0} \int_{-\infty}^{\infty} f(O_i^*, y_i; \gamma, \beta, \sigma, \rho) dy dO^* \cdot \prod_{O_i=1} \int_{0}^{\infty} \int_{-\infty}^{\infty} f(O_i^*, y_i; \gamma, \beta, \sigma, \rho) dy dO^*$$

where $f(O_i^*, y_i; \gamma, \beta, \sigma, \rho)$ is the joint normal density function, which is a function of the parameters. The negative of the log of the likelihood function was minimized using the estimates from the Heckman procedure as starting values.

Once the treatment-effect model was estimated, the difference in costs between organic and conventional dairies was determined by (Greene, pg. 788):

$$E\left[y_i \middle| O_i = 1\right] - E\left[y_i \middle| O_i = 0\right] = \delta + \rho\sigma_\varepsilon \left[\frac{\phi_i}{\Phi_i(1-\Phi_i)}\right] \quad (4)$$

where ϕ is the standard normal density function and Φ is the standard normal cumulative distribution function evaluated at variable means.