



The Cost of Producing Milk in Maine: Results from the 2002 Dairy Cost of Production Survey

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FOREWORD

This report summarizes the results of the 2002 Dairy Cost of Production survey implemented by The University of Maine and the Maine Milk Commission. Funding for this report was provided by the Maine Milk Commission. Supplemental funding was provided by a University of Maine Work Merit award for undergraduate research assistance.

The report can be downloaded from: <http://www.ume.maine.edu/rep/facstaff/facpubs.html>

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INTRODUCTION

This report is organized into three sections. Section I provides a descriptive review of the resource and production practices employed in dairy production in the state of Maine. This section provides an overview and summary of the responses from the 2002 Dairy Cost of Production study implemented by The University of Maine and the Maine Milk Commission. Data in this section is the basis for developing dairy cost-of-production budgets. Section II provides a brief overview of the approach used to develop the cost-of-production budgets. Section III presents the cost estimates and analyzes their implications for Maine dairy farmers.

The analysis-and-discussion of the data in this report focuses on four major groups called clusters. Cluster analysis attempts to identify relatively homogenous groups based upon identifying characteristics. This procedure was used to create representative farm types for the cost-of-production budgeting. One hundred and fifteen survey observations (27% of all Maine producers) were used in the cluster analysis. From the onset, organic and very large farms (over 300 cows) were selected for independent analysis apart from the main data set. There were six farms in each of these two categories that were examined independent of the remaining data. The remaining 103 observations were then submitted for cluster analysis using two factors related to size (the number of cows and the number of heifers); three factors related to production technology (milking system, housing system, and percentage of forage raised on-farm); three factors related to on-farm income generation (total milk shipped in 2001, total milk sales in 2001, and total livestock sales in 2001); and one categorical factor related to income diversification (the importance of off-farm income). Three clusters were generated from this procedure: small farms, medium farms, and large farms. A final cluster representing all farms is titled "State." The data from this cluster includes the small, medium, and large farms plus the organic and very large farms. Data from the small, medium, and large farms are used to construct the cost-of-production budgets. The organic and very large farm data is not used in the budget analysis.

History of Dairying in Maine

Dairying, and the study of the industry, has a long history in Maine. In fact, dairying was once described by George Dow, in his Experiment Station Bulletin published in 1932, as being "one of the principal farm enterprises in Maine, ranking second only to potatoes as a source of farm income." (Dow 1932: 1) Dow also felt that the

agricultural make up of the state of Maine was well suited for dairying and offered the resources for expansion of the industry. This expansion allowed the state to respond to increased annual demand from the Boston pool that occurred between 1921 and 1929.

The last 75 years have brought about an evolution of both production technology and farming activities. Despite these advancements, farm operators today face similar issues that challenged the industry three-quarters of a century ago. Andrew E. Watson and Emil Rauchenstein described the situation as one in which “(n)et returns in farming depend largely upon the efficiency of management, the quality of the land and price relationships” in their Experiment Station Bulletin published in 1940 (Watson and Ravchenstein 1940: 1).

Technological improvements have resulted in falling herd size and growing milk production per cow. Figure 1 portrays the evolution of this relationship by comparing the total number of milk cows in Maine against milk production per cow (measured in cwt) from 1925 to 2000. Evaluating the data over the entire time frame reveals that the average total herd size for the state has fallen by 73.5% and milk production per cow (cwt) has risen by 259%. Overall, this resulted in the total milk production for the state falling only 4.7% over the last 75 years.

Changes in herd size and milk production per cow have been unusually large, and it is unlikely that the same pattern will continue over the next 75 years. The period between 1955 and 1965 exposed the industry to large changes. Both size and productivity categories

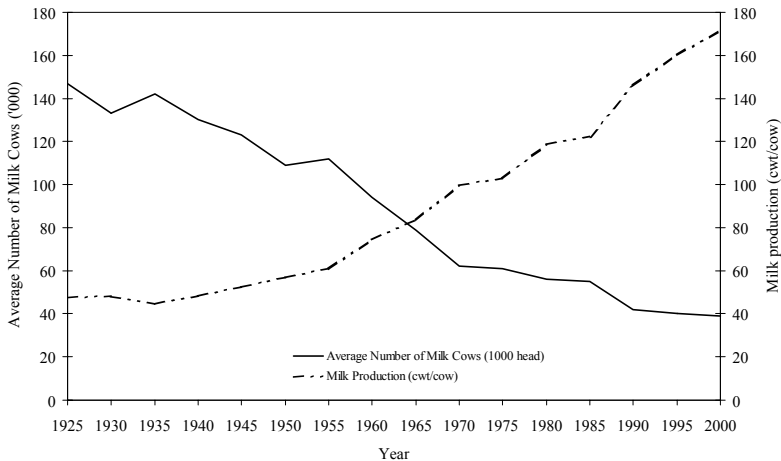


Figure 1. Average number of milk cows and milk production per cow for the state of Maine (1925–2000). Source: USDA NASS (2002)

changed, on average, by 18% per year. Over the period of 1970 to 2000, the decrease in average number of milk cows has slowed and leveled off while milk production per cow for the state has risen by 9.5 % per year.

SECTION I: A DESCRIPTIVE STUDY ON THE MAINE DAIRY INDUSTRY

Demographics

At the state level, owner/operators who grew up on a farm represent 89% of the current Maine dairy farmers. Sixty-eight percent of these farmers continue to operate the same farms they grew up on. Correspondingly, 71% of those running a farm have not farmed elsewhere.

The small farm cluster is similar to the state in that 89% of these owners indicate they grew up on a farm. Only 59% are operating the same farm they grew up on. This is reflected in the 76% of this group indicated that they had not farmed elsewhere.

All of the owners in the medium farm cluster indicated they grew up on a farm. Eighty-two percent of the owners in this group are operating the farm they grew up on and have not farmed elsewhere.

It is in the large farm cluster where there is a slight variation from the state levels. Those farmers who grew up on a farm represent 85% of this group. Only 30% of owners in this group operate the same farm they grew up on and only 38% indicated they had not farmed elsewhere before their current operation.

Farm establishment

The small and medium farms are the oldest of the three size clusters. The typical farm from these two groups was established in 1914-15. The average for the state cluster is 1919. The average year of establishment for a large farm is 1928. In each of these cases, the mean is earlier than the median, indicating that within each cluster the number of older farms is greater than younger farms. These younger farms pull the median year of establishment to 1940-1941 for small farms, large farms, and the state. The medium-sized farms remain the oldest of the clusters with a median establishment date of 1933.

Tenure, education, and age

Large farm owners have been operating their farms since early to mid-1970s. Both small and medium farm owners took up operations in the late 1970s to early 1980s. All of the dairy farmers in Maine have,

on average, a high school education. The distribution around this average is equal for all three farm types indicating there is no significant education level difference between farm types. The average age of a dairy farmer in Maine is 53 years of age. The large farm owners are the oldest among all dairy farmers with an average age of 57 (Figure 2).

Legal structure

Small farms are predominantly sole proprietorships or family partnerships. There are no farms of this size that are non-family partnerships. Corporations account for 11.8% of the farms in this category. Medium and large farms make use of the same three types of legal structure, but there is a greater use of the corporate structure in these two groups, between 31% and 32%. Sole proprietorships and family partnerships are still the most frequent, between 68% and 69% combined, for both groups. For all groups, businesses indicating they are family partnerships are owned by two families.

On-farm technology use

Farms of all scale perform the practice of pre-dipping and post-dipping teats before and after milking, respectively. None of the farms in the survey use a seasonal milking program described as a period of two or three months when all cows are dry. All of the farms surveyed

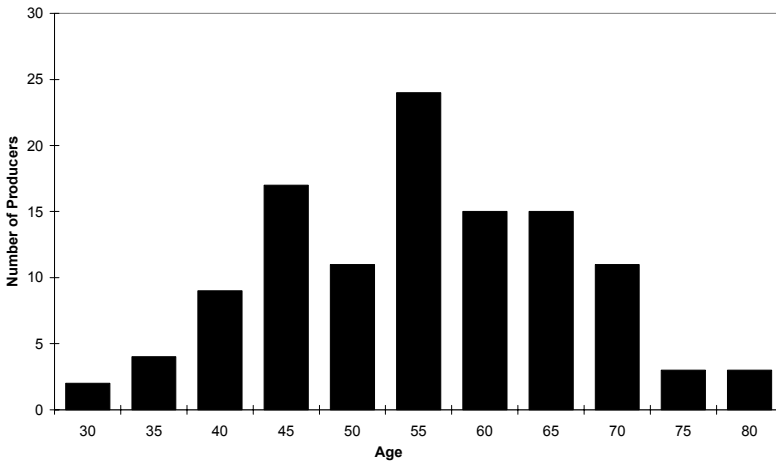


Figure 2. Statewide distribution of average age of farm owner/operator (years). Source: 2002 Cost of Production Survey.

do not hire out financial management to a service agency. They conduct their own analysis of farm financial performance.

