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An Economic Evaluation of Two Alternative Uses of Excess Capacity in the Milking Parlor

by

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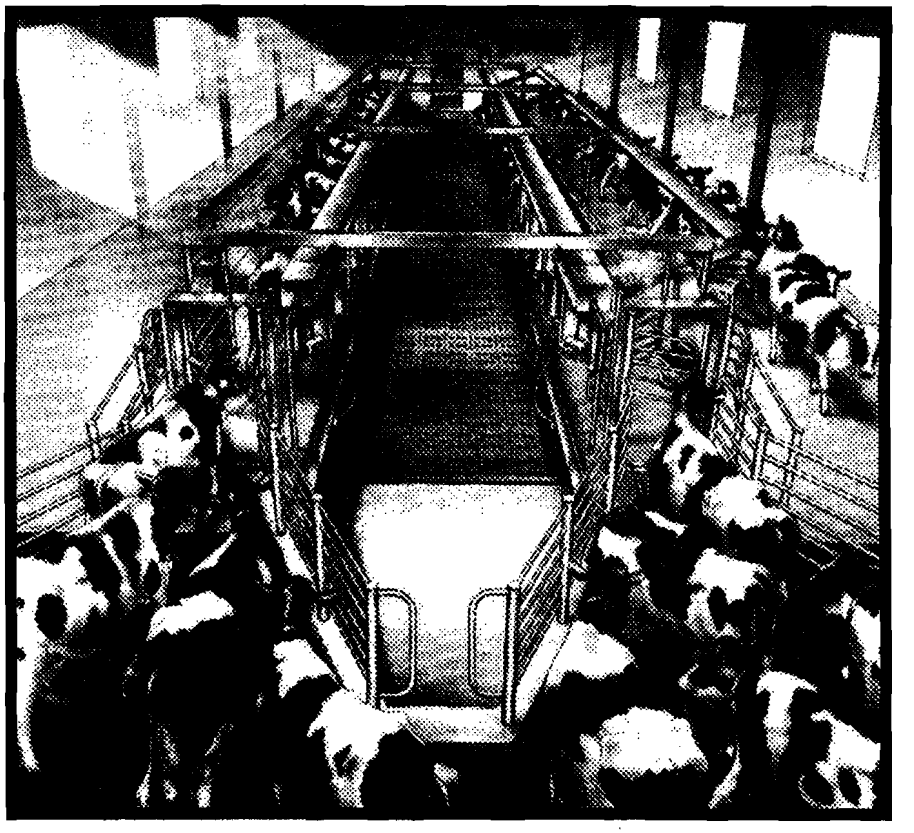

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ABSTRACT

Milking parlors are a large and often underutilized investment on most dairy farms. Two viable options for increasing usage of the milking parlor are switching to three times daily milking or increasing the number of cows milked twice daily. A basic scenario was developed from data collected on New York dairy farms in 1992. To determine the economic impact of the two alternatives on the base farm, prepared statements of income and cash flow are reviewed. Net farm income and cash flow increase with the adoption of either alternative. Net cash flow increases more rapidly with the move to three times daily milking and does not require new debt. Expansion of the herd milked twice daily results in a larger increase in net farm income. Fluctuations in milk price, milk production, feed costs, and interest rate have a greater impact on net farm income and cash flow for the herd expansion option.

INTRODUCTION

In past years, many dairy farmers designed milking systems with excess capacity to avoid milking cows for long periods each day. Excess capacity in the milking parlor refers to an imbalance between the potential and actual number of hours of milking parlor use; i.e., the milking parlor remains unused for some portion of the day. Dairy farmers are constantly evaluating strategies aimed at increasing efficiency and profitability, and one strategy that deserves attention is evaluating the best alternative for unused capacity in the milking parlor. With the availability of hired labor, more efficient use can be made of previously underutilized resources. Excess capacity in the milking parlor can be reduced by milking the existing herd three times daily (**3X**) or by increasing the number of cows milked twice daily (**2X**); both alternatives are being assessed by many dairy farm managers.

The purpose of this study is to analyze the managerial decisions of increasing herd size and maintaining 2X milking versus maintaining herd size but implementing 3X milking. A model farm is developed using data collected from New York dairy farms in 1992 and provides a basis for a static analysis of the two options. Statements of income and cash flow are used to appraise the economic impact of the two alternative uses of excess capacity in the milking parlor.

