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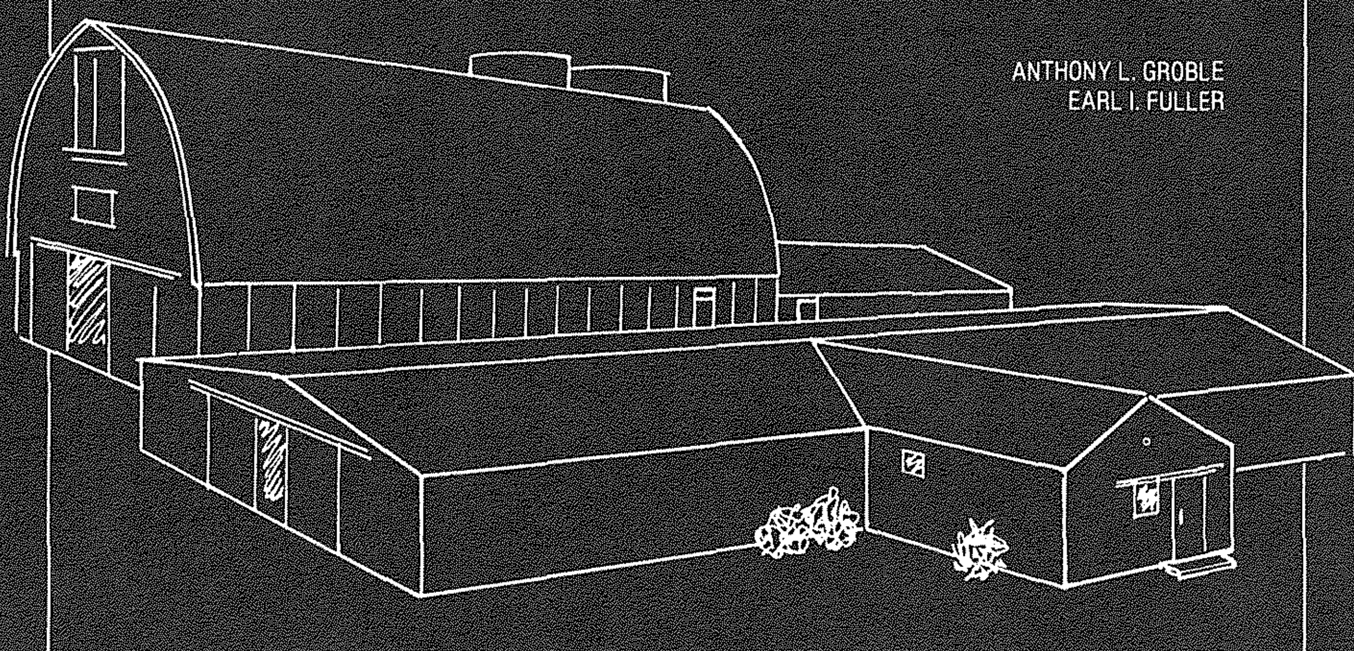
An Economic Evaluation of Six Dairy Herd Expansion Alternatives



ANTHONY L. GROBLE
EARL I. FULLER

AGRICULTURAL EXPERIMENT STATION • UNIVERSITY OF MINNESOTA

Authors:

Anthony L. Groble was formerly a research specialist in the Department of Agricultural and Applied Economics. Earl I. Fuller is a professor in the Department of Agricultural and Applied Economics.

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Introduction

This study investigates the economic implications of various problems encountered in dairy farm expansion on limited land base operations. Six expansion alternatives for a typical Minnesota dairy farm doubling its herd size from 40 to 80 cows are economically simulated and compared.

Using information derived from the St. Cloud area and the Winona area *1977 Farm Business Management Annual Reports*, an above-average dairy farm is developed. The farm consists of 201 tillable acres, 40 milk cows plus replacements, and an average milk production of 15,400 pounds per cow. Cows are milked in a stall barn with a pipeline milker. Barn cleaning and manure hauling are daily chores.

Both rapid and gradual rates of expansion are simulated. Rapid expansion is defined as attaining the 80-cow herd size by the first year of expansion by purchasing springing heifers and yearlings. In the gradual expansion situation, some cattle are also bought initially but the desired herd size is not reached until the end of the fourth year of expansion. The following alternatives are investigated for both rapid and gradual rates of expansion:

(1) Assuming that the present dairy facility is still useful, similar housing, milking, and feeding systems are added to accommodate the increase in herd size.

(2) Assuming that the present dairy facility must be replaced, a new tie stall barn with pipeline milking and a new feeding system is built.

(3) Assuming that the present dairy facility must be replaced, a new cold free stall barn with a parlor and a new feeding system are built.

In all of the above cases a switch is made from a daily clean and haul manure system to a system involving a piston pump and a six-month storage basin.

For the first five years of expansion, monthly cash flows for each alternative are constructed. For the remainder of the 30-year planning span, annual cash flows are estimated. The alternatives are compared on the basis of: (1) management effects during the expansion process; (2) investment costs involved, (3) labor requirements; (4) liquidity effects; and (5) after-tax internal rate of return.

An economic approach which is more positive than normative is taken; that is, implied resource use reflects that group of Minnesota dairy farmers studied and does not necessarily imply optimal resource allocation. While recognizing that the problems and costs involved during expansion are site specific, this study presents a conceptual model and a methodology of use to owners/managers in making more profitable and satisfactory decisions.

Recent Research Results

Trends in Farm Size

A considerable decline in the number of dairy farms in Minnesota occurred between 1967 and 1976, dropping from 62,000 to 31,000 farms. During the same period, average herd size increased from 17 to 28 cows.[16] This decline in farm numbers and a shift to larger, more specialized dairy operations has been the trend not only in Minnesota but nationally as well.[19,27]

Although the national trend since 1960 has been toward free stall systems, Minnesota dairymen have been building more new stanchion or tie stall barns than free stall barns.[3]

The following table contains a breakdown of the number of Minnesota DHI dairymen who either extensively remodeled their old facilities or built new ones since 1967. The percentage of new free stall barns has decreased from 42 percent of the total in 1967-68 to 24 percent of the total in 1975-76.

Table 1. Number of new or extensively remodeled housing facilities in Minnesota DHI herds, by years.[3]

	Stall	Free stalls			Percent
Year	barns	Warm	Cold	Total	free stalls
1967-68	73	23	29	125	41
1969-70	102	21	34	157	35
1971-72	157	22	51	230	32
1973-74	252	19	52	323	25
1975-76	132	16	26	174	24
Total	716	101	192	1,009	29

*This paper is a contribution to Minnesota Agricultural Experiment Station Project No. 14-36, Management Information Systems for Minnesota Farm Firms.

Reasons for Expansion

Brake *et. al.* surveyed 19 farmers who expanded their operations by doubling their herd size. (Michigan, 1968).[7] The study showed that almost all farmers who expanded their operations did so to increase income. Several farmers expanded to support a family partnership. Other reasons for expanding included making use of excess labor or land.

It was found that in doubling herd size, net income per cow dropped 18 percent but net income per farm increased 66 percent. This implies that net income increased not because of the lowering of average cost of production but because of increased volume.

Buxton and Jensen, however, showed that economies of size exist in dairying and that the size of the dairy herd must be increased to fully utilize new developments in housing, milking, and feeding systems that typically require large investment expenditures (Minnesota, 1968).[9]

Willett *et. al.* suggest the following developments which have encouraged size economies in dairying (Wisconsin, 1972):[33]

(1) An increase of more productive and capital intensive technology. When the cost of capital falls relative to labor costs, as it has in the last few years, there is an incentive to substitute mechanized technology for labor. Higher overhead costs must be spread over a greater volume to reduce per unit costs.

(2) Thin profit margins per cwt. of milk produced. Costs of production have increased along with higher milk prices, causing profit margins to remain narrow. As a result, dairymen are forced to generate more volume to maintain or increase their income.

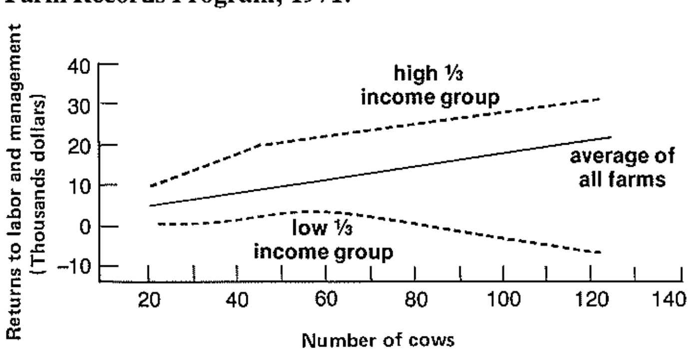
(3) Better dairy farm managers. Today's dairyman is better educated than his predecessor and is better equipped to handle the complexities of running a large operation.

Problems Occurring in Farm Expansion

"Get better before getting bigger" has become cliché advice to farmers considering expansion. Nevertheless, a dairyman's chance for a financially successful herd expansion is best if he is in the top third of his herd size group when ranked by a profit measure such as return to management.[33]

Figure 1, from a Wisconsin study, illustrates that milking more cows is not necessarily the cure for income problems.

Figure 1. Average returns to labor and management per farm by income group and herd size, Wisconsin Electronic Farm Records Program, 1971.[33]



Financial and management problems are both reported in two Michigan studies.

In the most recent study (1974), 47 farms with minimum additions of 40 cows were investigated; 18 rapid expansions and 29 gradual expansions.[29] Although not significant, there was a decrease in management income during the first two years of expansion, particularly in the rapidly expanding herds. Because of the differences in herd size between the rapid and gradual expansion farms, objective determination of the best rate of expansion was not possible.