There are some management techniques and production technologies that are adopted with different frequencies among the farms in the state. Table 1 outlines these differences. Large farms make regular use of scheduled veterinary services. For the small and medium farms, the usage of scheduled veterinary services is split evenly between used and not used on these farms.

Medium and large farms balance the feed rations at least four times per year. These same farms also use total mix ration (TMR) machinery. Small farms on average do not make use of these techniques. Large farms use both the DHIA dairy record program and personal computers to manage their herds. Small and medium farms indicated that these practices are not used on those farms.

Herd size

The total livestock holdings per farm for Maine as a whole are shown in Figure 3. The “total herd size” is the summation of the number of dairy cows (including dry cows), dairy heifers, and dairy calves held on a farm. This total is not the same as the “milking herd” category that was used to generate clusters from the survey population. There is an inverse relationship between number of livestock and number of farms. As the herd size increases, the total number of farms holding that amount of livestock decreases.

Table 1. Management and production practices used (percentage of responses).

		Small	Medium	Large	State
Scheduled veterinarian services	yes	50.0	50.0	92.3	57.4
	no	50.0	50.0	7.7	42.6
Balanced feed rations	yes	45.6	81.8	92.3	60.9
	no	54.4	18.2	7.7	39.1
TMR machinery	yes	19.1	63.6	84.6	39.1
	no	80.9	36.4	15.4	60.9
DHIA record	yes	35.3	45.5	69.2	44.3
	no	64.7	54.5	30.8	55.7
Herd mgmt. with personal computer	yes	7.4	27.3	61.5	23.5
	no	92.6	72.7	38.5	76.5

Source: 2002 Cost of Production Survey.

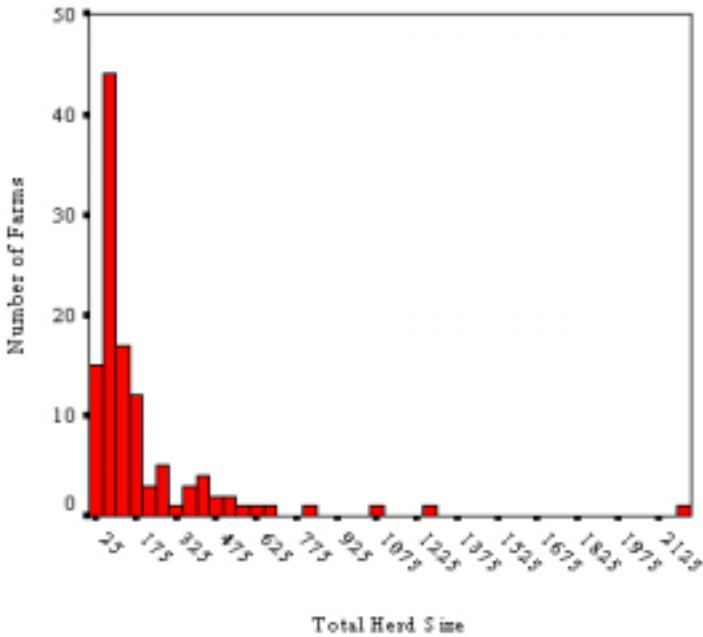


Figure 3. Distribution of herd size by farm. Source: 2002 Cost of Production Survey.

Figure 3 indicates that the state is made up of predominately small and medium farms with typical herd sizes of 74 and 181, respectively. The ratio of small farms to large farms from the sample surveyed is five to one. What is important to point out here is that the large farm livestock holdings account for 34% of the aggregated total livestock holdings among all three clusters.

Production Systems

Milking systems

The stanchion or tie-stall barn with pipeline transfer system accounts for 52% of the milking systems in the state. The herringbone parlor system is used by 23% of the farms in Maine. These two practices represent the most frequently used practices in Maine. Newer technologies such as rotary parlors, parallel parlors, flat parlors, or side-open stall parlors (either tandem or diagonal) are used by approximately 15% of the farms at varying levels of frequency. The remaining 10% of the farms use stanchion or tie-stall barns with dumping station transfer.

The farms in the small cluster use the more traditional milking systems with greatest frequency. These farms rely predominantly on stanchion or tie-stalls with either a dumping station or pipeline transfer. For the medium cluster, a number of farms use the stanchion with pipeline. However, the herringbone parlor is used in the medium farm cluster with greater frequency than in the small farm cluster. The larger farms incorporate both the herringbone parlor and the parallel parlor as their systems. The milking system technology used is connected with the cluster designation and therefore herd size. As the milking herd size grows larger, the tendency is to employ more labor-efficient milking systems.

Milking occurs twice a day for all farms in the state. The average number of people who are either milking or helping with milking at one time, for all farms, is two. The total time spent per milking is two hours. The only exception is for the large farm. In this case, twice as much time, four hours, is spent milking the herd. As a result, the total time spent per milking on average is almost twice the time that all other farms in the state spend on milking.

Five milking units is the typical number of units available for the herds across the state. In general, these units do not have automatic takeoffs. Small farms have four milking units that do not have automatic takeoffs. Medium farms have eight units and also do not have automatic takeoffs. Large farms have sixteen units and they are equipped with automatic takeoffs. Breaking these numbers down across the clusters shows that the number of units doubles as the farm size increases.

Housing

The size of the dairy barn along with total barn capacity as represented by the number of stalls available in the barn is outlined in Table 2. The natural correlation of farm size, barn size in square footage, and maximum capacity is evident. As the farm size, indicated by the herd size, grows, the housing size and capacity grow as well.

Table 2. Size of main dairy barn (sq. ft.) and maximum livestock capacity (#) by farm.

	Small	Medium	Large	State
Number of stalls available (max. cap.)	49	77	200	60
Size of main dairy barn (sq. ft)	5000	9860	16400	6800

Source: 2002 Cost of Production Survey.

The herd housing types used by farms across the state are stanchion, tie or comfort stall, or cold covered free stall. The only cluster that makes use of a different housing system to any great degree is the large farm that uses a warm enclosed free stall. Without exception, the base surface used in the barn is concrete and the bedding material used is sawdust.

For the most part, farms do not have a separate hospital and/or maternity barn for the herd apart from the main barn. When separate housing is used, it is for the farm's calves. The number of farms having separate calf barns is not significantly different from the number without separate barns at the state level. The differences are more easily seen at the cluster level. Small farms generally do not use separate calf barns while medium and large farms do.

The size of these separate calf barns is quite different for these two clusters. The medium farm has a barn that is 1900 sq. ft. with a capacity of 40 head. The large farm has a barn that is 3600 sq. ft. with a capacity of 108 head. The medium farm calf barn is representative of the state as a whole.

Assets

This section discusses the capital assets of each group and attempts to characterize the typical farm within each cluster. Assets have been broken down into five main categories. These categories are (1) farm land, which includes both acreage and personal residence, (2) farm buildings, which includes all of the remaining fixed structures on the farm, (3) dairy production equipment, (4) crop production equipment, and (5) farm vehicles and tractors. Total values, as reported by producers, for each for each asset category and farm type are found in Table 3. On average, a \$550/acre price of farmland was estimated from the surveys.

It is recognized that throughout the state, there are individual differences between farms within a cluster and between clusters. However, in order to create a representative description of assets held by farms within a cluster, the asset allocation had to be based on defining a typical asset. In order for an asset to be included in the capital asset report, it needed to be held by approximately 50% or more of the farms in the cluster. There are assets that are held by handfuls of farms across the state that were not included in the report below. These include a separate hospital/maternity barn, machine barn/shed, silo(s), housing for hired help, and a hutch/super hutch.

In general, the asset values increase by an average factor of two between each cluster. The one exception to this is found in the farm equipment category. The asset values increase by an average factor of

three between the small and medium cluster as more of the medium farms use parlor milking systems. The state cluster consistently falls between the small and medium cluster in asset values. The individual differences are a consequence of two issues: size and age. The first issue relates to the overall size of the farm described by each cluster. The smaller farm requires a smaller operation to care for a smaller herd when compared to the larger farms. Also, the asset values are a function of the current market value of the asset. Because the smaller farms tend to also be older, the market values of these assets tend to be lower than the younger and larger farms.

Ratio comparison of individual asset categories to the total asset value for each cluster can be done to take a different look at the asset mix. This analysis eliminates the monetary size differences and allows a different assessment through side-by-side comparison. The ratio analysis in this case shows that the small and medium farms have similar asset allocations. The large farms tend to allocate more assets to farm buildings and less to farm land than the other two groups.