METHODOLOGY

Base Farm Outline

A dairy farmer operates a 2 X 10 herringbone, rapid-exit parlor for his herd of 160 cows. Milk production is 18,000 lbs. per cow over a 305 day lactation, and the dairy farmer receives $13.00 of milk sold. The farmer is evaluating two alternatives to utilize the excess capacity in the milking parlor. Increased utilization may be accomplished by switching to 3X milking or by increasing herd size but maintaining 2X milking. Upon implementation, neither activity changes the existing milking parlor,

but rather makes more efficient use of it. For the 3X milking option, milk production is expected to increase 15% based on past experience of dairy farmers (1, 2, 3, 7, 8).

The base farm of 160 cows on 2X milking consists of crop acreage sufficient to enlarge the herd without renting additional land. Corn silage (**CS**) and legume haycrop silage (**HCS**) are the principal types of forages produced; the quality of either forage is assumed to be excellent. Ground shelled corn (**GSC**) is the only grain produced, and, if the farmer produces more GSC than can be fed, the surplus can be sold locally at market price. Soybean meal (**SBM**) is not produced on the farm and must be purchased at the prevailing market price.

Alternatives to Reduce Excess Capacity in the Milking Parlor

A maximum of 240 cows (2X) or 135 cows (3X) can be milked in 8 hours using a 2 X 10 herringbone, rapid-exit parlor (6). The number of cows milked per 8 hours includes 1 hour of preparation and clean-up per milking. Therefore, if 15% of the herd is assumed to be dry, a herd of 280 cows milked 2X can efficiently utilize a 2 X 10 herringbone, rapid-exit parlor in 8 hours. Similarly, a herd of 160 cows milked 3X can efficiently use an identical milking system in the same period. Similar guidelines can be applied to the base herd of 160 cows. If 15% of the herd is dry, one worker can milk the remaining 135 cows 2X in about 5.4 hours.

Base Farm: Acreage and Feed Requirements

The forage base for the dairy farm is a 50:50 (wt/wt; dry matter (**DM**) basis) mixture of CS and HCS supplemented with GSC and SBM (5). Average crop yields for dairy farms of 150 to 199 cows in New York are used to calculate the number of acres needed to produce sufficient quantities of CS and HCS to support the base herd. The average yield for CS is 15 tons/acre with a 32% DM content, and the average yield for HCS is 7.3 tons/acre with a 45% DM content (10). The amounts of CS and HCS needed to feed the base herd with milk production of 18,000 lbs. per cow are estimated in Table 1. About .81 and 1.18 acre/year of CS and HCS are needed per cow to grow the requisite amount of forage. A total of 319 acres/year are needed to

Table 1. Amount of Forage Crops Required to Feed One Cow for 1 Year.

Crop[1]	Annual feed consumed per cow[2]	Feed for replacement heifer[3]	Storage and feeding losses[4]	Total forage requirement	Yield	Land requirement
		(tons, DM)			(tons DM/acre)	(acre)
Amount needed for 2X milking						
CS	2.70	.68	.51	3.89	4.8	.81
HCS	2.70	.68	.51	3.89	3.3	1.18
Additional amount needed for 3X milking						
CS	.10	.03	.02	.15	4.8	.03
HCS	.10	.03	.02	.15	3.3	.05

[1]CS = Corn silage, 32% DM; HCS = haycrop silage, 45% DM

[2]The applicable milk production is 18,000 lbs. under twice daily milking (2X) and 21,000 lbs. under three times daily milking (3X).

[3]An additional 25% of the feed consumed by all cows is required to feed replacement heifers.

[4]Storage and feeding losses of 15% are expected.

produce enough forage to sustain a herd of 160 cows on 2X milking.

Additional energy and protein are supplied by GSC and SBM. Because of constraints on land and machinery and climate limitations, only GSC is grown. The amount of land to be allocated to GSC under 2X milking is about .73 acre per cow (Table 2). For a 160-cow herd, 117 acres are budgeted for the production of GSC. In total, 436 acres/year are needed to produce the required amounts of CS, HCS, and GSC for a 160-cow herd on 2X milking.