These results are similar to those in the earlier Michigan study (1968).[7]

Wells reported the following observations by lenders who have financed herd expansions:[30]

(1) Herd size increased faster than anticipated. By failing to keep the lender informed of progress and credit needs, problems were created in providing necessary credit when needed.

(2) Dairymen used split lines of credit, thus compounding repayment problems.

(3) Management ability did not increase with herd size.

The Relationship Between Herd Expansion, Barn Type, and Milk Production

Milk sales are the major source of income to a dairyman, therefore, the effect that expansion and/or a switch in milking and housing systems has on milk production is of major concern. However, the results of most of the work done in this area remain inconclusive.

Studies have included the relationship of milk production with a change in barn type,[33] herd size, [8,20,22] and the interaction of the two[26].

Meek studied the relationship between housing and milking systems and milk production and found no production loss for either parlor users or cows housed in either loose housing or free stalls (New York, 1965).[20] A study cited by Wiggens and Van Vleck also indicated that average production for herds that switched to free stalls from stanchion barns did not decline and that roughly equal numbers of herds had a higher average as had a lower average compared with the years before the change in systems, even with an increasing number of cows (New York, 1970).[33]

Likewise, a 1968 West Virginia study cited by Meller *et. al.* concluded that the type of housing and milking system and the size of herd were not significantly related to production.[22]

Brown and White, however, in investigating changes in herd size and initial herd size with milk production, concluded that yearly production is affected by a change in herd size (Virginia, 1973).[8] Generally herd size changes in harge herds had a much greater influence on production than a similar rate of change in smaller herds.

Recent Minnesota and Michigan studies also concluded that herd expansion results in at least some initial loss in production.

The 1978 Minnesota study was designed to determine the effects of changing barn types and herd expansion on milk production and income over feed costs.[26] One hundred ninety-two Minnesota dairy farms which had made one of the following system changes: (1) stanchion to tie stall (STS); (2) loose housing to cold free stall (LCFS); (3) stanchion to cold free stall

(SCFS); or (4) stanchion to warm free stall (SWFS) were studied. Herd growth and milk production were followed through four years after the change occurred.

It was found that with the addition of 10 cows, average production increased each year in the STS and LCFS switches. Both the SWFS and SCFS switches experienced a loss in production the year of expansion, but the pre-expansion level of production was recovered within two years.

In a 20-cow expansion, average production dropped in all but the STS switch. Initial production was recovered within two years for the LCFS and SCFS switches and within four years in the SWFS switch.

When 30 cows were added, average production dropped in all cases the year of expansion. The production loss was recovered within two years of the STS or LCFS switch and within four years in the SWFS and SCFS switch.

The expected changes in production for various system switches at three rates of growth are illustrated in Table 2.

In the LCFS, SWFS, and SCFS switches, production losses were minimized for a 30-cow expansion when 10 cows were added every two years rather than adding all 30 cows in the first year. Work done at Michigan also concluded that rapidly expanded farms experienced a greater degree of production loss than the gradually expanded farms.[29]

The Michigan study found that farms undergoing expansion experienced the following problems:[29]

(1) An average annual decrease of 941 pounds of milk production per cow during either the first or second year after expansion.

(2) An average increase of 2.4 percent in the culling rate during the early years of expansion.

(3) An increase of 8 percent in calf mortality during the first or second year after expansion.

(4) An increase of 119 percent in identified reproductive problems during the early years of expansion.

(5) An increase of 13.1 percent in veterinarian service per cow during the early years of expansion.

Methods and Procedures

The financial success of an investment depends not only on long range profitability but also on how cash flow is affected. This study involves a nine-step approach which is applicable in considering any expansion alternative. This procedure results in the determination of both long range profitability as measured by the after-tax internal rate of return (IRR) of the investment and liquidity effects.

The nine steps for each alternative are:

(1) Determination of present financial and managerial status.

(2) Estimation of the management affects of expansion alternatives.

(3) Construction of the livestock inventory for the expanded herd.

(4) Determination of the feed requirements for the expanded herd.

(5) Identification of the sources of the feed requirements.

(6) Estimation of the investment costs involved in expansion.

(7) Determination of labor requirements.

(8) Projection of monthly and annual cash flows.

(9) Determination of liquidity affects and long range profitability.

The benchmark data used in this study is from a number of sources. The description of the current farm situation is based on summarized *Farm Business Management* records.[34] Estimates of management affects are based on a recent Minnesota study,[26] the *1978 DHI Annual Summary*,[23] and consultation with Minnesota dairy experts.[4,27] Investment costs were supplied by area contractors and equipment and machinery dealers.

Determination of Present Financial and Managerial Status

Net worth is the difference between the total value of assets and the total value of liabilities at a given point in time. A yearly net worth statement aids in:

(1) Determining if:

(a) A manager has financial control of a business.

(b) Present assets provide sufficient security for the liabilities owed.

(c) The business has the financial strength to use more borrowed funds.

(2) Providing creditors with financial data needed to evaluate a business on an historical basis.

(3) Providing information necessary in the development of other financial measures such as cash flow projections.

The net worth statement of the original 40-cow farm used in this study is derived from the December 31, 1977, average net worth statement for dairy farms with 35-45 cows ranking in the upper 20 percent in returns to labor as drawn from the St. Cloud area and Winona area *Farm Business Management Annual Reports*. The net worth statement is adjusted to December 31, 1978, by taking new capital purchases into account and inflating values by the Consumer Price Index.

Table 2. Calculated changes in 3.5 percent fat-corrected milk from initial production for a 40-cow herd at three rates of growth.[26]

	Type of change in dairy system											
Number of	STS			LCFS			SWFS			SCFS		
cows added:	10	20	30	10	20	30	10	20	30	10	20	30
	---------pounds change in 3.5 percent FCM produced per cow---------											
Year of switch	+ 49	+ 11	− 38	+ 46	−294	−616	−85	−211	−336	+ 47	−132	−198
Two years after switch	+348	+392	+433	+294	+169	+ 52	+ 5	− 35	− 94	+258	+120	− 19
Four years after switch	+646	+773	+906	+504	+631	+690	+96	+141	+148	+564	+372	+161

Table 3. December 31, 1978, net worth statement for benchmark 40-cow dairy farm.

Total productive livestock	$32,621	
Crop, seed, and feed	22,538	
Total power, machinery, and equipment	34,112	
Land	52,377	
Buildings, fences, etc.	33,294	
TOTAL FARM CAPITAL		$174,942
Nonfarm assets, cash	13,031	
Dwelling	12,074	
TOTAL ASSETS		$200,637
Real estate mortgages	39,462	
Chattel mortgages	29,705	
Notes	5,467	
Accounts payable	2,531	
TOTAL LIABILITIES		$ 77,165
NET WORTH		$123,472

The January 1, 1979, benchmark farm size is 274 acres with 201 tillable acres. Present enterprises, the size of each enterprise, and per unit cash costs of production are shown in Table 4.

Table 4. January 1, 1979, enterprises, size, and per unit cash costs of production of each enterprise for original 40-cow dairy farm.[1,2,34]

	Enterprise				
	Corn	Haylage full prod.	Haylage establish	Corn silage	Dairy
Yield per unit	110 bu./A	7.6 ton/A	4.5 ton/A	18.2 ton/A	154 cwt./cow
Number of units	136	27	9	29	40
Cash cost of production per unit*	$70	$15	$94	$70	$221

*Cash costs for crops include: seed, fertilizer, chemicals, and insurance. Cash costs for livestock include: purchased feed, breeding, health, supplies, and marketing expenses.

Estimation of Management Effects

The estimates of the managemental effects which occur during the expansion process are based on a recent Minnesota study,[26] 1978 DHI data for herds at the given production level,[23] and consultation with Minnesota dairy management experts.[4,27]

It is assumed that the original herd consists of 40 milk cows and 36 replacement heifers, evenly distributed according to age. The cows are milked in a stall barn which is typical for Minnesota dairy farms. Average freshening age for heifers is 28 months and the average calving interval is 13 months. Culling rates and mortality rates for owned and purchased cattle initially increase and then return to the pre-expansion rates within four years of initial expansion. Changes in milk production and culling rate depend on speed of expansion and type of housing switch. For the stable 40-cow dairy farm, production increases steadily at a little more than 200 pounds per cow, per year. In all cases, milk production stabilizes in the fourth year after expansion begins.

Estimated culling rates, mortality rates, and milk production for each of the alternatives are illustrated in Tables 5 and 6.

Table 5. Culling rates and mortality rates for current and purchased cattle.[4,23]

	Year into expansion*			
	1	2	3	4
	-----percent-----			
Cull rate for current cows				
Benchmark — 40-cow herd	26	26	26	26
Slow expansion	26	30	28	26
Rapid tie stall to tie stall	26	30	28	26
Rapid tie stall to free stall	26	35	30	26
Cull rate for current heifers	8	10	8	8
Cull rate for purchased heifers	10	8	8	8
Mortality rate for replacements				
0-6 months	14	20	17	14
7 months-breeding	1	3	2	1

*Year 1 = Year expansion begins.
Year 2 = Second year of expansion process.
Year 3 = Third year of expansion process.
Year 4 = Fourth year of expansion process.

Table 6. Expected milk production changes by year.[26,27]

	Change in dairy system				
	Tie stall to tie stall			Tie stall to free stall	
Year	Benchmark 40-cow herd	Gradual expansion	Rapid expansion	Gradual expansion	Rapid expansion
	---------pounds produced per cow per year----------				
1	15,600	15,500	15,300	15,300	15,000
2	15,800	15,800	15,800	15,600	15,200
3	16,100	16,200	16,300	16,000	15,400
4	16,300	16,500	16,500	16,300	15,600

Projection of Livestock Inventories

Investment costs for the new or additional facilities and feed and labor requirements depend on herd size. Based on the calving interval and the expected changes in culling and mortality rates, a year-by-year cattle inventory for the first five years is estimated. Constructing this livestock inventory helps in planning for labor needs, cropping changes, and changes in cash inflow and outflow.