The cost-of-production budgets, in Section Two of this report, reflect the values in the Table 3, but do not replicate them. The data in Table 3 were generated solely from the survey results and may, in some cases, be based on subjective values. The production budgets were generated using an economic-engineering approach. For this reason, there are differences between the production budgets and Table 3.

Table 3. Value of capital assets by farm.

	Small	Medium	Large	State
Value of farmland	\$160,450	\$330,000	\$373,000	\$249,000
Value of farm buildings	\$62,000	\$135,000	\$395,320	\$116,000
Total value of all farmland and buildings	\$222,450	\$465,000	\$768,320	\$365,000
Value of dairy production equipment	\$7,950	\$29,500	\$67,500	\$13,500
Value of crop production equipment	\$17,000	\$53,950	\$131,500	\$23,800
Value of farm vehicles and tractors	\$30,500	\$109,500	\$178,750	\$50,000
Total value of farm equipment	\$55,450	\$192,950	\$377,750	\$87,300
Total value of capital assets	\$277,900	\$657,950	\$1,146,070	\$452,300

Source: 2002 Cost of Production Survey.

Livestock, Land Holdings, and Crop Production

Livestock

The livestock holdings throughout the state are almost entirely Holstein. Both the medium and large farms hold a small percentage of their herd as Jersey. The small farms show the greatest diversity. While the holdings of Holstein are a significant percentage of their herd, a few of the small farms hold other breeds such as Jersey, Guernsey, Brown Swiss, Ayrshire, and milking Shorthorn.

The total herd size, which is made up of dairy cows (including dry cows), dairy heifers (more than one year old), and dairy calves is detailed in Table 4. A few farms throughout the state may also hold beef cows, feeder cattle, or mature bulls. These exceptions will be discussed separately. This table breaks down the varying herd sizes and resulting value associated with that herd.

It is worthwhile to point out that the average herd size more than doubles between the cluster classifications of small to medium or medium to large. However, the average herd size for the state falls between the small- and medium-sized farms. This is consistent with the point discussed earlier that the state consists primarily of small- and medium-sized farms.

Livestock holdings, other than those noted in the previous paragraphs, vary throughout the state. Less than 10% of the farms in the clusters own beef cows. The number held on each farm ranges from three to 20, with the medium farms holding the largest number. The market value is stated at \$600.

Only small and medium farms hold any beef calves or feeder cattle. Again, less than 10% of the farms from the clusters indicate that they hold these types of livestock. There is one exception, slightly more than 20% of farms in the small farm cluster hold beef calves. The feeder cattle hold a market value of \$500 per animal, and beef calves are valued at \$225 per animal.

Mature bulls are held with greater frequency among the farms, but they are not found throughout the state. Between 40% and 50% of the farms in each cluster indicate they hold mature bulls as part of their herd. Typically the small farms hold one bull and medium-sized farms hold two, the stated market value is approximately \$500. Large farms hold three bulls with a market value of \$900.

Land holdings

The value of the land asset is discussed briefly in the capital asset section of this report. Table 5 outlines the amount of land held by farms across the state according to land type. Holdings are broken down into five different categories: tillable crop land, permanent hay field,

Table 4. Total herd size and value by farm.

	Small			Medium			Large			State		
	# held	Market value* (\$ per animal)	Total Value (\$)	# held	Market value* (\$ per animal)	Total Value (\$)	# held	Market value* (\$ per animal)	Total Value (\$)	# held	Market value* (\$ per animal)	Total Value (\$)
Dairy cows	44	\$1095	\$48,180	95	\$1236	\$117,420	200	\$1152	\$230,400	54	\$1139	\$61,506
Dairy heifers	15	\$1000	\$15,000	46	\$1100	\$50,600	90	\$1100	\$99,000	22	\$1000	\$22,000
Dairy calves	15	\$400	\$6,000	40	\$450	\$18,000	90	\$250	\$22,500	22	\$400	\$8,800
Total	74		\$69,180	181		\$186,020	380		\$351,900	98		\$92,306

* Market value based on November 2001 prices.
 Source: 2002 Cost of Production Survey.

pasture, wood, and other land. These land categories were then broken down to indicate whether the land was owned or leased by the farm.

Because there is a great deal of variation in land holdings across the state, a description of the typical land holdings within each cluster is required. Typical land holdings are determined using the same process used in the capital asset section. In order for a type of land to be described as typical, 50% or more of the farms in the cluster needed to indicate ownership or operation of the land as part of the farm. Lands held by a minority of farms in a cluster are discussed separately. The total land holdings include all land types regardless of whether it is held by the majority of farms in a cluster or not.

Acres listed as owned are lands owned by the farm and include land leased or rented out to others. Acres that are listed as leased are owned by someone else but leased, rented in, or used at no cost to the farm. Few farmers rent their land to others.

In contrast, farms from all clusters augment either their current tillable crop land or hay field land, or both, with leased lands. The pasture land holdings do not correlate with herd sizes. The small farms hold more pasture than medium farms while holding a milking herd that is less than half the size. This is due to a heavy reliance on pasture land by small farms. Woodland held is also not strongly correlated to farm size. Total land holdings increase proportionally with farm size. And, each cluster augments their current holdings with leased lands by at least 30%.

Crop diversification

The types of crops grown on farms across the state are very similar. There are two main crops grown: corn for silage and hay or haylage (which includes clover, alfalfa, Timothy, other legumes, small

Table 5. Median land ownership by farm type (acres).

		Small	Medium	Large	State
Tillable crop land	Own	97	100	250	115
	Lease	0	110	160	105
Permanent hay field	Own	60	95	146	60
	Lease	65	63	98	73
Pasture	Own	30	25	43	30
Wood	Own	100	235	200	120
Other land	Own	5	7	13	6
Total land holdings	Own	249	400	563	295
	Lease	80	155	247	124

Source: 2002 Cost of Production Survey.

grains, trefoil, triticale, and grass). Other crops such as barley, oats, or corn for grain are grown on only a handful of farms that vary in their size classification.

Hay or haylage is by far the most dominant crop grown. Approximately 90% of the farms in the state indicated they grew their own hay for the herd. All of the owners indicated they used 100% of the hay on their own farms. An average of 178 acres of hay was grown, and the range is between 100 acres on the small farms and 280 acres on the large farms.

The second most prevalent crop grown is corn for silage. Just a little under half of the farms surveyed, 48%, grew corn for silage. The medium and large farms represent the majority of the farms growing corn in the state. Results from the state cluster indicate that the average acreage committed to this crop is 80 acres. If corn is grown on a farm, the range runs between 29 acres on the small farms and 195 acres on the large farms. All of the corn grown is used on the farm that cultivated the crop.

All of the other crops grown in the state, such as barley, oats, corn for grain, squash, and wheat are grown only on the small and large farms. One exception occurs, a medium farm cultivates both barley and oats. None of the farms in the survey indicated they devoted any acreage to potatoes. Also, custom hired crop production is not commonly done.

Crop inputs

There are two major categories of crop inputs used throughout the state. Seed is one generalized form of production input that encompasses a number of different types of seed. Corn seed is the most commonly used of all seed inputs. Also, it is predominantly used on medium and large farms based upon the data reported regarding crops grown in 2001. Due to the range of different means of purchasing seed, it is difficult to state an average quantity used in each cluster. Other seed inputs include grass, sorghum, and soybean seed.

The other type of input used includes products used to optimize crop growth. The most common of these inputs are fertilizer, lime, and chemicals/sprays. Other products, such as wood ash and manure, are used, but only on an infrequent basis in each cluster. Again, due to the varied packaging methods and ways of purchasing these inputs, it is difficult to state an exact amount that is typically used on the farms. It can be said, however, that the quantity of input used is directly proportional to the quantity of land in crop or hay production.

Livestock Production

Forage

In general, forage that is used on the farms for livestock feed is grown entirely on each farm. As would be expected, the amount of forage fed is influenced by the herd size. The total tonnage fed in 2001 is 297, 1,990, and 5,000 for the small, medium, and large farms, respectively.

There are a handful of farms from each cluster that obtain forage from another source. These farms purchase forage for a total cost that ranges between \$3,500 and \$5,300. The purchase was generally through another farmer and the location of the forage source was less than ten miles away.

Storage of the feed on small farms is in the barn or hay shed with a total capacity of 345 tons. Both medium and large farms make use of barns and horizontal storage (bunker, trench, and stack) with capacities for each cluster at 2,250 and 5,750 tons, respectively. For the state overall, the storage facilities used are both barn and horizontal storage with a total capacity of 775 tons.

The survey results indicate that only one person is involved with feeding and spends between two and three hours feeding concentrated feed and forage to the herd per day. Rotational grazing and pastures are an important source of feed for small farms during the grazing season. Medium and large farms do not rely upon grazing as a feeding strategy. There are two predominant styles for moving herds between pastures. About one-third of the farms wait longer than one week to move their herd to fresh pastures. Another third use pasture more intensively and move their herds to fresh pastures after one to three days.