The SBM, which must be purchased, is the primary feed expense for the dairy. Table 2 specifies that .88 tons/year of SBM (DM) are required to feed one cow on 2X milking; a total of 140.8 tons of SBM are required to feed a herd of 160 cows. However, SBM must be purchased on an as-fed basis. If 90% DM is assumed, then a total of 156.4 tons of SBM must be purchased, and, at $260/ton, a total of $40,676 is spent on SBM for the base herd (9). Other feed-related expenses include calf starter and milk replacer to raise calves to 250 lbs. as well as salt and mineral supplements for cows and replacement heifers. The feed cost of raising a replacement heifer to

Table 2. Amount of Concentrate Required to Feed One Cow for 1 Year.

Crop[1]	Annual feed consumed per cow[2]	Feed for replacement heifer[3]	Storage and feeding losses[4]	Total concentrate requirement	Yield[5]	Land requirement
		(tons, DM)			(tons DM/acre)	(acre)
Amount needed for 2X milking						
GSC	1.08	.27	.14	1.48	2.04	.73
SBM	.64	.16	.08	.88	---	---
Additional amount needed for 3X milking						
GSC	.46	.12	.06	.64	2.04	.31
SBM	.16	.04	.02	.21	---	---

[1]GCS = Ground shelled corn, 89% DM; SBM = soybean meal, 90% DM.

[2]The applicable milk production is 18,000 lbs. under twice daily milking (2X) and 21,000 lbs. under three times daily milking (3X).

[3]An additional 25% of the feed consumed by all cows is required to feed replacement heifers.

[4]Storage and feeding losses of 10% are expected.

[5]Soybean meal is purchased, not grown; therefore, yields are not included.

250 lbs. is $75 (4). For the 114 heifers that are raised annually, the total feed cost is $8,550. The cost of salt and minerals for one cow and replacement heifer is $25; a total of $4,000 per year is spent on salt and mineral supplements. For the base herd $53,226 is spent on dairy concentrates and feed supplements (Table 3).

New York dairy farms with herds of 150 to 199 cows averaged 485 acres of tillable land in 1992 (10). If the base farm follows the state average for the amount of tillable land, a fraction of the feed produced in the base scenario may be available to sell. At $3.00/bushel, GSC can generate an additional $12,054 in revenue, assuming that the average of 49 acres/year of GSC is in excess of the GSC requirements for the base farm.

3X Option: Acreage and Feed Requirements

Milking 3x increases milk production 15%, i.e., annual production increases to 21,000 lbs. per cow. Under 3X milking, the amount of forage and concentrates consumed increase to satisfy the nutrient requirements of each cow. Thus, more feed has to be grown or purchased. The additional forage requirement per cow under 3X

milking is modest (1,3,8). A total of 13 acres/year are needed to provide the additional forage requirements for a herd of 160 cows, i.e., an extra 5 acres of CS and 8 acres of HCS (Table 1).

Because of the high energy demands of producing an incremental amount of milk, most additional feed consumed consists of grains and other concentrates. Under 3X milking, an additional 50 acres of GSC is needed for the base herd (Table 2). The amount of SBM consumed also increases with the implementation of 3X milking. An additional 33.6 tons of SBM (DM) are required for the 160-cow herd. The cost of the additional SBM at $260/ton is $9,707 when purchased on an as-fed basis (9). This figure represents the difference in the purchased feed costs between the base farm and the 3X milking option in Table 3.

As noted, 436 acres are required to produce feed for the 160 cow base herd using 2X milking practices. Switching to 3X increases the amount of land needed to 499 acres to produce enough CS, HCS, and GSC to sustain the 160-cow herd. The additional 14 acres of cropland can be rented at a cost of $40/acre, which amounts to $560 annually (10).

Herd Expansion Option: Acreage and Feed Requirements

Under the herd expansion scenario, additional land must be rented to produce the forage crops. From Table 1, .81 acre/year of CS and 1.18 acre/year of HCS are needed to feed one cow. With 280 cows, 227 acres/year of CS and 331 acres/year of HCS are needed, bringing the total amount of land necessary for forage crop production to 558 acres/year. Because only 485 acres are owned, the additional 73 acres must be rented. At $40/acre, the total cost of renting land is $2,920. Clearly, even more land could be rented to produce the GSC required, but this option is waived so that only forage crops are grown. Facilities previously used to store GSC under the base farm scenario may be converted to hold forage or may be unused. Although corn harvesting equipment that is not needed for forage production could be sold, such machinery or implements would be worth little in the used equipment market.