The livestock inventories for the first five years of each of the alternatives are listed in Table 7.

In the rapid expansion situations 40 bred heifers and 13 yearling heifers are purchased in the year expansion begins. In the gradual expansion situations, two bred heifers and four yearling heifers are purchased the year expansion begins. The desired herd size of 80 cows is reached in the first year of the rapid expansion and the fourth year of the gradual expansion.

Determination of Feed Requirements

Annual feed requirements were calculated for one cow unit (one cow, associated young cattle equaling one replacement) using NRC values for feedstuffs.[24] Once feed requirements were determined, they were easily converted into acreage requirements for a given herd size. The annual feed requirements (including 12 percent wastage loss) for one cow unit are listed in

Table 8. The acreage requirements for 40, 60, and 80-cow herd sizes are listed in Table 9.

Table 7. Livestock inventories for first five years.

Type of animal	Year into expansion 1	2	3	4	5
	-----number of livestock-----				
BENCHMARK 40-cow herd					
Total cows	40	40	40	40	40
Total replacements	41	42	40	40	40
Bull calves sold	20	20	19	20	20
Bred heifers sold	3	7	11	9	12
Cull cows sold	10	12	12	12	12
RAPID EXPANSION Tie stall to tie stall					
Total cows	82	80	80	80	80
Total replacements	74	75	73	75	77
Bull calves sold	43	31	33	43	42
Bred heifers sold	2	9	13	18	19
Cull cows sold	10	16	12	12	12
RAPID EXPANSION Tie stall to free stall					
Total cows	82	80	80	80	80
Total replacements	74	76	74	74	77
Bull calves sold	43	31	33	42	42
Bred heifers sold	2	8	13	20	19
Cull cows sold	10	17	13	13	13
GRADUAL EXPANSION Tie stall to tie stall or Tie stall to free stall					
Total cows	56	62	72	80	80
Total replacements	52	61	60	72	78
Bull calves sold	29	31	29	39	44
Bred heifers sold	0	0	0	2	10
Cull cows sold	10	12	12	13	15

Table 8. Annual feed requirements (including 12 percent loss) for one cow unit; based on requirements for 1,350-pound cow producing 3.6 percent butterfat milk.

Production level lbs. milk/day	Type of feed: Corn silage ton	Haylage ton	Corn eq. bu.	SBM cwt.
48	12.9	5.8	117	9.2
50	12.9	5.8	120	9.4
52	12.9	5.8	126	9.8
54	12.9	5.8	132	10.1

Identification of Feed Sources

At the 40-cow herd size corn is grown as a cash crop on tillable land not used to produce feed for the herd. By the time the herd expands to 80 cows, more land is required than is available. At some point prior to this a decision must be made whether to buy the needed feed or purchase the additional land. In this study, additional grain is purchased while the farmer grows all the required forage and some grain. The current inventory of corn is approximately 6,778 bushels. If kept for feed and not sold, grain does not have to be purchased until the third year in the rapid expansion situations. In the gradual expansion situations, herd growth is such that corn is grown as a cash crop until the fourth year when corn must be purchased. The price used for corn is $2.50 per bushel.

Feed purchases in years 3, 4, and 5 for each of the alternatives are listed in Table 10.

Table 9. Acreage requirements for various herd sizes.

Crop	Yield/ acre	Annual req./ cow unit	Herd size (cow units) 40	60	80
Corn silage	18 ton	12.9 ton	29	44	58
Hay establish	4.5 ton	5.8 ton	9	14	17
Haylage	7.6 ton		27	41	54
Corn grain	110 bu.	120-132 bu.	44-48	64-72	86-96
TOTAL ACREAGE REQUIRED			109-113	162-170	216-226
TOTAL LAND BASE 201 tillable acres					

Estimation of Investment Costs

The construction costs involved in a dairy enterprise expansion are influenced by, among others:

(1) The degree of obsolescence of the present facilities.

(2) The condition of the present facilities and/or their alternative uses.

(3) The location of the present facilities.

(4) The farmer's ability to do some part of the construction.

As stated previously, if the present dairy facilities are assumed useful, the construction costs involved are for similar housing, milking, and feeding systems which are added to the present facilities to accommodate the increase in herd number. If the present dairy facilities must be replaced, two alternative systems are investigated. Either a new tie stall barn with pipeline milking and a new feed storage and handling system are built or a new cold free stall barn with parlor and a new feed storage and handling system are built. In all alternatives, a switch is made in the manure system to a manure system involving manure removal via a piston-pump and six-month basin storage. Haylage and silage are fed in all situations, thus requiring more silos than would be necessary if baled hay were fed but allowing a greater degree of automation.

For the purposes of the study, all work is assumed to be contracted out. Investment cost data was obtained from area contractors and equipment dealers.

Providing adequate calf and heifer facilities is quite an important aspect of herd expansion which is often overlooked. The style and costs of possible replacement facilities vary from calf hutches to environmentally controlled units; therefore, they are not specifically included in this analysis. Two approaches are taken: (1) the cash balance is summed from year to year; from this annual costs for specific replacement facilities can be subtracted and (2) when the IRR for each alternative is determined, a sensitivity table is provided which allows for differences in the original investment.

Table 10. Feed purchases for the expanded herd.

Alternative	Year 3 Amount (bu.)	Year 3 Value ($)	Year 4 Amount (bu.)	Year 4 Value ($)	Year 5 Amount (bu.)	Year 5 Value ($)
RAPID EXPANSION						
Tie stall to tie stall	771	1,929	2,305	5,764	2,305	5,764
Tie stall to free stall	78	194	1,826	4,564	1,826	4,564
GRADUAL EXPANSION						
Tie stall to tie stall	0	0	520	1,299	2,305	5,764
Tie stall to free stall	0	0	113	281	2,305	5,764

The rapid expansion situations achieve the desired herd expansion in the first year by purchasing cattle. In the gradual expansion situations, full expansion is not achieved until near the end of the fourth year because growth is primarily dependent on home-grown herd replacements, although some cattle are purchased initially.

In all cases, building starts in September of year 1 (1979). In the rapid expansion situations, facilities for the entire expanded herd are completed by the end of October. Heifers are bought to freshen in October and November. In the gradual expansion situations, construction of facilities is in two phases. The first phase is in September-October of year 1 (1979), providing facilities to accommodate 60 cows. Also, in the first phase manure storage and bulk tank are purchased to accommodate the fully expanded 80-cow herd. Facilities for the fully expanded herd are completed in September-October of year 3 (1981) when herd size is approximately 70 cows.

In the tie stall alternatives, when herd expansion is completed, the number of stalls in the barn equal the total number of cows. In the cold free stall alternatives, when herd expansion is completed, there is approximately 15 percent overcrowd; that is, the number of stalls is approximately equal to the average number of cows in milk.

As the size of facilities increase, average construction cost per cow decreases. This is due to the fixed costs involved in most construction ("fixed costs" refer to the construction costs involved independent of size). The effects of these fixed costs are that: (1) an increase in size of facilities is usually associated with less than a proportionate increase in construction costs and (2) when facilities are constructed in stages, as in the gradual expansion alternatives, some fixed construction costs are incurred at each stage; therefore, the total construction costs incurred for a given size facility exceed the construction costs incurred when facilities are constructed in one stage, as in the rapid expansion situations.

The construction costs, listed by component, for each alternative are found in Table 11. Annual costs, expressed as a percent of the total costs, are found in Table 12. Table 13 contains the investment costs for the cattle purchased.

Table 11. Total investment costs involved for various expansion alternatives.

Speed of expansion	Component	System: Tie stall addition	System: New tie stall	System: New free stall
Rapid	Facilities	$105,136	$207,309	$175,385
	Cattle	44,500	44,500	44,500
	Total	$149,636	$251,809	$219,885
Gradual	Facilities — year 1	$ 70,518	$172,692	$151,310
	year 3	42,218	42,218	30,800
	Cattle	13,400	13,400	13,400
	Total	$126,136	$228,300	$197,510

Table 11a. Investment and overhead costs for a rapid expansion to a tie stall addition to present facilities.

Component	Invest. cost	Deprec.	Repairs	Insurance
		Assumed annual overhead costs		
		$	$	$
Building	$ 27,750			
Concrete for building	15,250	2,359.70	943.90	707.91
Tie stalls	3,520			
Wiring, plumbing	674			
Bulk tank	8,732	873.20	349.30	131.00
Milking equipment (add.)	1,880	235.00	75.20	28.20
Silo: 20′ x 70′	12,802	1,048.10	209.00	314.40
Silo: 18′ x 50′	8,160			
Silo unloaders: 20′	3,733	734.80	367.50	110.23
18′	3,615			
Feed bunk (add.)	1,532	107.60	84.40	42.18
Auger for feed bunk (add.)	1,280			
Manure transfer pump	7,796	779.00	389.80	116.94
Gutter cleaner (add.)	1,400	116.00	70.00	21.00
Manure basin	7,012	350.00	70.10	105.20
Total	$105,136	$6,685.00	$2,559.00	$1,577.00

Table 11b. Investment and overhead costs for a rapid expansion to new tie stall facilities.