Concentrated feed

None of the concentrate fed to herds in 2001 was grown on the typical farm in each cluster. The amount of concentrate fed to the herd as well as the total cost is correlated to the size of the herd (Table 6). The concentrate is purchased from a feed dealer or store in Maine, and the farms are located within 40 miles from the dealer.

Livestock health and breeding

Half of the small- and medium-sized farms chose to manage their herd health with scheduled veterinarian services. Small farms receive a total of nine veterinarian visits per year for an annual cost of \$2,100. Medium farms receive 13 visits per year for a total annual cost of \$3,900. These two groups are representative of the state as a whole. Almost all of the large farms manage their herd with regularly

Table 6. Quantity of concentrate purchased and total cost by farm.

	Small	Medium	Large	State
Commercial concentrate (tons)	120	300	950	150
Total cost of concentrate (\$)	24,500	84,000	182,600	33,000

Source: 2002 Cost of Production Survey.

scheduled veterinarian visits. They receive 30 veterinarian visits per year for a total annual cost of \$12,300.

Each group indicated that their veterinarian was located within 20 miles of their farm. Also, each group indicated they did purchase other medicine or health treatments for the herd in 2001 apart from those administered by the veterinarian. There are four methods that are typically used to purchase the extra medication. These are route truck, mail-order through a catalog, farm or feed store, and another local supplier. The farms using another supplier or farm store travel approximately ten miles for the purchase. The total annual cost for these medications is \$560, \$1,635, and \$3,020, respectively, for small, medium, and large farms. The state cluster falls between the small and medium cluster at a cost of \$950.

Each of the clusters indicated they used artificial insemination (AI) services on their dairy herd in 2001. The cost ranged from \$1,400 for small farms, to \$2,750 for medium farms, and to \$9,530 for large farms. Again, the state cluster falls between the small and medium clusters at a total cost of \$1,800. The replacement heifers are not contracted to be raised on another farm.

Labor Use and Off-farm Employment

The following section discusses the use of farm labor and the importance of off-farm income. The farm labor is broken down into two sections: family labor and hired non-family labor. Also, efficiency benchmarks and non-family paid wage are evaluated for each cluster.

The importance of off-farm income sources was evaluated based on four categories. These categories are

- 1) More important than farm income (greater than 50% of total income);
- 2) As important as farm income (about 50% of total income);
- 3) Less important than farm income (between 1% and 50% of total income);
- 4) No off-farm income.

Table 7 indicates that small farms rely more heavily on off-farm income than either the medium or large farms. Twenty-four percent

of the farms surveyed indicated that the earnings received from off-farm work was at least as important if not more important than on-farm income. However, a fairly significant portion of the small farms support themselves mainly through on-farm earnings. On-farm income plays a larger role in the family budget as the farm size increases.

The number of on-farm workers, both family and non-family, and their total annual hours is presented in Table 8. Annual hours are based on the estimated average hours of farm work per week multiplied by the number of weeks that person worked on the dairy farm in 2001. Family and non-family labor hours are combined to generate the total annual labor for each cluster.

Not unexpectedly, the results show that as the farm size increases so does the number of workers, family and non-family, as indicated by the rising number of total labor hours used. Non-family employees play a larger role on the medium and large farms. Only 28% of the small farms indicated that they hired at least one non-family worker.

Average annual wage for non-family employees is a function of average direct compensation of these workers and the hours worked. Compensation takes the form of direct payment through either a cash wage or cash salary or non-paid reimbursement for hours worked. Non-paid reimbursement is defined as, but not limited to, housing, calves, or beef, and is commonly practiced in each cluster. For each cluster, the form of direct compensation for family labor is a cash salary and, for non-family labor, direct compensation is a cash wage. Benefits such as social security, unemployment compensation tax, worker's compensation insurance, and health insurance charges are not calculated in the reported hourly wage.

The number of cows per full-time employee (FTE) is a useful measure of labor efficiency. The figure is a ratio based on the total number of dairy cows in the herd and full-time employees on the farm. Efficiency standards are segmented based on milking system. Workers in a tie-stall or stanchion systems should be able to handle 30 to 35 cows per FTE while workers in free stall-parlor systems should be able

Table 7. Importance of income earned off-farm by rank and by farm (percentage of responses).

Ranking Options	Small	Medium	Large	State
1) More important	15	5	8	12
2) As important	9	10	8	9
3) Less important	37	35	8	32
4) No off-farm income	38	50	77	47

Source: 2002 Cost of Production Survey.

Table 8. Family and non-family annual labor usage by farm.

	Small	Medium	Large	State
Labor used (hours)				
Family	4,160	6,240	7,175	5,148
Non-family	0	2,885	3,140	550
Number of full time equivalents (FTE)	1.7	3.2	3.3	2.0
Average non-family hourly wage (\$)	(na)	\$8.74	\$11.42	\$10.90
Number of dairy cows per FTE	27	34	50	30

Source: 2002 Cost of Production Survey.

to handle 40 to 50 cows per FTE (OSU 2002). Survey results indicate that small farms, which use the tie-stall or stanchion systems, are using more labor than recommended. Medium farms, which use both the tie-stall and free stall-parlor systems, are more efficient than small farms, but still do not maximize efficiency. This may be due in part to the mixture of milking systems used in this cluster. Large farms, which use the free stall-parlor systems, are at the high end of labor efficiency.

Future Outlook

When asked how long the dairy farm would be operating, the majority of owners, 93.2%, indicated that they would not stop milking in 2002. While this sounds encouraging at first, what does this really mean for the dairying industry in Maine? The survey results show that a large number of farms across the state plan to leave the dairy industry within the next ten years. More specifically, less than half of all the small farms plan to be in operation more than ten years from now.

The results in Table 9 point out that 6.8% of farms in the state cluster, which includes 115 farms, plan to stop milking in 2002. This indicates that eight farms from the survey sample plan to leave the industry by the end of the year. This translates into a total loss of 30 farms through out the state, based on a 27% response rate to the survey. Coupled with this is the fact that another 37.8% of the owners indicated they would stop milking within the next 5 to 10 years.

Slightly more than half of all the owners surveyed, 55.3%, indicated their current farm would still be operating over ten years from now. The state should anticipate that small-sized farms will leave the milk production industry in the greatest numbers. Fifty-four percent of the small farm owners surveyed felt they would leave dairy

Table 9. Future outlook of owner/operators by farm responses (percentage).

	Small	Medium	Large	State
Future				
How much longer do you expect farm to operate?				
less than one year	9.8	5.0	0	6.8
less than five years	26.2	10.0	15.4	19.4
less than ten years	18.0	15.0	23.1	18.4
more than ten years	41.2	70.0	61.5	55.3
Farm growth/changes over next five years				
Add more cows				
unlikely/very unlikely	65	50.0	38.5	54.8
equally likely/unlikely	11.7	10.0	7.7	13.5
likely/very likely	23.4	40.0	53.9	31.7
Reduce the number of cows				
unlikely/very unlikely	64.9	94.1	88.9	74.5
equally likely/unlikely	12.3	0	11.1	10.6
likely/very likely	22.8	5.9	0	14.9
Try another type of farming				
unlikely/very unlikely	70.2	93.3	66.7	77.2
equally likely/unlikely	10.5	6.7	22.2	9.8
likely/very likely	19.3	0	11.1	13
Transfer management				
Unlikely/Very unlikely	66.1	72.2	50.0	63.8
Equally likely/unlikely	10.7	11.1	20.0	11.7
Likely/Very likely	23.2	16.7	30.0	24.5

Source: 2002 Cost of Production Survey.

farming within the next ten years. And, 10% of these owners will leave dairy farming in 2002. The data also indicates there will be little to no expansion in herd size on these farms in the coming years.

It is unlikely that current owners, who choose to leave dairying, will transition into a different industry within the agricultural sector. This is due to the fact that only 13% of all the owners surveyed indicated that they would leave dairy farming for another type of farming. Coupled with this is the factor that only 24.5% of all the current owners anticipated that they would transfer management of their current farm to another person.

The data shows that a restructuring of the dairy-farming landscape will occur. Based on current conditions and feelings among dairy farm owners, the structure will be one in which there are a few larger-sized farms producing milk in Maine. It is on these farms where the expansion of the herd size will continue to occur. Also, the owners

in this group are the most optimistic that they will be operating the same farm more than ten years from now and that the management of the farm will be transferred to another person.