Although this alternative to purchasing the 120 cows is feasible, such a venture requires more management and is less convenient than purchasing the entire group of 120 cows. Additional 2 year old cows can be purchased for $1,200 each (9). For 120 cows, the total cost is $144,000. Rapid expansion of a herd is likely to result in a decrease in milk production throughout the first 3 to 5 years following expansion (11). An average decrease in milk production of 500 lbs./cow/year is used for the first 5 years of expansion to account for the negative impact on milk production (Table 5).

Herd Expansion Option: Acquisition of Debt Capital

The barn and the silo are financed with 100% debt capital using a 15 year loan at 8.0% interest. Interest payments on the loan for the barn and silo average $11,854 over the first 5 years, and the total amount of interest paid on the loan is $118,224 (Table 4). The cows needed for expansion are also financed with 100% debt capital at 8.0% interest. Livestock loans are generally amortized over less time than buildings and other structures; most livestock loans are 3 to 5 years in length. As shown in Table 4, a repayment period of 5 years at 8.0% interest requires annual payments of $35,038. The interest payments on the cattle loan average $6,237 over the five years; the total amount of interest paid on the loan is $31,187. Annual payments for the freestall barn, silo, and expansion cattle total $53,863 for each of the first 5 years of the expansion and $18,826 for the last 10 years of the expansion. Scheduled annual loan payments for the herd expansion option are the sum of the annual payments on the new loans plus the scheduled annual payments on existing loans for the base farm (Table 6). Dairy farms with 160 cows average $73,700 in scheduled annual loan payments (10).

3x and Herd Expansion Options: Labor Requirements

Additional labor is required in both scenarios. To change to 3X milking but maintain herd size at 160 cows, additional labor is required in the milking parlor. Milking time increases from 5.4 to 8 hours/day; the added worker contributes 2.6 hours/day in the milking parlor. The milker can be added at a cost of $7.50/hour,

Table 4. Scheduled Annual Loan Payments On Freestall Barn, Bunk Silo and Additional Cattle for Herd Expansion Alternative.

	Freestall barn and silo[1]		Expansion cattle[2]		
Year	Principal	Interest	Principal	Interest	Annual payment[3]
			($)		
1	5,906	12,919	24,400	10,638	53,863
2	6,396	12,429	26,426	8,613	53,864
3	6,927	11,898	28,619	6,420	53,864
4	7,502	11,323	30,994	4,044	53,863
5	8,125	10,701	33,561	1,472	53,859
6	8,800	10,026	---	---	18,826
7	9,530	9,296	---	---	18,826
8	10,321	8,505	---	---	18,826
9	11,177	7,648	---	---	18,825
10	12,105	6,721	---	---	18,826
11	13,110	5,716	---	---	18,826
12	14,198	4,628	---	---	18,826
13	15,376	3,449	---	---	18,825
14	16,652	2,174	---	---	18,826
15	18,035	791	---	---	18,826
Totals	164,160	118,224	144,000	31,187	457,571

[1]The barn and silo are financed with 100% debt capital at 8.0% interest. The barn cost is estimated at $144,000, and the silo cost is estimated at $21,160. A repayment period of 15 years is applicable.

[2]The cattle are financed with 100% debt capital at 8.0% interest. The estimated cost of obtaining 120 cows is $144,000. A repayment period of 5 years is applicable.

[3]The annual payment on the loans is the sum of the principal and interest due each year on the freestall barn, bunk silo, and expansion cattle.

including benefits (9). The additional hired labor cost is $7,118/year.

For the herd expansion scenario, the 1992 labor estimates for New York dairy farms with herds of 200 to 299 cows indicate that additional workers are needed primarily for herd health, crop production, and manure handling (10). After adjusting the labor values to a herd of 280 cows, the three additional workers needed are estimated to cost $56,461/year (Table 3).