Component	Invest. cost	Assumed annual overhead costs		
		Deprec.	Repairs	Insurance
Milk house	$ 11,300	$	$	$
Building	52,050			
Concrete for building	29,600	5,239.50	2,096.00	1,571.85
Tie stalls	7,040			
Wiring, plumbing	4,799			
Bulk tank	8,732	873.20	349.30	131.00
Silos: 18′ x 50′ (2)	16,320	2,096.00	419.25	628.80
20′ x 70′ (2)	25,604			
Silo unloaders: 18′ (2)	7,230	1,469.60	734.80	220.45
20′ (2)	7,466			
Feed bunk	3,210	521.25	233.40	116.70
Auger for feed bunk	4,570			
Manure transfer pump	7,796	779.60	389.80	116.94
Gutter cleaner	5,749	477.15	287.45	86.25
Manure basin	7,012	350.60	70.10	105.20
Milking equip. (pipeline)	8,831	1,103.85	441.55	132.45
Total	$207,309	$12,911.00	$5,021.00	$3,110.00

Table 11c. Investment and overhead costs for a rapid expansion to new free stall facilities.

Component	Invest. cost	Assumed annual overhead costs		
		Deprec.	Repairs	Insurance
Free stall building	$ 23,587	$	$	$
Concrete for building	9,658			
Free stalls	9,100	3,129.20	1,251.00	1,148.85
Plumbing, wiring	826			
Parlor building, inc. conc.	19,419			
Double-4 herr. w/grain fd.	14,000	1,750.00	1,047.00	131.00
Bulk tank	8,732	873.20		
Silos: 18′ x 50′ (2)	16,320	2,096.00	419.20	628.90
20′ x 70′ (2)	25,604			
Silo unloaders: 18′ (2)	7,230	1,469.60	734.90	120.46
20′ (2)	7,466			
Feed bunk	1,631	108.70	176.40	88.20
Auger feeder for bunk	4,250	283.30		
Manure transfer pump	7,796	799.60	802.90	300.87
Automatic scraper	8,262	826.20		
Cross conveyor	1,492	149.20	74.60	22.40
Concrete for manure system	3,000	150.00	30.00	45.00
Manure basin	7,012	350.60	70.10	105.20
Total	$175,385	$11,966.00	$4,607.00	$2,631.00

Table 11d. Investment and overhead costs for a gradual expansion to a tie stall addition to present facilities — stage 1.

Component	Invest. cost	Assumed annual overhead costs: Deprec.	Repairs	Insurance
Building	$17,100	$	$	$
Concrete for building	8,200	1,369.90	547.90	411.00
Tie stalls	1,760			
Wiring, plumbing	337			
Bulk tank	8,732	873.20	350.00	131.00
Silo: 20′ x 70′	12,802	640.10	128.00	192.03
Silo unloader	3,733	373.30	186.70	56.00
Milking equipment (add.)	940	117.50	37.60	14.10
Feed bunk (add.)	766	51.00	23.00	11.45
Auger for feed bunk (add.)	640	42.70	19.20	9.60
Manure transfer pump	7,796	779.60	389.80	176.94
Gutter cleaner (add.)	700	58.40	35.00	10.50
Manure basin	7,012	350.60	70.10	105.20
Total	$70,518	$4,657.00	$1,787.00	$1,058.00

Gradual expansion via a tie stall addition to present facilities — stage 2.

Component	Invest. cost	Assumed annual overhead costs: Deprec.	Repairs	Insurance
Building	$17,100	$	$	$
Concrete for building	8,200	1,369.90	547.60	411.00
Tie stalls	1,760			
Wiring, plumbing	337			
Silo: 18′ x 50′	8,160	408.00	81.60	122.40
Silo unloader: 18′	3,615	361.50	180.80	54.23
Milking equipment (add.)	940	117.50	37.60	14.10
Feed bunk (add.)	766	51.00	23.00	11.50
Auger for feed bunk (add.)	640	42.70	19.20	9.60
Gutter cleaner (add.)	700	58.40	35.00	10.50
Total	$42,218	$2,409.00	$926.00	$633.00

11e. Investment and overhead costs for a gradual expansion to new tie stall facilities — stage 1.

Component	Invest. cost	Assumed annual overhead costs: Deprec.	Repairs	Insurance
Milk house	$ 11,300	$	$	$
Building	41,400			
Concrete for building	22,550	4,249.65	1,699.85	1,274.90
Tie stalls	5,280			
Wiring, plumbing	4,463			
Bulk tank	8,732	873.20	349.30	131.00
Silo: 18′ x 50′	8,160	1,688.20	338.00	506.50
20′ x 70′ (2)	25,604			
Silo unloaders: 18′	3,615	1,108.10	554.00	166.23
20′ (2)	7,466			
Feed bunk	2,444	427.05	191.20	95.60
Auger for feed bunk	3,930			
Manure transfer pump	7,796	779.60	389.80	176.94
Gutter cleaner	5,049	419.10	252.45	75.75
Manure basin	7,012	350.60	70.10	105.20
Milking equipment (pipeline)	7,891	986.40	394.55	118.35
Total	$172,692	$10,882.00	$4,238.00	$2,590.00

Gradual expansion to new tie stall facilities — stage 2.

Component	Invest. cost	Assumed annual overhead costs		
		Deprec.	Repairs	Insurance
Building	$17,100	$	$	$
Concrete for building	8,200	1,369.00	547.90	411.00
Tie stalls	1,760			
Wiring, plumbing	337			
Silo: 18′ x 50′	8,160	408.00	81.60	122.40
Silo unloader: 18′	3,615	361.50	180.80	54.23
Milking equipment (add.)	940	117.50	37.60	14.10
Feed bunk (add.)	766	51.00	23.00	11.50
Auger for feed bunk (add.)	640	42.70	19.20	9.60
Gutter cleaner (add.)	700	58.40	35.00	10.50
Total	$42,218	$2,409.00	$926.00	$633.00

11f. Investment and overhead costs for a gradual expansion to new free stall facilities — stage 1.

Component	Invest. cost	Assumed annual overhead costs		
		Deprec.	Repairs	Insurance
Free stall building	$ 18,447	$	$	$
Concrete for building	7,366			
Free stalls	8,415	2,619.90	1,048.00	1,024.65
Plumbing, wiring	664			
Parlor building, inc. conc.	19,419			
Double-4 herr. w/grain fd.	14,000	1,750.00	1,049.00	153.40
Bulk tank	8,732	873.20		
Silos: 18′ x 50′	8,160	1,688.20	338.00	506.50
20′ x 70′ (2)	25,604			
Silo unloaders: 18′	3,165	1,108.10	554.00	166.23
20′ (2)	7,466			
Feed bunk	1,165	318.40	143.30	54.15
Auger feeder for bunk	3,610			
Manure transfer pump	7,796	779.60	802.90	300.88
Automatic scraper	8,262	826.20		
Cross conveyor	1,492	149.20	74.60	22.40
Concrete for manure system	2,000	100.00	20.00	30.00
Manure basin	7,012	350.60	70.10	105.20
Total	$151,300	$10,564.00	$4,099.00	$2,270.00

Gradual expansion to new free stall facilities — stage 2.

Component	Invest. cost	Assumed annual overhead costs		
		Deprec.	Repairs	Insurance
Free stall building	$10,600	$	$	$
Concrete work	3,300	833.00	333.40	249.90
Free stalls	2,600			
Plumbing, wiring	161			
Silo: 18′ x 50′	8,160	408.00	81.60	122.40
Silo unloader: 10′	3,615	361.50	180.80	54.23
Feed bunk	460	30.70	33.00	6.90
Auger feeder for bunk	640	42.70		9.60
Manure scraper w/conc. work	1,264	76.40	23.20	18.96
Total	$30,800	$1,753.00	$652.00	$462.00

Table 12. Assumed annual costs as a percent of total investment costs.*

Component	Depreciation	Repairs	Insurance
Free stall building	5.0	2.0	1.5
Tie stall building	5.0	2.0	1.5
Concrete for barns	5.0	2.0	1.5
Parlor building	5.0	2.0	1.5
Milking equipment	12.5	5.0	1.5
Bulk tank	10.0	4.0	1.5
Silo, concrete stave	5.0	1.0	1.5
Silo unloader	10.0	5.0	1.5
Feed bunk	6.7	3.0	1.5
Auger feeder for bunk	6.7	3.0	1.5
Gutter cleaner	8.3	5.0	1.5
Automatic scraper	10.0	5.0	1.5
Manure transfer pump	10.0	5.0	1.5
Manure basin	5.0	1.0	1.5

*Real estate taxes are assumed to be .7 percent of the value of all structures, excluding equipment.

Table 13. Purchased cattle investment.

	Speed of expansion			
	Gradual		Rapid	
Cattle type	Number purchased	Value	Number purchased	Value
Bred heifers	12	$11,400	40	$38,000
Yearling heifers	4	2,000	13	6,500
Total	16	$13,400	53	$44,500

Determination of Labor Requirements

Labor requirements depend on the number of cattle, cropping pattern, and technologies employed by the farmer. Labor requirements change with the expansion of the herd, the change in cropping pattern to greater production of forage, the elimination of daily manure hauling, and with the change in milking technologies.

For most chores there is both a fixed and an added labor requirement per cow. The fixed labor requirement refers to the amount of time that is involved in doing a chore independent of the number of livestock. The added labor requirement is that requirement associated with the addition of another head of livestock. Therefore, an increase in herd size is usually associated with less than a proportionate increase in labor requirements for the herd.

For the benchmark 40-cow herd, some seasonal labor is hired in the spring and fall. In the gradual expansion situations, hired labor expenses increase until year 4 (1982), at which point full-time help is employed. In the rapid expansion situations, full-time help is hired as of January in year 2 (1980). The annual salary for full-time labor is $10,800 in each alternative.

Seasonal distribution and costs of the hired labor are covered in the next section of the study.

Table 14 lists the annual labor requirements for the expansion alternatives.