SECTION II: FARM REPRESENTATION AND BUDGETING APPROACH

The cost of producing milk in Maine is estimated using procedures similar to those followed in estimating the cost of processing milk in Maine (Dalton et al. 2001; Dalton et al. 2002). The procedure is also consistent with the guidelines for budgeting approved by American Agricultural Economics Association and the USDA Economic Research Service (AAEA Task Force on Commodity Costs and Returns 2000).

Farm Representation

Three cost-of-production budgets are estimated: one for each of the three clusters. These budgets are then combined into one single representative budget by weighting the small, medium, and large budgets by the proportion of Maine producers found in each cluster. These proportions were estimated from a list of producers provided by the Maine Milk Commission current to November 1, 2002. According to this list, there were 412 dairy producers in the state on that date. Within the entire population are two groups for which representative budgets were not estimated: the very large farms with greater than 300 dairy cows and the organic producers. The numbers of returned surveys were insufficient to generate operation-specific budgets.

The average herd size for the organic producers is 46 cows. All but two of these farms are smaller than 80 cows. On the other extreme, 4.1% of Maine producers have herds that are considered “large” by USDA standards (greater than 300 cows). Eighty-four percent of the organic producers were attributed to the small cluster and 16% to the medium cluster. All of the very large farms were attributed to the large cluster. As a result, the composite representative budget is composed of 68.8% of the small farm budget, 23.7% of the medium farm budget, and 7.5% of the large budget.

Budget Components

The cost-of-production budgets are decomposed into three major categories: annual operating expenses, annual overhead expenses, and annual depreciation and interest expenses. The first two categories can be combined to approximate the variable cost of production while the last represents the fixed cost of production. Each category is discussed below.

Annual Operating Expenses

Annual operating expenses are those production costs that vary with production. It includes labor, purchased feed, livestock expenses, crop and pasture expenses, maintenance and equipment expenses, milk check deductions, and interest on working capital. Estimation procedures for each of these components follows.

Labor expenses

Labor cost is broken into three categories: family labor, hired labor, and management expense. The total quantity of family and hired labor is estimated from survey responses. An average hourly wage for hired labor was also estimated at \$8.67/hr from survey response¹. To this wage is added Social Security, unemployment compensation tax, and workers compensation insurance charges. The total cost of labor includes wages and benefits.

Family labor is treated in two ways. In order to explicitly capture the opportunity cost of family labor, the hired wage rate is used for family labor as well. This approximates the potential family earnings if a dairy producer was employed in an alternative agricultural wage-earning activity. Benefits are added to this charge as well. The return to family labor is also calculated at the bottom of each budget. This procedure does not attribute a wage rate to family labor, but calculates an implicit wage. This is done by determining short-run and long-run profits without family labor costs, and then dividing this amount by total family labor.

Management expense occurs on the large farm only. This value acts to control for size differences and the value of time that must be allocated to manage labor, scheduling, and non-livestock production activities. Forty thousand dollars were attributed only to the large farm because of its size. This fee only adds \$0.07/cwt to labor costs in the composite budget.

Purchased feed expenses

The purchased feed category includes two components: dairy forage and dairy concentrate. Nearly all farmers who responded to the survey produced 100% of their forage requirements. As a result, there is no cost in this budget line. All costs of production for forage are included in crop and pasture expense, labor, and machinery and equipment depreciation. Dairy concentrate includes all composite feeds, and this budget line was derived from survey responses.

¹This is the average wage rate for the medium and large farms and not the "state" wage reported in Table 8, which also includes the very large farms and the organic producers.

Livestock expenses

Livestock expenses include those costs that can be directly attributed to the dairy herd, including breeding (artificial insemination), veterinary and medicine, bedding, DHIA record keeping, and livestock insurance. Artificial insemination plus veterinary and medicine charges are estimated from the surveys. Bedding costs are engineered based upon the herd size. It is constructed by multiplying the herd size by a fixed bedding coefficient by the cost of sawdust and wood shavings. DHIA expenses are estimated at an average cost of \$0.07/cwt. Small farms did not use DHIA record keeping on average while the medium and large did. An average insurance rate of 1.2% is applied to the value of the herd.

Crop and pasture expenses

Crop and pasture expenses include all variable costs of producing feed and forage. It includes seeds, crop protection chemicals, fertilizer, lime, and "other" costs. Each of these budget lines are derived from survey responses.

Maintenance and equipment expenses

The fifth category includes those charges associated with the operation of mechanical equipment on the farm. It includes fuel and oil charges for the day-to-day operation and repair expenses for equipment. These costs are derived from survey responses.

Deduction expenses

The sixth category includes charges associated with the marketing and transportation of milk. Milk marketing charges are composed of federal milk promotion taxes of \$0.150/cwt, Maine Dairy Industry Association fees of \$0.010/cwt, Maine Milk Commission levies of \$0.025/cwt, and cooperative fees of \$0.100/cwt. As not all dairy producers are members of cooperatives, this fee is weighted by the percentage of farms marketing their milk through a cooperative. Approximately one-third of Maine producers market through a cooperative. Hauling and trucking charges are calculated from survey responses.

Working capital interest expenses

The final charge in the operating cost section is an interest charge on working capital used to account for the opportunity cost of input purchase. An 8% short-term interest rate is applied to half of the total annual operating expense. This rate is based upon Farm Credit Service rates for operating credit, and it is converted to a real interest of 4.7% to control for annual inflation.

Annual Overhead Expenses

Annual overhead expenses are costs that are attributed to the farm operation as a whole. They include property taxes, farm insurance, dues and professional fees, utilities, and miscellaneous charges.

Property taxes are estimated using the weighted average property tax rates for all dairy producers. This was calculated by matching the municipal mill rates with the location of each producer. Using this procedure, the weighted average property tax rate was 1.795%. This rate was multiplied against the estimated total asset value of the farm. Farm insurance rates are also calculated at a fixed rate of 1.2% of the total value of the farm (Diversified Agrinsurance 2002).

The final three components of the annual overhead expense section are derived from survey responses. They include dues to professional organizations and fees paid to accountants, consultants, legal, and other sources. Utility expenses include electricity, fuel oil, propane, water, and any other utility charge. The final category is general miscellaneous expense derived from survey response.

Annual Depreciation and Interest Expenses

Annual depreciation and interest charges are calculated using an economic-engineering approach and applied to land, buildings, machinery, and the livestock herd. All land is valued at the average value reported in the survey of \$550/acre. This value is consistent with values reported for pasture and cropland in the Maine State Department of Revenue Property Tax Bulletin No. 18. That report was produced to provide information on the Farm and Open Space Tax law debate. While there is considerable variation in land prices due to quality and location, these factors cannot be taken into consideration in an average budgeting approach.

Farm buildings and equipment compliments were derived from survey responses. Based upon farmer responses, typical farm building and equipment portfolios were generated. Replacement costs were estimated for each of these components. Buildings costs were estimated using the RSMeans Building Construction Cost Data 2002 guidelines adjusted to the Lewiston/Auburn area. Equipment costs were derived from the budgeting guidelines and equipment dealers (AAEA 2000).

Based upon these cost estimates, depreciation and interest charges are derived using the capital recovery approach detailed in Dalton et al. 2002. These two components capture the use value of capital and the opportunity cost of investing farm or bank capital into these operations. Interest charges were calculated based upon a 9% loan rate typical for intermediate-term assets provided to a farm with an

“average” credit history. This nominal rate was converted to a real rate by controlling for an average inflation rate of 3.1% calculated over the past 20 years. This resulted in a real interest rate of 5.7%. By explicitly specifying this interest rate, the opportunity cost of investment in dairy production is captured. All budget calculations thus contain what can be considered either as interest recovery on bank equity or the farmer’s return to equity.

Depreciation and interest are also calculated over livestock. All animals are valued at the farm estimates from the survey. Dairy cows (the breeding herd) are depreciated over a cull rate of 25% while a death loss of 10% is assumed for the remaining animals in the herd.

SECTION III: DAIRY COST-OF-PRODUCTION BUDGETS AND IMPLICATIONS

Budget results based upon the descriptive statistics and information provided in Section I, and the budgeting approach described in Section II, are presented in this section. These results are based upon a representative herd size of 68 cows. They should be compared with two recent studies that have estimated the cost of producing milk for the Northeast.

In 1999, the cost of producing fluid milk for the New England milk market was estimated for the Northeast Dairy Compact Commission (Lass 1999). This survey collected information from 271 operations located in Maine, New Hampshire, Vermont, Massachusetts, New York, Connecticut, and Rhode Island. Eleven percent of the responses were from Maine. Under an assumed wage rate of \$7.18/hr for farm labor and an 8.05% interest rate on capital, the study estimated a cost of production of \$21.06/cwt.