Table 5. Accrual Receipts, Profitability and Dairy Analyses, and Labor Efficiency for a 160 Cow Dairy Farm Under Two Milking Frequencies and a 280 Cow Dairy Farm During Two Phases of Expansion.

	160 cows		280 cows	
	2X[1]	3X	2X[2]	2X[3]
Accrual Receipts				
Milk sales, $	374,400	436,800	637,000	655,200
Dairy cattle, $	36,840	36,840	63,169	63,139
Dairy calves, $	7,189	7,189	10,134	10,134
Crop sales, $	11,735	0	0	0
Miscellaneous receipts, $	8,436	8,436	20,326	20,326
Total accrual receipts, $	438,919	489,265	730,629	748,799
Profitability analysis				
Net farm income[4], $	80,929	100,854	101,720	131,726
Number of operators	1.66	1.66	1.66	1.66
Net farm income/operator, $	48,752	60,755	61,277	79,353
Dairy analysis:				
Number of cows	160	160	280	280
Number of heifers	114	114	229	229
Milk sold, lbs.	2,880,000	3,360,000	4,900,000	5,040,000
Milk sold per cow, lbs.	18,000	21,000	17,500	18,000
Milk price, $/cwt.	$13.00	$13.00	$13.00	$13.00
Labor efficiency				
Worker equivalent	4.49	4.83	7.4	7.4
Operator equivalent	1.66	1.66	1.66	1.66
Milk sold per worker, cwt.	6,414	6,957	6,622	6,811
Cows per worker	36	33	38	38

[1]2X = twice daily; 3X = three times daily.

[2]Values represent the first 5 years of expansion.

[3]Values represent the last 10 years of expansion.

[4]Net farm income does not include appreciation.

RESULTS AND DISCUSSION

Comparison of the two alternatives for more intensive uses of the milking parlor with the base farm shows that expansion of the herd has a larger positive effect on annual net farm income (**NFI**) and net cash flow than 3X milking. Milking the herd 3X increases NFI by $19,925 or 25% above the base farm amount (Table 5). In years 1 to 5 of the expansion option, NFI is increased by about $20,791 (26%). After the cattle loan is repaid (at the end of year 5), the herd expansion strategy increases NFI by $50,797 (63%) over the NFI of the base farm. Although the 3X milking option yields a lower percentage increase in annual NFI than expansion of the herd size, no new loans are added to the existing base farm loans under the 3X milking scheme.

Both alternatives to the base farm scenario increase annual net cash flow (Table 6). Expansion of the herd results in a larger increase in net cash flow, but the increase occurs less rapidly than that from conversion to 3X milking because of the inherent time delays in constructing new facilities and assembling cattle for expansion. Adoption of the 3X milking strategy increases annual net cash flow by about $13,919 (68%) above the base farm level and does not require new loans. The combination of new and existing loans results in large scheduled annual payments for the herd expansion strategy in years 1 to 5. Annual net cash flow falls to $13,960, which is about 31% less than the base farm amount. After the expansion cattle loan is repaid, net cash flow is remarkably improved; net cash flow increases by nearly $45,000, which is over twice the net cash flow of the base farm.

A measure that evaluates the ability of a business to repay debts is the cash flow coverage ratio (**CFCR**). A CFCR of 1 indicates that, for every dollar of debt, a dollar of cash is available to service the debt. As shown in Table 6, the CFCR for the expansion alternative in years 1 to 5 is 1.11, indicating that the dairy farmer can repay the loans for the expansion cattle and structures. A CFCR of 1.70 in years 6 to 15 of the expansion suggests a strong capacity for the farm to make scheduled debt payments. The 3X option results in a CFCR of 1.47, which is substantially greater

Table 6. Annual Net Cash Flow for a 160 Cow Dairy Farm Under Two Milking Frequencies and a 280 Cow Dairy Farm During Two Phases of Expansion.

	160 cows		280 cows	
	2X[1]	3X	2X[2]	2X[3]
Cash inflows			($)	
Cash farm receipts	438,919	489,265	730,629	748,799
Cash outflows				
Cash farm expenses less interest	298,449	328,870	536,683	537,043
Personal withdrawals and family expenses	46,417	52,423	52,423	54,154
Total outflows	344,866	381,293	589,106	591,197
Cash available for debt payments	94,053	107,972	141,523	157,602
Scheduled debt payments	73,700	73,700	127,563	92,526
Cash available less scheduled debt payments	20,353	34,272	13,960	65,076
Cash flow coverage ratio[4]	1.28	1.47	1.11	1.70

[1]2X = Twice daily milking; 3X = three times daily milking.