More man-hours of labor are required to do the chores in the tie stall facilities than in the free stall facilities; 89 hours per week versus 61 hours per week for an 80-cow herd. If the labor requirements are assumed to be equally divided between the employee and the owner/manager in each system, the result would be a higher hourly wage for the employee of a free stall operation than the employee of a tie stall operation. For example, given the annual salary used in this study ($10,800) and assuming that the employee in each situation is responsible for half of the labor requirements, the employee in a free stall operation would, in effect, be receiving an hourly wage of $6.75 versus $4.63 for the employee in the tie stall operation. If the employee in each system is assumed fully employed (*e.g.*, 40-50 hours per week), less of the owner's manager's time is required to do the chores, allowing more time for management of the operation.

If the hours of labor available would be a limiting constraint on the size of the expanded herd, fewer cattle could be cared for in a tie stall system than in a free stall system with a given amount of labor. For example, if only 61 hours of labor are available per week, then only 55 cows can be cared for in a tie stall operation as opposed to 80 cows in a free stall operation.

Table 14. Annual herd and field labor requirements.*

	Herd size				
	40	60		80	
	Tie stall	Tie stall	Free stall	Tie stall	Free stall
	-----man-hours required per year-----				
Chores					
Milking, prep., cleanup	1,695	2,335	1,530	2,974	1,879
Forage feeding, 2/day	231	386	386	541	541
Grain feeding, 2/day	131	171	—	211	—
Waste handling	176	264	159	352	212
Misc. labor, inc. grain repairs, routine work	373	469	469	564	564
Field crops					
Corn grain	315	237		167	
Corn silage	87	132		175	
Alfalfa establish	25	38		47	
Haylage	95	144		190	
Total	3,128	4,175	3,095	5,221	3,775

*Labor requirements do not include those for care of replacements.

Monthly and Annual Cash Flow Development

Used alone, annual cash flows are not always adequate to determine how liquidity is affected by an investment. By ignoring seasonal variations in sources and uses of funds, a business may show an acceptable cash position for the entire year, but periods may exist during the year when short term credit is needed. In dairying there is a minimal amount of seasonal variation in income and expenses. However, in an expansion situation, the first few years can be critical and deserve careful analysis. Monthly cash flow analysis can be useful in planning an expansion and can minimize interest expense by arranging for credit needs in advance.

Monthly cash flows for the first five years and annual cash flows for the remainder of the planning span are projected for each alternative. The annual cash flows for the sixth through the thirtieth year are based on the annual cash flow for the fifth year. Changes are made in cash outflow as debts are retired and with changes in the federal and state income taxes paid. The assumption that milk production stabilizes in year 4 leads to the assumption that cash inflow also stabilizes, although minor changes may occur due to number of cull cows, bull calves, and bred heifers sold. Constant prices are used throughout the planning span.

The sources of income for the expanded farms are milk sales, cull cow and bull calf sales, and the sale of bred heifers not needed to maintain a constant herd size. Cash crop sales are an additional source of income for the stable 40-cow farm. Prices used for livestock and crop sales are: (1) milk — $11 per cwt., (2) bull calves — $90, (3) cull cows — $540, (4) bred heifers — $800, (5) corn — $2.50 per bushel, and (6) hay — $45 per ton.

Livestock, crop, and other farm expenses are based on the area *Farm Business Management Reports* and the University of Minnesota livestock and crop budgets. In addition, there is an annual capital replacement expenditure of $11,000 per year. This value is a compromise between calculated depreciation and actual capital replacement expenditures as reported in the reports. Loans for the investments were amortized as follows: (1) structures and equipment at 9 percent over 30 years, (2) purchased cattle at 10 percent over 7 years, and (3) capital replacement at 10 percent over 10 years (capital replacement loans occur only in year 1). Additionally, there is the original land bank payment of $5,881 per year and the original bank payment of $7,637 per year with 10 and 15 years, respectively, remaining until retirement of the loans.*

Table 15 illustrates the investment costs and yearly payments required for each alternative. Federal and state income taxes and social security taxes incurred through the planning span for each alternative are listed in Table 16.

In examining the monthly cash flows for each alternative, no liquidity problems were observed. Table 17 contains the monthly cash flows for each alternative in year 2 (1980); the first full year after the expansion process begins. Liquidity problems would most likely occur at that time, if at all. The typical seasonal distribution and total annual cash inflows and outflows are illustrated for each alternative.

The annual cash flows for each alternative in the first five years are listed in Table 18.

*This information was not directly available from the reports. It is based on the present real estate and chattel mortgages of $39,462 and $29,705, respectively. It is an assumption of the authors that the real estate loan is at 7 percent over 30 years and that the chattel mortgage is at 8 percent over 10 years.

Table 15. Investment costs, amount borrowed, and yearly principal and interest payments for each alternative.

Alternative	Source	New invest. cost	Amount borrowed	Yearly P & I payment
RAPID EXPANSION				
Tie stall addition	System	$105,136	$ 93,136	$11,261
(RTS ADD)	Cattle	44,500	44,500	9,141
New tie stall	System	207,309	195,309	19,860
(RTS NEW)	Cattle	44,500	44,500	9,141
New free stall	System	175,385	163,385	18,404
(RFS NEW)	Cattle	44,500	44,500	9,141
GRADUAL EXPANSION				
Tie stall addition	System			
(GTS ADD)	Year 1	70,518	58,518	6,825
	Year 3	42,218	40,000	4,107
	Cattle	13,400	13,400	2,753
New tie stall	System			
(GTS NEW)	Year 1	172,692	160,692	15,427
	Year 3	42,218	40,000	4,107
	Cattle	13,400	13,400	2,753
New free stall	System			
(GFS NEW)	Year 1	151,310	139,310	15,042
	Year 3	30,800	28,000	2,859
	Cattle	13,400	13,400	2,753

Table 16. State and federal income tax and social security tax paid per year.*

Year	Benchmark 40-cow	RTS ADD	RTS NEW	RFS NEW	GTS ADD	GTS NEW	GFS NEW
1	$16,050	$ 4,850	$ 4,050	$ 4,000	$10,200	$ 4,400	$ 4,400
2	18,850	12,450	2,900	2,850	7,050	700	800
3	26,900	17,950	4,350	4,500	16,000	6,000	5,400
4	24,600	22,750	5,500	5,350	24,700	4,450	4,750
5	25,400	20,350	7,500	4,750	27,800	10,850	1,220
6-30	25,400	20,350	10,850	10,500	27,800	12,800	13,400

*Assuming current laws and dollars.

Table 17. Monthly cash flows for each alternative in year 2.

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*** Cash inflows ***	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Total
Beg cash bal	19602.	22462.	12677.	12439.	17891.	19244.	22762.	26339.	29970.	33404.	35884.	25566.	19602.
Corn	0	4500.	0	0	4500.	0	0	0	0	0	0	0	9000
Hay	0	0	0	7875.	0	0	0	0	0	0	0	0	7875.
Lvstk Milk	6355.	6271.	5773.	5649.	6610.	7353.	7411.	7466.	7269.	7137.	7030.	6325.	80649.
Total inflow	25957.	33233.	18450.	25963.	29001.	26597.	30173.	33805.	37239.	40541.	42914.	31891.	117126.
*** Cash outflows ***													
Hired labor	0	0	0	0	136.	136.	136.	136.	136.	136.	136.	0	955.
Repairs	76.	76.	76.	152.	152.	152.	152.	152.	152.	152.	152.	76.	1519.
Purch. feed	203.	203.	203.	203.	203.	203.	203.	203.	203.	203.	203.	203.	2439.
Seed	0	0	1237.	1471.	0	0	0	0	0	0	0	0	2709.
Fertilizer	0	0	1279.	2940.	1279.	0	0	0	0	383.	0	0	5880.
Chemicals	0	0	0	90.	2970.	0	0	0	0	0	0	0	3060.
Crop insur.	0	0	0	0	0	0	0	0	0	0	1152.	0	1152.
Mach. hire	0	0	0	0	1233.	0	0	0	0	0	1233.	0	2467.
Breeding	117.	117.	117.	117.	117.	117.	117.	117.	117.	117.	117.	117.	1399.
Vet. & med.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	1200.
Lsk supplies	117.	117.	117.	117.	117.	117.	117.	117.	117.	117.	117.	117.	1399.
Lvstk. mktg.	200.	200.	200.	200.	200.	200.	200.	200.	200.	200.	200.	200.	2399.
Gas, oil, dry	128.	128.	128.	128.	256.	256.	256.	256.	256.	256.	383.	128.	2555.
Farm taxes	0	0	0	0	440.	0	0	0	0	440.	0	0	880.
Farm insur.	0	1012.	0	0	0	0	0	0	0	0	0	0	1012.
Utilities	178.	178.	178.	178.	178.	178.	178.	178.	178.	178.	178.	178.	2136.
Fam. living	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	15000.
Inc & SS tax	0	16050.	0	0	0	0	0	0	0	0	0	0	16050.
Min end bal	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.
Tot. outflow	2868.	19930.	5384.	7446.	9130.	3208.	3208.	3208.	3208.	4031.	5721.	2868.	64711.
Surp. or def	23089.	13303.	13066.	18518.	19871.	23389.	26965.	30596.	34031.	36511.	37193.	29023.	52415.
*** Capital purchases ***													
Mach. purch.	0	0	0	0	0	0	0	0	0	0	11000.	0	11000.
Tot. cap pur	0	0	0	0	0	0	0	0	0	0	11000.	0	11000.
Surp. or def	23089.	13303.	13066	18518.	19871.	23389.	26965.	30596.	34031.	36511.	26193.	29023.	41415.
*** Debt payments ***													
FLB payment	490.	490.	490.	490.	490.	490.	490.	490.	490.	490.	490.	490.	5881.
Bnk NRE pymt	636.	636.	636.	636.	636.	636.	636.	636.	636.	636.	636.	636.	7637.
Tot debt pay	1127.	1127.	1127.	1127.	1127.	1127.	1127.	1127.	1127.	1127.	1127.	1127.	13518.
Surp. or def.	21962.	12177.	11939.	17391.	18744.	22262.	25839.	29470.	32904.	35384.	25066.	27897.	27897.
Acc. AO int.	0	0	0	0	0	0	0	0	0	0	0	0	0
AO prin. pay	0	0	0	0	0	0	0	0	0	0	0	0	0
*** AO loan balances ***													
Beg AO bal	0	0	0	0	0	0	0	0	0	0	0	0	0
End AO bal	0	0	0	0	0	0	0	0	0	0	0	0	0
End cash bal	22462.	12677.	12439.	17891.	19244.	22762.	26339.	29970.	33404.	35884.	25566.	28397.	28397.