A second recent study was conducted by the USDA Economic Research Service for the Northern Crescent region. The Northern Crescent region includes all of the Northeast, portions of Pennsylvania, Maryland, Minnesota, and Ohio plus all of Michigan and Wisconsin. This study estimated the cost of producing milk at \$20.58 based on a herd size of 68 milk cows. This herd size is identical to the representative model for Maine, and it was also estimated based on cost-of-production information for 2001 (USDA ERS 2002).

Based upon the farm types and procedures described in the preceding sections of this report, the total weighted average cost of producing milk in Maine is estimated at \$22.81/cwt (Table 10). This is \$1.75/cwt greater than the value reported in the New England Dairy Compact study and \$2.23/cwt higher than the results calculated by the USDA for the Northern Crescent region². Total annual operating costs

are \$13.75/cwt and total overhead cost is \$3.10/cwt. Combined, these two costs represent the short-run cost of production of \$16.85/cwt. Ownership expense is \$5.96/cwt and captures the full economic cost of capital usage plus an explicit real return to investment (producer or bank equity) of 5.7%. Budgets for the small, medium, and large farms are found in the Appendix.

In comparison with the USDA estimates for the Northern Crescent, labor costs and purchased feed costs are very similar between the two budgets. With regards to livestock production, veterinary and medicine costs, overall profession service costs, including DHIA record keeping, are lower for Maine producers, but bedding costs are similar to the Northern Crescent budgets.

Several factors are distinctly higher for Maine producers than for the Northern Crescent estimates. Fuel, lubrication, and utility costs are estimated at \$1.01/cwt for Maine producers, but only \$0.54/cwt for the Northern Crescent. Repair costs are also \$0.42 higher for Maine producers, which is reflective of the advanced age of the capital assets used by most of the producers in the small and medium clusters. In addition to these two categories, taxes and insurance are significantly higher for Maine producers than for the Northern Crescent. Taxes and insurance for the Northern Crescent are only \$0.22/cwt while property taxes alone are \$0.92/cwt for Maine producers. Combined, these three factors account for \$1.59/cwt of additional operating and overhead cost for Maine producers.

Implications for Maine Producers and Budget Simulations

The budgets highlight several significant factors in the cost of production. Based upon the statistical uniform price for the first nine months of this year, and adjusting the remaining months of 2003 to similar levels, the average annual price of milk for 2002 is estimated at \$12.57/cwt. When livestock and crop revenue is integrated into total farm revenue, the farm will require a producer milk price of \$21.77/cwt in the long-run or \$15.81/cwt in the short-run to breakeven. The short-run measure does not include depreciation and interest charges and provides a benchmark of the minimum price required to breakeven in the near term. The long-run breakeven price is \$9.20/cwt higher than current prices and \$3.24/cwt higher than the short-run price.

When family labor is not explicitly accounted for with the \$8.67/hr wage assumption, the long-run return to family labor, net of all other costs of production including the return to investment, indicates

²Applying the \$7.18 wage rate and 8.05% interest rate used in the Lass (1999) study to the budgets estimated in this project would increase the cost of producing milk in Maine to \$23.44/cwt or \$2.38/cwt higher than the Northeast average in the Compact study.

Table 10. Cost-of-production budget for representative Maine farm.

	Total	Per Cow	Per cwt
Number of Cows	68		
Annual Milk Shipment (cwt)	11,754		
Annual Milk Shipment (lbs/cow)	16,185		
Annual Revenue			
Milk Receipts	\$147,701	\$2,034	\$12.57
Crop and Hay Revenue	\$3,241	\$56	\$0.36
Livestock Revenue	\$7,806	\$111	\$0.69
"Other" Revenue	\$ -	\$ -	\$ -
Total Revenue	\$158,748	\$2,201	\$13.61
Annual Operating Expenses			
<i>Labor Expenses</i>			
Family	\$47,026	\$803	\$5.13
Hired	\$7,970	\$73	\$0.39
Management Fee	\$3,000	\$15	\$0.07
<i>Subtotal</i>	<i>\$57,996</i>	<i>\$891</i>	<i>\$5.60</i>
<i>Purchased Feed Expenses</i>			
Dairy Forage	\$ -	\$ -	\$ -
Dairy Concentrate	\$46,945	\$620	\$3.80
<i>Subtotal</i>	<i>\$46,945</i>	<i>\$620</i>	<i>\$3.80</i>
<i>Livestock Expenses</i>			
Breeding Fees	\$2,329	\$32	\$0.20
Veterinary and Medicine	\$4,519	\$63	\$0.39
Bedding	\$2,420	\$35	\$0.22
DHIA Expenses	\$504	\$4	\$0.02
Livestock Insurance	\$1,541	\$22	\$0.13
<i>Subtotal</i>	<i>\$11,314</i>	<i>\$156</i>	<i>\$0.96</i>
<i>Crop and Pasture Expenses</i>			
Seeds	\$2,017	\$27	\$0.17
Chemicals	\$747	\$13	\$0.08
Fertilizer	\$3,026	\$41	\$0.25
Lime	\$1,067	\$15	\$0.09
Other	\$1,671	\$17	\$0.10
<i>Subtotal</i>	<i>\$8,527</i>	<i>\$113</i>	<i>\$0.69</i>
<i>Maintenance and Equipment Expenses</i>			
Fuel and Oil	\$6,108	\$82	\$0.50
Machinery Repairs	\$11,611	\$166	\$1.03
<i>Subtotal</i>	<i>\$17,719</i>	<i>\$249</i>	<i>\$1.54</i>

Table 10. Continued.

	Total	Per Cow	Per cwt
<i>Deduction Expenses</i>			
Milk Marketing	\$2,566	\$35	\$0.22
Hauling and Trucking	\$6,813	\$100	\$0.63
<i>Subtotal</i>	\$9,379	\$136	\$0.84
<i>Interest (4.7% on half of total operating expense)</i>	\$3,569	\$51	\$0.32
Total Operating Expenses	\$155,449	\$2,215	\$13.75
Annual Overhead Expenses			
Property Tax	\$9,317	\$145	\$0.92
Farm Insurance	\$7,348	\$112	\$0.70
Dues and Professional Fees	\$1,127	\$16	\$0.10
Utilities	\$6,289	\$97	\$0.61
Miscellaneous	\$9,636	\$127	\$0.78
Total Overhead Expenses	\$33,717	\$497	\$3.10
Annual Depreciation and Interest Expenses			
Land	\$11,231	\$186	\$1.18
Buildings	\$23,835	\$355	\$2.22
Machinery and Equipment	\$11,474	\$145	\$0.88
<i>Subtotal</i>	\$46,539	\$686	\$4.28
<i>Livestock Herd Expenses</i>			
Cows (Milking and Dry)	\$15,212	\$212	\$1.31
Heifers	\$3,226	\$43	\$0.26
Calves	\$1,081	\$16	\$0.10
Dairy Bulls	\$64	\$1	\$0.01
<i>Subtotal</i>	\$19,582	\$272	\$1.68
Total Ownership Expenses	\$66,121	\$958	\$5.96
Total Annual Cost	\$255,287	\$3,670	\$22.81
Long-run net return	\$(96,539)	\$(1,469)	\$(9.20)
Short-run return over variable cost	\$(30,418)	\$(511)	\$(3.24)
Performance Measures			
<i>Breakeven Price(\$/cwt)</i>			
Long-run to Cover All Costs		\$3,503	\$21.77
Short-run to Cover Operating and Overhead		\$2,545	\$15.81
<i>Return to Family Labor</i>			
		Total	Hourly
Long-run Return to Family Labor		\$(49,513)	\$(9.05)
Short-run Return to Family Labor		\$16,608	\$3.49

that dairy families are not receiving any wage for their labor but are losing \$9.05/hr. This hourly loss may be viewed as the amount of money that dairy producers are *paying* to produce milk when all other factors of production are accounted for. In the short-run, that is omitting depreciation and interest from the budget estimates, the return to family labor is only \$3.49/hr.

The return to investment is often implicitly derived rather than explicitly accounted for as in these budgets. When this assumption is changed, and no interest is charged to the farm investment, the long-run cost of production drops to \$19.36/cwt and the short-run remains unchanged. Approximately \$3.45 of the cost of producing milk is tied to the interest cost of farm investment leaving \$2.51 to depreciation. Even without an explicit return to capital, the breakeven price is significantly higher than current price levels.

Energy Costs

Energy costs were identified as being significantly higher for Maine producers than for Northern Crescent producers. Electricity prices for Maine are similar to those found in New Hampshire and Vermont, but higher than those found in Massachusetts. Two rates are compared in Table 11 from data compiled by the Energy Information Agency: residential and small commercial rates for 2000 (EIA 2002).

Average residential rates for electricity are higher in New Hampshire than in Maine. In addition, commercial rates were also lower in Vermont and Massachusetts. On average, the greatest price differences existed between Maine and Massachusetts where residential rates were 23% lower (\$0.0239/kwhr) and commercial rates were 12% lower (\$0.0155/kwhr). Overall this illustrates that not only Maine, but northern New England, has higher electricity price than Massachusetts.