[2]Values represent the first 5 years of expansion.

[3]Values represent the last 10 years of expansion.

[4]Cash available for debt payments + scheduled debt payments.

than the CFCR of the early years of expansion of herd size but well below the CFCR of the later years of herd expansion.

A sensitivity analysis indicates that two financial measures, NFI and CFCR, are influenced by changes in milk production, milk price, feed prices, and interest rates (Table 7). Furthermore, fluctuations in milk production or milk price have a larger effect on NFI and CFCR than do changes in feed prices or interest rates. For example, under 3X milking, a 1% decrease in milk production or milk price reduces NFI by 4.3% and CFCR by 4.4%. During the first 5 years of herd expansion, a similar reduction in milk production or milk price decreases NFI and CFCR by 6.3% and 4.6%,

Table 7. Sensitivity of Financial Measures to Changes in Various Factors for a 160 Cow Dairy Farm Under 3X Milking and a 280 Cow Dairy Farm During Two Phases of Expansion.

Factors affecting decision[1]	160 cows, 3X[2]	280 cows, 2X[3]	280 cows, 2X[4]
Milk production/year per cow or milk price/cwt.			
Production used in analysis, ΔΔ874Xlbs	18,000	17,500	18,000
Price used in analysis, $/cwt.	13.00	13.00	13.00
Change in production or price, %	1	1	1
Effect on NFI, %	4.3	6.3	5.0
Effect on CFCR, %	4.4	4.6	4.2
Feed Prices[5]			
Change in feed prices, %	1	1	1
Effect on NFI, %	-.6	-1.4	-1.1
Effect on CFCR, %	-.9	-1.1	-.7
Interest rate[6]			
Rate used in analysis, %/year	---	8.0	8.0
Change in rate, percentage points	---	1.0	1.0
Effect on NFI, %	---	-2.0	-.5
Effect on CFCR, %	---	-1.5	-.5

[1]NFI = Net farm income without appreciation; CFCR = cash flow coverage ratio.

[2]2X = Twice daily milking; 3X = three times daily milking.

[3]Values represent the first 5 years of expansion.

[4]Values represent the last 10 years of expansion.

[5]All prices for feed and feed supplements increase by 1%.

[6]No new loans are needed for 3X milking.

respectively. Similarly, the NFI and CFCR during the last 10 years of expansion decrease by 5.0% and 4.2%, respectively. For each 1% increase in feed prices, NFI and CFCR are slightly decreased for either alternative, and a rise in the interest rate

by one percentage point has a similarly insignificant impact on the financial measures for the two phases of herd expansion. The effect of changing each of the factors is symmetric with respect to NFI and CFCR. For example, under 3X milking, a 1% *increase* in milk production or milk price *increases* NFI and CFCR by 4.3% and 4.4%, respectively.

CONCLUSIONS

As the search for more efficient uses of resources in dairy farming intensifies, dairy farm managers must constantly look for resources that are underutilized or not fully utilized. A large investment that is underutilized on many farms is the milking parlor. Net cash flow and NFI increase with the adoption of 3X milking or milking more cows 2X in an underutilized parlor. Net cash flow increases rapidly with 3X milking. Expansion of the herd also increases cash flow but requires new loans. The greatest increase in NFI occurs with expansion of the herd. A sensitivity analysis suggests that either alternative may be adversely impacted by declines in milk price or milk production. An increase in feed prices or interest rates has a small effect on the economic profiles of the two options.

An asset difference exists between the two alternative uses of excess capacity in the milking parlor that is not reflected in the analyses of NFI and cash flow. Although the additional barn and bunk silo have little value after 15 years of use, the herd expansion option results in ownership of 120 more cows.

The analysis of two alternatives to utilize fully excess capacity in the milking parlor relies on a static model with specific conditions and prices. Managers are encouraged to use conditions and prices applicable to their region before embarking on the decision to determine the best use of an underutilized milking parlor.

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