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*** Cash inflows ***	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Total
Beg cash bal	16550.	24879.	24760.	28382.	28814.	27069.	31964.	36542.	40438.	41906.	40177.	28689.	16550.
Lvstk milk	15700.	14672.	13002.	12382.	12451.	12763.	12447.	11764.	9355.	7714.	10884.	14634.	147768.
Total inflow	32250.	39551.	37762.	40764.	41265.	39832.	44411.	48306.	49793.	49620.	51061.	43323.	164318.
*** Cash outflows ***													
Hired labor	900.	900.	900.	900.	900.	900.	900.	900.	900.	900.	900.	900.	10800.
Repairs	204.	204.	204.	408.	408.	408.	408.	408.	408.	408.	408.	204.	4078.
Purch. feed	412.	407.	407.	407.	407.	401.	401.	401.	407.	407.	407.	407.	4868.
Seed	0	0	998.	1439.	0	0	0	0	0	0	0	0	2437.
Fertilizer	0	0	1031.	2784.	1031.	0	0	0	0	723.	0	0	5568.
Chemicals	0	0	0	170.	2394.	0	0	0	0	0	0	0	2564.
Crop insur.	0	0	0	0	0	0	0	0	0	0	1104.	0	1104.
Mach. hire	0	0	0	0	2051.	0	0	0	0	0	2051.	0	4101.
Breeding	236.	233.	233.	233.	233.	230.	230.	230.	233.	233.	233.	233.	2793.
Vet. & med.	202.	200.	200.	200.	200.	197.	197.	197.	200.	200.	200.	200.	2394.
Lsk supplies	236.	233.	233.	233.	233.	230.	230.	230.	233.	233.	233.	233.	2793.
Lvstk. mktg.	405.	400.	400.	400.	400.	355.	395.	395.	400.	400.	400.	400.	4788.
Gas, oil, dry	331.	331.	331.	331.	661.	661.	661.	661.	661.	661.	.992.	331.	6612.
Farm taxes	0	0	0	0	834.	0	0	0	0	834.	0	0	1668.
Farm insur.	0	2589.	0	0	0	0	0	0	0	0	0	0	2589.
Utilities	368.	368.	368.	368.	368.	368.	368.	368.	368.	368.	368.	368.	4420.
Fam. living	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	15000.
Inc & SS tax	0	4850.	0	0	0	0	0	0	0	0	0	0	4850.
Min end bal	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.
Tot. outflow	5044.	12465.	7054.	9623.	11869.	5542.	5542.	5542.	5560.	7117.	9045.	5026.	83927.
Surp. or def	27206.	27087.	30708.	31141.	29396.	34290.	38869.	42765.	44233.	42504.	42016.	38298.	80391.
*** Capital purchases ***													
Mach. Purch.	0	0	0	0	0	0	0	0	0	0	11000.	0	11000.
Tot. cap pur	0	0	0	0	0	0	0	0	0	0	11000.	0	11000.
Surp. or def	27206.	27087.	30708.	31141.	29396.	34290.	38869.	42765.	44233.	42504.	31016.	38298.	69391.
*** Debt payments ***													
FLB payment	1279.	1279.	1279.	1279.	1279.	1279.	1279.	1279.	1279.	1279.	1279.	1279.	15352.
Bnk NRE pymt	1547.	1547.	1547.	1547.	1547.	1547.	1547.	1547.	1547.	1547.	1547.	1547.	18568.
Tot debt pay	2827.	2827.	2827.	2827.	2827.	2827.	2827.	2827.	2827.	2827.	2827.	2827.	33920.
Surp. or def	24379.	24260.	27882.	28314.	26569.	31464.	36042.	39938.	41406.	39677.	28189.	35471.	35471.
Acc. AO int.	0	0	0	0	0	0	0	0	0	0	0	0	0
AO prin. pay	0	0	0	0	0	0	0	0	0	0	0	0	0
*** AO loan balances ***													
Beg AO bal	0	0	0	0	0	0	0	0	0	0	0	0	0
End AO bal	0	0	0	0	0	0	0	0	0	0	0	0	0
End cash bal	24879.	24760.	28382.	28814.	27069.	31964.	36542.	40438.	41906.	40177.	28689.	35971.	35971.

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	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Total
*** Cash inflows ***													
Beg cash bal	13087.	20427.	18586.	21234.	20578.	17363.	21146.	24612.	27396.	27752.	24528.	11934.	13087.
Lvstk milk	15700.	14672.	13002.	12382.	12451.	12763.	12447.	11764.	9355.	7714.	10884.	14634.	147768.
Total inflow	28787.	35099.	31588.	33616.	33029.	30126.	33593.	36376.	36751.	35466.	35412.	26568.	160855.
*** Cash outflows ***													
Hired labor	900.	900.	900.	900.	900.	900.	900.	900.	900.	900.	900.	900.	10800.
Repairs	327.	327.	327.	654.	654.	654.	654.	654.	654.	654.	654.	327.	6540.
Purch. feed	412.	407.	407.	407.	407.	401.	401.	401.	407.	407.	407.	407.	4868.
Seed	0	0	990.	1432.	0	0	0	0	0	0	0	0	2422.
Fertilizer	0	0	1023.	2768.	1023.	0	0	0	0	723.	0	0	5537.
Chemicals	0	0	0	170.	2376.	0	0	0	0	0	0	0	2546.
Crop insur.	0	0	0	0	0	0	0	0	0	0	1098.	0	1098.
Mach. hire	0	0	0	0	2051.	0	0	0	0	0	2051.	0	4101.
Breeding	236.	233.	233.	233.	233.	230.	230.	230.	233.	233.	233.	233.	2793.
Vet. & med	202.	200.	200.	200.	200.	197.	197.	197.	200.	200.	200.	200.	2394.
Lsk supplies	236.	233.	233.	233.	233.	230.	230.	230.	233.	233.	233.	233.	2793.
Lvstk. mktg.	405.	400.	400.	400.	400.	395.	395.	395.	400.	400.	400.	400.	4788.
Gas, oil, dry	331.	331.	331.	331.	661.	661.	661.	661.	661.	661.	992.	331.	6612.
Farm taxes	0	0	0	0	1217.	0	0	0	0	1217.	0	0	2435.
Farm insur.	0	4122.	0	0	0	0	0	0	0	0	0	0	4122.
Utilities	368.	368.	368.	368.	368.	368.	368.	368.	368.	368.	368.	368.	4420.
Fam. living	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	15000.
Inc & SS tax	0	4050.	0	0	0	0	0	0	0	0	0	0	4050.
Min end bal	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.
Tot. outflow	5167.	13321.	7162.	9846.	12473.	5788.	5788.	5788.	5806.	7746.	9285.	5149.	87819.
Surp. or def	23620.	21779.	24427.	23770.	20555.	24338.	27805.	30589.	30945.	27720.	26126.	21419.	73036.
*** Capital purchases ***													
Mach. purch.	0	0	0	0	0	0	0	0	0	0	11000.	0	11000.
Tot. cap pur	0	0	0	0	0	0	0	0	0	0	11000.	0	11000.
Surp. or def	23620.	21779.	24427.	23770.	20555.	24338.	27805.	30589.	30945.	27720.	15126.	21419.	62036.
*** Debt payments ***													
FLB payment	2145.	2145.	2145.	2145.	2145.	2145.	2145.	2145.	2145.	2145.	2145.	2145.	25741.
Bnk NRE pymt	1547.	1547.	1547.	1547.	1547.	1547.	1547.	1547.	1547.	1547.	1547.	1547.	18568.
Tot debt pay	3692.	3692.	3692.	3692.	3692.	3692.	3692.	3692.	3692.	3692.	3692.	3692.	44309.
Surp. or def	19927.	18086.	20734.	20078.	16863.	20646.	24112.	26896.	27252.	24028.	11434.	17727.	17727.
Acc. AO int.	0	0	0	0	0	0	0	0	0	0	0	0	0
AO prin. pay	0	0	0	0	0	0	0	0	0	0	0	0	0
*** AO loan balances ***													
Beg AO bal	0	0	0	0	0	0	0	0	0	0	0	0	0
End AO bal	0	0	0	0	0	0	0	0	0	0	0	0	0
End cash bal	20427.	18586.	21234.	20578.	17363.	21146.	24612.	27396.	27752.	24528.	11934.	18227.	18227.