Energy cost estimates used in the budgets were derived from 2001 data, which were lower than current energy prices. Data is available from the Energy Information Administration only to July 2002. Information from several monitors of daily gasoline prices indicate

Table 11. Average electricity prices in 2000 for four New England states (\$/kwh).

	Residential	Commercial
Maine	0.1292	0.1077
Vermont	0.1230	0.1061
New Hampshire	0.1314	0.1087
Massachusetts	0.1053	0.0922

Source: EIA (2002)

that current price levels for gasoline are sharply higher, approximately 28%, than one year ago (MaineGasPrices 2002). Based upon this evidence, a conservative 25% increase in the cost of energy was simulated in the cost-of-production budgets. This increase added \$0.15/cwt to the cost of producing milk.

CONCLUSIONS

A cost-of-production estimate for a representative Maine dairy farm was presented in this study. This estimate is based upon responses from the 2002 Cost of Production survey implemented by The University of Maine and the Maine Milk Commission. These surveys were used to develop typical farm units to represent the dairy farming population as a whole. From these characteristic farms, economic-engineering budgeting approaches were applied to value all factors used in dairy production following best-practice-budgeting approaches. Budgets for the small, medium and large farms are presented in Appendix Tables 1–3.

Overall, when all factors of production are accounted for, including variable operating expenses, overhead, depreciation and interest, the long-run cost of producing milk is estimated at \$22.81 for Maine dairy producers. When depreciation and interest are omitted, the short-run cost of production is \$16.85.

Several factors contribute to the higher cost of production for Maine dairy farmers over Northern Crescent dairy farmers. Comparison of the two budgets indicates that three factors—energy costs, property taxes, and repair expenses—account for \$1.59/cwt of additional operating and overhead cost to Maine producers. Dairy producers are price-takers with the first two factors; that is they operate under set rules and regulations that are beyond their control. Producers do have control over repair expenses, but in order to reduce this cost, investment in new equipment is required. Under current price conditions in the dairy sector, capital formation for these purchases will be difficult making cost savings in this component difficult to realize.

At current milk prices, the returns to farm labor are negative, indicating that dairy producers will be forced to reduce inventories or liquidate farm assets to remain in operation. Based upon the results of these budgets, this situation will only become exacerbated, as petroleum prices are approximately 25% higher now than when the survey data was collected.

Future analysis will examine alternative strategies to reduce costs for Maine dairy farmers. This includes determining appropriate

strategies for small, medium, and large farms. While the medium and large farms indicated that they are considering herd expansion as a strategy to benefit from economies of scale, small farmers indicated that they are not interested in expanding. An alternative strategy may lie in modernization of milking systems to reduce labor demand and increase labor efficiency.

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APPENDIX: PRODUCTION BUDGETS FOR ALL THREE FARM TYPES

Appendix Table 1. Cost of production budget for small farm.

	Total	Per Cow	Per cwt
Number of Cows	44		
Annual Milk Shipment (cwt)	6,611.6		
Annual Milk Shipment (lbs/cow)	15,026		
Annual Revenue			
Milk Receipts	\$83,083	\$ 1,888.24	\$12.57
Crop and Hay Revenue	\$2,651	\$60.25	\$0.40
Livestock Revenue	\$4,316	\$98.09	\$0.65
"Other" Revenue	\$ -	\$ -	\$ -
Total Revenue	\$90,050	\$2,047	\$13.62
Annual Operating Expenses			
<i>Labor Expenses</i>			
Family	\$40,142	\$912	\$6.07
Hired	\$ -	\$ -	\$ -
Management Fee	\$ -	\$ -	\$ -
<i>Subtotal</i>	<i>\$40,142</i>	<i>\$912</i>	<i>\$6.07</i>
<i>Purchased Feed Expenses</i>			
Dairy Forage	\$ -	\$ -	\$ -
Dairy Concentrate	\$24,000	\$545	\$3.63
<i>Subtotal</i>	<i>\$24,000</i>	<i>\$545</i>	<i>\$3.63</i>
<i>Livestock Expenses</i>			
Breeding Fees	\$1,400	\$32	\$0.21
Veterinary and Medicine	\$2,583	\$59	\$0.39
Bedding	\$1,500	\$34	\$0.23
DHIA Expenses	\$ -	\$ -	\$ -
Livestock Insurance	\$893	\$20	\$0.14
<i>Subtotal</i>	<i>\$6,376</i>	<i>\$145</i>	<i>\$0.96</i>
<i>Crop and Pasture Expenses</i>			
Seeds	\$960	\$22	\$0.15
Chemicals	\$660	\$15	\$0.10
Fertilizer	\$1,500	\$34	\$0.23
Lime	\$600	\$14	\$0.09
Other	\$400	\$9	\$0.06
<i>Subtotal</i>	<i>\$4,120</i>	<i>\$94</i>	<i>\$0.62</i>
<i>Maintenance and Equipment Expenses</i>			
Fuel and Oil	\$3,200	\$73	\$0.48
Machinery Repairs	\$6,843	\$156	\$1.04
<i>Subtotal</i>	<i>\$10,043</i>	<i>\$228</i>	<i>\$1.52</i>

Appendix Table 1. Continued.

	Total	Per Cow	Per cwt
<i>Deduction Expenses</i>			
Milk Marketing	\$1,444	\$33	\$0.22
Hauling and Trucking	\$4,430	\$101	\$0.67
<i>Subtotal</i>	\$5,873	\$133	\$0.89
<i>Interest (4.7% on half of Total Operating Expense)</i>			
	\$2,128	\$48	\$0.32
Total Operating Expenses	\$92,682	\$2,106	\$14.02
Annual Overhead Expenses			
Property Tax	\$6,667	\$152	\$1.01
Farm Insurance	\$5,011	\$114	\$0.76
Dues and Professional Fees	\$ 664	\$15	\$0.10
Utilities	\$4,386	\$100	\$0.66
Miscellaneous	\$4,500	\$102	\$0.68
Total Overhead Expenses	\$21,229	\$482	\$3.21
Annual Depreciation and Interest Expenses			
Land	\$9,092	\$207	\$1.38
Buildings	\$15,440	\$351	\$2.34
Machinery and Equipment	\$4,928	\$112	\$0.75
<i>Subtotal</i>	\$29,460	\$670	\$4.46
<i>Livestock Herd Expenses</i>			
Cows (Milking and Dry)	\$8,687	\$197	\$1.31
Heifers	\$1,603	\$36	\$0.24
Calves	\$ 651	\$15	\$0.10
Dairy Bulls	\$ 46	\$1	\$0.01
<i>Subtotal</i>	\$10,988	\$250	\$1.66
Total Ownership Expenses	\$40,448	\$919	\$6.12
Total Annual Cost	\$154,359	\$3,508	\$23.35
Long-run Net Return	\$(64,310)	\$(1,462)	\$(9.73)
Short-run Return over Variable Cost	\$(23,861)	\$(542)	\$(3.61)
Performance Measures			
<i>Breakeven Revenue per Cow and Price(\$/cwt)</i>		\$/cow	\$/cwt
Long-run to Cover all Costs		\$3,350	\$22.29
Short-run to Cover Operating and Overhead		\$2,431	\$16.18
<i>Return to Family Labor</i>		Total	Hourly
Long-run Return to Family Labor		\$(24,167)	\$(5.81)
Short-run Return to Family Labor		\$16,281	\$ 3.91

*Based upon an average blended price of \$12.57/cwt

Appendix Table 2. Cost-of-production budget for medium farm.