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*** Cash inflows ***													
Beg cash bal	12271.	19345.	17825.	20295.	19517.	16317.	20005.	23380.	26075.	26383.	23262.	9991.	12271.
Lvstk milk	15142.	14173.	12548.	11972.	12060.	12356.	12043.	11345.	8977.	7367.	9901.	14853.	142737.
Total inflow	27413.	33518.	30373.	32267.	31577.	28673.	32048.	34725.	35052.	33750.	33163.	24844.	155008.
*** Cash outflows ***													
Hired labor	900.	900.	900.	900.	900.	900.	900.	900.	900.	900.	900.	900.	10800.
Repairs	306.	306.	306.	613.	613.	613.	613.	613.	613.	613.	613.	306.	6126.
Purch. feed	412.	407.	407.	407.	407.	401.	401.	396.	401.	401.	407.	407.	4853.
Seed	0	0	998.	1439.	0	0	0	0	0	0	0	0	2437.
Fertilizer	0	0	1031.	2784.	1031.	0	0	0	0	723.	0	0	5568.
Chemicals	0	0	0	170.	2394.	0	0	0	0	0	0	0	2564.
Crop insur.	0	0	0	0	0	0	0	0	0	0	1104.	0	1104.
Mach. hire	0	0	0	0	2051.	0	0	0	0	0	2051.	0	4101.
Breeding	236.	233.	233.	233.	233.	230.	230.	227.	230.	230.	233.	233.	2784.
Vet. & med	202.	200.	200.	200.	200.	197.	197.	195.	197.	197.	200.	200.	2387.
Lsk supplies	236.	233.	233.	233.	233.	230.	230.	227.	230.	230.	233.	233.	2784.
Lvstk. mktg.	405.	400.	400.	400.	400.	395.	395.	390.	395.	395.	400.	400.	4773.
Gas, oil, dry	331.	331.	331.	331.	661.	661.	661.	661.	661.	661.	992.	331.	6612.
Farm taxes	0	0	0	0	1098.	0	0	0	0	1098.	0	0	2195.
Farm insur.	0	3643.	0	0	0	0	0	0	0	0	0	0	3643.
Utilities	368.	368.	368.	368.	368.	368.	368.	368.	368.	368.	368.	368.	4420.
Fam. living	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	15000.
Inc & SS tax	0	4000.	0	0	0	0	0	0	0	0	0	0	4000.
Min end bal	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.
Tot. outflow	5146.	12771.	7156.	9828.	12338.	5746.	5746.	5728.	5846.	7566.	9250.	5128.	86651.
Surp. or def	22267.	20747.	23217.	22439.	19239.	22927.	26302.	28997.	29305.	26184.	23913.	19716.	68357.
*** Capital purchases ***													
Mach. purch.	0	0	0	0	0	0	0	0	0	0	11000.	0	11000.
Tot. cap pur	0	0	0	0	0	0	0	0	0	0	11000.	0	11000.
Surp. or def	22267.	20747.	23217.	22439.	19239.	22927.	26302.	28997.	29305.	26184.	12913.	19716.	57357.
*** Debt payments ***													
FLB payment	1875.	1875.	1875.	1875.	1875.	1875.	1875.	1875.	1875.	1875.	1875.	1875.	22495.
Bnk NRE pymt	1547.	1547.	1547.	1547.	1547.	1547.	1547.	1547.	1547.	1547.	1547.	1547.	18568.
Tot debt pay	3422.	3422.	3422.	3422.	3422.	3422.	3422.	3422.	3422.	3422.	3422.	3422.	41063.
Surp. or def	18845.	17325.	19795.	19017.	15817.	19505.	22880.	25575.	25883.	22762.	9491.	16294.	16294.
Acc. AO int.	0	0	0	0	0	0	0	0	0	0	0	0	0
AO prin. pay	0	0	0	0	0	0	0	0	0	0	0	0	0
*** AO loan balances ***													
Beg AO bal	0	0	0	0	0	0	0	0	0	0	0	0	0
End AO bal	0	0	0	0	0	0	0	0	0	0	0	0	0
End cash bal	19345.	17825.	20295.	19517.	16317.	20005.	23380.	26075.	26383.	23262.	9991.	16794.	16794.

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*** Cash inflows ***													
Beg cash bal	19222.	23690.	15686.	17148.	16070.	11964.	14857.	17704.	20493.	22291.	22678.	10425.	19222.
Lvstk milk	9438.	9236.	8628.	8474.	8328.	9130.	9103.	9044.	8072.	7965.	8194.	11349.	106961.
Total inflow	28660.	32926.	24314.	25622.	24398.	21094.	23960.	26748.	28565.	30256.	30872.	21774.	126183.
*** Cash outflows ***													
Hired labor	0	0	0	0	871.	871.	871.	871.	871.	871.	871.	0	6100.
Repairs	165.	165.	165.	331.	331.	331.	331.	331.	331.	331.	331.	165.	3306.
Purch. feed	290.	290.	290.	290.	290.	290.	295.	295.	300.	300.	310.	315.	3552.
Seed	0	0	1080.	1444.	0	0	0	0	0	0	0	0	2524.
Fertilizer	0	0	1116.	2832.	1116.	0	0	0	0	600.	0	0	5664.
Chemicals	0	0	0	140.	2592.	0	0	0	0	0	0	0	2732.
Crop insur.	0	0	0	0	0	0	0	0	0	0	1121.	0	1121.
Mach. hire	0	0	0	0	1785.	0	0	0	0	0	1785.	0	3570.
Breeding	166.	166.	166.	166.	166.	166.	169.	169.	172.	172.	178.	181.	2038.
Vet. & med	142.	142.	142.	142.	142.	142.	145.	145.	147.	147.	152.	155.	1747.
Lsk supplies	166.	166.	166.	166.	166.	166.	169.	169.	172.	172.	178.	181.	2038.
Lvstk. mktg.	285.	285.	285.	285.	285.	285.	290.	290.	295.	295.	305.	310.	3494.
Gas, oil, dry	230.	230.	230.	230.	460.	460.	460.	460.	460.	460.	690.	230.	4602.
Farm taxes	0	0	0	0	705.	0	0	0	0	705.	0	0	1409.
Farm insur.	0	2070.	0	0	0	0	0	0	0	0	0	0	2070.
Utilities	351.	351.	351.	351.	351.	351.	351.	351.	351.	351.	351.	351.	4209.
Fam. living	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	15000.
Inc & SS tax	0	10200.	0	0	0	0	0	0	0	0	0	0	10200.
Min end bal	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.
Tot. outflow	3545.	15815.	5741.	8127.	11010.	4812.	4831	4831.	4849.	6154.	8022.	3638.	75875.
Surp. or def	25115.	17110.	18572.	17495.	13388.	16281.	19129.	21918.	23716.	24102.	22850.	18137.	50308.
*** Capital purchases ***													
Mach. purch.	0	0	0	0	0	0	0	0	0	0	11000.	0	11000.
Tot. cap pur	0	0	0	0	0	0	0	0	0	0	11000.	0	11000.
Surp. or def	25115.	17110.	18572.	17495.	13388.	16281.	19129.	21918.	23716.	24102.	11850.	18137.	39308.
*** Debt payments ***													
FLB payment	986.	986.	986.	986.	986.	986.	986.	986.	986.	986.	986.	986.	11833.
Bnk NRE pymt	939.	939.	939.	939.	939.	939.	939.	939.	939.	939.	939.	939.	11263.
Tot debt pay	1925.	1925.	1925.	1925.	1925.	1925.	1925.	1925.	1925.	1925.	1925.	1925.	23096.
Surp. or def	23190.	15186.	16648.	15570.	11464.	14357.	17204.	19993.	21791.	22178.	9925.	16212.	16212.
Acc. AO int.	0	0	0	0	0	0	0	0	0	0	0	0	0
AO prin. pay	0	0	0	0	0	0	0	0	0	0	0	0	0
*** AO loan balances ***													
Beg AO bal	0	0	0	0	0	0	0	0	0	0	0	0	0
End AO bal	0	0	0	0	0	0	0	0	0	0	0	0	0
End cash bal	23690.	15686.	17148.	16070.	11964.	14857.	17704.	20493.	22291.	22678.	10425.	16712.	16712.