	Total	Per Cow	Per cwt
Number of Cows	95		
Annual Milk Shipment (cwt)	17,136.3		
Annual Milk Shipment (lbs/cow)	18,038		
Annual Revenue			
Milk Receipts	\$215,339	\$ 2,266.73	\$12.57
Crop and Hay Revenue	\$ 5,980	\$62.95	\$0.35
Livestock Revenue	\$ 14,750	\$155.26	\$0.86
"Other" Revenue	\$ -	\$ -	\$ -
Total Revenue	\$236,069	\$2,485	\$13.78
Annual Operating Expenses			
<i>Labor Expenses</i>			
Family	\$60,055	\$632	\$3.50
Hired	\$25,013	\$263	\$1.46
Management Fee	\$ -	\$ -	\$ -
<i>Subtotal</i>	<i>\$85,068</i>	<i>\$895</i>	<i>\$4.96</i>
<i>Purchased Feed Expenses</i>			
Dairy Forage	\$ -	\$ -	\$ -
Dairy Concentrate	\$70,686	\$744	\$4.12
<i>Subtotal</i>	<i>\$70,686</i>	<i>\$744</i>	<i>\$4.12</i>
<i>Livestock Expenses</i>			
Breeding Fees	\$2,750	\$29	\$0.16
Veterinary and Medicine	\$6,723	\$71	\$0.39
Bedding	\$3,538	\$37	\$0.21
DHIA Expenses	\$1,200	\$13	\$0.07
Livestock Insurance	\$2,378	\$25	\$0.14
<i>Subtotal</i>	<i>\$16,588</i>	<i>\$175</i>	<i>\$0.97</i>
<i>Crop and Pasture Expenses</i>			
Seeds	\$4,050	\$43	\$0.24
Chemicals	\$650	\$7	\$0.04
Fertilizer	\$5,500	\$58	\$0.32
Lime	\$2,000	\$21	\$0.12
Other	\$3,200	\$34	\$0.19
<i>Subtotal</i>	<i>\$15,400</i>	<i>\$162</i>	<i>\$0.90</i>
<i>Maintenance and Equipment Expenses</i>			
Fuel and Oil	\$9,586	\$101	\$0.56
Machinery Repairs	\$19,000	\$200	\$1.11
<i>Subtotal</i>	<i>\$28,586</i>	<i>\$301</i>	<i>\$1.67</i>

Appendix Table 2. Continued.

	Total	Per Cow	Per cwt
<i>Deduction Expenses</i>			
Milk Marketing	\$3,741	\$39	\$0.22
Hauling and Trucking	\$9,254	\$97	\$0.54
<i>Subtotal</i>	<i>\$12,995</i>	<i>\$137</i>	<i>\$0.76</i>
<i>Interest (4.7% on 1/2 of Total Operating Expense)</i>			
	\$5,389	\$57	\$0.31
Total Operating Expenses	\$234,712	\$2,471	\$13.70
Annual Overhead Expenses			
Property Tax	\$13,330	\$140	\$0.78
Farm Insurance	\$10,782	\$113	\$0.63
Dues and Professional Fees	\$1,500	\$16	\$0.09
Utilities	\$9,056	\$95	\$0.53
Miscellaneous	\$18,471	\$194	\$1.08
Total Overhead Expenses	\$53,139	\$559	\$3.10
<i>Annual Depreciation and Interest Expenses</i>			
Land	\$14,531	\$153	\$0.85
Buildings	\$36,460	\$384	\$2.13
Machinery and Equipment	\$20,860	\$220	\$1.22
<i>Subtotal</i>	<i>\$71,851</i>	<i>\$756</i>	<i>\$4.19</i>
<i>Livestock Herd Expenses</i>			
Cows (Milking and Dry)	\$22,841	\$240	\$1.33
Heifers	\$5,532	\$58	\$0.32
Calves	\$2,005	\$21	\$0.12
Dairy Bulls	\$93	\$1	\$0.01
<i>Subtotal</i>	<i>\$30,470</i>	<i>\$321</i>	<i>\$1.78</i>
Total Ownership Expenses	\$102,322	\$1,077	\$5.97
Total Annual Cost	\$390,173	\$4,107	\$22.77
Long-run Net Return	\$(154,103)	\$(1,622)	\$(8.99)
Short-run Return over Variable Cost	\$(51,781.43)	\$(545.07)	\$(3.02)
Performance Measures			
<i>Breakeven Revenue per Cow and Price(\$/cwt)</i>		<i>\$/cow</i>	<i>\$/cwt</i>
Long-run to Cover all Costs		\$3,889	\$21.56
Short-run to Cover Operating and Overhead		\$2,812	\$15.59
<i>Return to Family labor</i>		<i>Total</i>	<i>Hourly</i>
Long-run Return to Family Labor		\$(94,048)	\$(15.07)
Short-run Return to Family Labor		\$8,273	\$1.33

*Based upon an average blended price of \$12.57/cwt

Appendix Table 3. Cost-of-production budget for large farm.

	Total	Per Cow	Per cwt
Number of Cows	200		
Annual Milk Shipment (cwt)	41,916.0		
Annual Milk Shipment (lbs/cow)	20,958		
Annual Revenue			
Milk Receipts	\$526,727	\$2,633.63	\$12.57
Crop and Hay Revenue	\$ -	\$ -	\$ -
Livestock Revenue	\$17,875	\$89.38	\$0.43
"Other" Revenue	\$ -	\$ -	\$ -
Total Revenue	\$544,602	\$2,723	\$12.99
Annual Operating Expenses			
<i>Labor Expenses</i>			
Family	\$69,006	\$345	\$1.65
Hired	\$27,224	\$136	\$0.65
Management Fee	\$40,000	\$200	\$0.95
<i>Subtotal</i>	<i>\$136,230</i>	<i>\$681</i>	<i>\$3.25</i>
<i>Purchased Feed Expenses</i>			
Dairy Forage	\$ -	\$ -	\$ -
Dairy Concentrate	\$182,400	\$912	\$4.35
<i>Subtotal</i>	<i>\$182,400</i>	<i>\$912</i>	<i>\$4.35</i>
<i>Livestock Expenses</i>			
Breeding Fees	\$9,527	\$48	\$0.23
Veterinary and Medicine	\$15,319	\$77	\$0.37
Bedding	\$7,325	\$37	\$0.17
DHIA Expenses	\$2,934	\$15	\$0.07
Livestock Insurance	\$4,841	\$24	\$0.12
<i>Subtotal</i>	<i>\$39,947</i>	<i>\$200</i>	<i>\$0.95</i>
<i>Crop and Pasture Expenses</i>			
Seeds	\$5,284	\$26	\$0.13
Chemicals	\$1,850	\$9	\$0.04
Fertilizer	\$9,200	\$46	\$0.22
Lime	\$2,400	\$12	\$0.06
Other	\$8,500	\$43	\$0.20
<i>Subtotal</i>	<i>\$27,234</i>	<i>\$136</i>	<i>\$0.65</i>
<i>Maintenance and Equipment Expenses</i>			
Fuel and Oil	\$21,800	\$109	\$0.52
Machinery Repairs	\$32,000	\$160	\$0.76
<i>Subtotal</i>	<i>\$53,800</i>	<i>\$269</i>	<i>\$1.28</i>

Appendix Table 3. Continued.

	Total	Per Cow	Per cwt
<i>Deduction Expenses</i>			
Milk Marketing	\$9,152	\$46	\$0.22
Hauling and Trucking	\$20,958	\$105	\$0.50
<i>Subtotal</i>	<i>\$30,110</i>	<i>\$151</i>	<i>\$0.72</i>
<i>Interest (4.7% on 1/2 of total operating expense)</i>	<i>\$11,038</i>	<i>\$55</i>	<i>\$0.26</i>
Total Operating Expenses	\$480,758	\$2,404	\$11.47
Annual Overhead Expenses			
Property Tax	\$20,941	\$105	\$0.50
Farm Insurance	\$17,938	\$90	\$0.43
Dues and Professional Fees	\$4,200	\$21	\$0.10
Utilities	\$15,000	\$75	\$0.36
Miscellaneous	\$28,825	\$144	\$0.69
Total Overhead Expenses	\$86,903	\$435	\$2.07
Annual Depreciation and Interest Expenses			
Land	\$20,425	\$102	\$0.49
Buildings	\$60,941	\$305	\$1.45
Machinery and Equipment	\$41,852	\$209	\$1.00
<i>Subtotal</i>	<i>\$123,217</i>	<i>\$616</i>	<i>\$2.94</i>
<i>Livestock Herd Expenses</i>			
Cows (Milking and Dry)	\$50,953	\$255	\$1.22
Heifers	\$10,823	\$54	\$0.26
Calves	\$2,100	\$10	\$0.05
Dairy Bulls	\$139	\$1	\$0.00
<i>Subtotal</i>	<i>\$64,015</i>	<i>\$320</i>	<i>\$1.53</i>
Total Ownership Expenses	\$187,232	\$936	\$4.47
Total Annual Cost	\$754,894	\$3,774	\$18.01
Long-run Net Return	\$(210,292)	\$(1,051)	\$(5.02)
Short-run Return over Variable Cost	\$(23,060)	\$(115)	\$(0.55)
Performance Measures			
<i>Breakeven Revenue per Cow and Price(\$/cwt)</i>		<i>\$/cow</i>	<i>\$/cwt</i>
Long-run to Cover all Costs		\$3,685.09	\$17.58
Short-run to Cover Operating and Overhead		\$2,748.93	\$13.12
<i>Return to Family Labor</i>		<i>Total</i>	<i>Hourly</i>
Long-run Return to Family Labor		\$(141,286)	\$(19.69)
Short-run Return to Family Labor		\$45,947	\$ 6.40

*Based upon an average blended price of \$12.57/cwt