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*** Cash inflows ***													
Beg cash bal	15758.	19237.	14513.	14986.	12797.	7197.	8979.	10715.	12393.	13080.	11972.	500.	15758.
Lvstk milk	9438.	9236.	8628.	8474.	8328.	9130.	9103.	9044.	8072.	7965.	8194.	11349.	106961.
Total inflow	25196.	28473.	23141.	23460.	21125.	16327.	18082.	19759.	20465.	21045.	20166.	11849.	122719.
*** Cash outflows ***													
Hired labor	0	0	0	0	871.	871.	871.	871.	871.	871.	871.	0	6100.
Repairs	288.	288.	288.	576.	576.	576.	576.	576.	576.	576.	576.	288.	5757.
Purch. feed	290.	290.	290.	290.	290.	290.	295.	295.	300.	300.	310.	315.	3552.
Seed	0	0	1080.	1444.	0	0	0	0	0	0	0	0	2524.
Fertilizer	0	0	1116.	2832.	1116.	0	0	0	0	600.	0	0	5664.
Chemicals	0	0	0	140.	2592.	0	0	0	0	0	0	0	2732.
Crop insur.	0	0	0	0	0	0	0	0	0	0	1121.	0	1121.
Mach. hire	0	0	0	0	1785.	0	0	0	0	0	1785.	0	3570.
Breeding	166.	166.	166.	166.	166.	166.	169.	169.	172.	172.	178.	181.	2038.
Vet. & med	142.	142.	142.	142.	142.	142.	145.	145.	147.	147.	152.	155.	1747.
Lsk supplies	166.	166.	166.	166.	166.	166.	169.	169.	172.	172.	178.	181.	2038.
Lvstk. mktg.	285.	285.	285.	285.	285.	285.	290.	290.	295.	295.	305.	310.	3494.
Gas, oil, dry	230.	230.	230.	230.	460.	460.	460.	460.	460.	460.	690.	230.	4602.
Farm taxes	0	0	0	0	1088.	0	0	0	0	1088.	0	0	2175.
Farm insur.	0	3602.	0	0	0	0	0	0	0	0	0	0	3602.
Utilities	351.	351.	351.	351.	351.	351.	351.	351.	351.	351.	351.	351.	4209.
Fam. living	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	15000.
Inc & SS tax	0	4400.	0	0	0	0	0	0	0	0	0	0	4400.
Min end bal	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.
Tot. outflow	3668.	11670.	5864.	8372.	11638.	5057.	5076.	5076.	5094.	6782.	8267.	3760.	74824.
Surp. or def	21528.	16803.	17277.	15088.	9487.	11269.	13006.	14683.	15371.	14263.	11899.	8089.	47895.
*** Capital purchases ***													
Mach. purch.	0	0	0	0	0	0	0	0	0	0	11000.	0	11000.
Tot. cap pur	0	0	0	0	0	0	0	0	0	0	11000.	0	11000.
Surp. or def	21528.	16803.	17277.	15088.	9487.	11269.	13006.	14683.	15371.	14263.	899.	8089.	36895.
*** Debt payments ***													
FLB payment	1852.	1852.	1852.	1852.	1852.	1852.	1852.	1852.	1852.	1852.	1852.	1852.	22225.
Bnk NRE pymt	939.	939.	939.	939.	939.	939.	939.	939.	939.	939.	939.	939.	11263.
Tot debt pay	2791.	2791.	2791.	2791.	2791.	2791.	2791.	2791.	2791.	2791.	2791.	2791.	33488.
Surp. or def	18737.	14013.	14486.	12297.	6697.	8479.	10215.	11893.	12580.	11472.	-1891.	5298.	3407.
Acc. AO int.	0	0	0	0	0	0	0	0	0	0	0	16.	16.
AO prin. pay	0	0	0	0	0	0	0	0	0	0	0	1891.	1891.
*** AO loan balances ***													
Beg AO bal	0	0	0	0	0	0	0	0	0	0	0	1891.	0
End AO bal	0	0	0	0	0	0	0	0	0	0	1891.	0	0
End cash bal	19237.	14513.	14986.	12797.	7197.	8979.	10715.	12393.	13080.	11972.	500.	3891.	3891.

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*** Cash inflows ***													
Beg cash bal	15477.	19033.	14706.	15266.	13173.	7750.	9620.	10994.	12760.	13548.	12623.	500.	15477.
Lvstk milk	9326.	9126.	8526.	8375.	8230.	9023.	8545.	8937.	7978.	7872.	8078.	11220.	105236.
Total inflow	24803.	28159.	23232.	23641.	21403.	16773.	18165.	19931.	20738.	21420.	20701.	11720.	120713.
*** Cash outflows ***													
Hired labor	0	0	0	0	871.	871.	871.	871.	871.	871.	871.	0	6100.
Repairs	281.	281.	281.	562.	562.	562.	562.	562.	562.	562.	562.	281.	5618.
Purch. feed	290.	290.	290.	290.	290.	290.	295.	295.	300.	300.	310.	315.	3552.
Seed	0	0	1080.	1444.	0	0	0	0	0	0	0	0	2524.
Fertilizer	0	0	1116.	2832.	1116.	0	0	0	0	600.	0	0	5664.
Chemicals	0	0	0	140.	2592.	0	0	0	0	0	0	0	2732.
Crop insur.	0	0	0	0	0	0	0	0	0	0	1121.	0	1121.
Mach. hire	0	0	0	0	1785.	0	0	0	0	0	1785.	0	3570.
Breeding	166.	166.	166.	166.	166.	166.	169.	169.	172.	172.	178.	181.	2038.
Vet. & med	142.	142.	142.	142.	142.	142.	145.	145.	147.	147.	152.	155.	1747.
Lsk supplies	166.	166.	166.	166.	166.	166.	169.	169.	172.	172.	178.	181.	2038.
Lvstk. mktg.	285.	285.	285.	285.	285.	285.	290.	290.	295.	295.	305.	310.	3494.
Gas, oil, dry	230.	230.	230.	230.	460.	460.	460.	460.	460.	460.	690.	230.	4602.
Farm taxes	0	0	0	0	1007.	0	0	0	0	1007.	0	0	2014.
Farm insur.	0	3282.	0	0	0	0	0	0	0	0	0	0	3282.
Utilities	351.	351.	351.	351.	351.	351.	351.	351.	351.	351.	351.	351.	4209.
Fam. living	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	1250.	15000.
Inc & SS tax	0	4400.	0	0	0	0	0	0	0	0	0	0	4400.
Min end bal	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.	500.
Tot. outflow	3661.	11343.	5857.	8358.	11544.	5044.	5062	5062.	5080.	6687.	8253.	3753.	74204.
Surp. or def	21142.	16815.	17375.	15283.	9860.	11730.	13103.	14869.	15657.	14733.	12448.	7967.	46509.
*** Capital purchases ***													
Mach. purch.	0	0	0	0	0	0	0	0	0	0	11000.	0	11000.
Tot. cap pur	0	0	0	0	0	0	0	0	0	0	11000.	0	11000.
Surp. or def	21142.	16815.	17375.	15283.	9860.	11730.	13103.	14869.	15657.	14733.	1448.	7967.	35509.
*** Debt payments ***													
FLB payment	1671.	1671.	1671.	1671.	1671.	1671.	1671.	1671.	1671.	1671.	1671.	1671.	20050.
Bnk NRE pymt	939.	939.	939.	939.	939.	939.	939.	939.	939.	939.	939.	939.	11263.
Tot debt pay	2609.	2609.	2609.	2609.	2609.	2609.	2609.	2609.	2609.	2609.	2609.	2609.	31313.
Surp. or def	18533.	14206.	14766.	12673.	7250.	9120.	10494.	12260.	13048.	12123.	-1162.	5357.	4196.
Acc. AO int.	0	0	0	0	0	0	0	0	0	0	0	10.	10.
AO prin. pay	0	0	0	0	0	0	0	0	0	0	0	1162.	1162.
*** AO loan balances ***													
Beg AO bal	0	0	0	0	0	0	0	0	0	0	0	1162.	0
End AO bal	0	0	0	0	0	0	0	0	0	0	1162.	0	0
End cash bal	19033.	14706.	15266.	13173.	7750.	9620.	10994.	12760.	13548.	12623.	500.	4686.	4686.

Table 18. Annual cash flows for each alternative for first five years.

	Benchmark 40-cow herd				
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
*** Cash inflows ***					
Beg cash bal	13031.	19602.	28397.	47208.	57231.
Corn	12500.	9000.	23334.	23104.	23104.
Hay	3375.	7875.	1575.	1575.	1350.
Lvstk milk	78351.	80649.	85431.	85011.	87049.
Total inflow	107257.	117126.	138737.	156898.	168734.
*** Cash outflows ***					
Hired labor	955.	955.	955.	955.	955.
Repairs	1519.	1519.	1519.	1519.	1519.
Purch. feed	2439.	2439.	2439.	2439.	2439.
Purch. hay				88.	
Seed	2524.	2709.	2709.	2709.	2709.
Fertilizer	5664.	5880.	5880.	5880.	5880.
Chemicals	2732.	3060.	3060.	3060.	3060.
Crop insur.	1121.	1152.	1152.	1152.	1152.
Mach. hire	2467.	2467.	2467.	2467.	2467.
Breeding	1399.	1399.	1399.	1399.	1399.
Vet. & med.	1200.	1200.	1200.	1200.	1200.
Lsk supplies	1399.	1399.	1399.	1399.	1399
Lvstk. mktg.	2399.	2399.	2399.	2399.	2399.
Gas, oil, dry	2555.	2555.	2555.	2555.	2555.
Farm taxes	880.	880.	880.	880.	880.
Farm insur.	1012.	1012.	1012.	1012.	1012.
Utilities	2136.	2136.	2136.	2136.	2136.
Fam. living	12000.	15000.	15000.	15000.	15000.
Inc. & SS tax	18729.	16050.	18850.	26900.	24600.
Min end bal	500.	500.	500.	500.	500.
Tot. outflow	63630.	64711.	67511.	75649.	73261.
Surp. or def	43627.	52415.	71226.	81249.	95473.
*** Capital purchases ***					
Mach. purch.	11000.	11000.	11000.	11000.	11000.
Tot. cap pur	11000.	11000.	11000.	11000.	11000.
Surp. or def	32627.	41415.	60226.	70249.	84473.
*** Debt payments ***					
FLB payment	5881.	5881.	5881.	5881.	5881.
Bnk NRE pymt	7637.	7637.	7637.	7637.	7637.
Tot debt pay	13518.	13518.	13518.	13518.	13518.
Surp. or def	19109.	27897.	46708.	56731.	70955.
*AO int.	7.	0	0	0	0
AO prin. pay	812.	0	0	0	0
*** AO loan balances ***					
Beg AO bal	0	0	0	0	0
End AO bal	0	0	0	0	0
End cash bal	19602.	28397.	47208.	57231	71455.

*AO: Annual operating

	Rapid expansion tie stall addition				
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
*** Cash inflows ***					
Beg cash bal	13031.	16550.	35971.	54260.	76161.
Corn	5000.				
Hay	2025.				
Lvstk milk	93895.	147768.	156202.	169155.	467783.
Total inflow	113951.	164318.	192173.	223415.	243950.
*** Cash outflows ***					
Hired labor	955.	10800.	10800.	10800.	10800.
Repairs	1519.	4078.	4078.	4078.	4078.
Purch. feed	3079.	4868.	4878.	4878.	4878.
Purch. corn			1929.	5764.	5764.
Seed	2524.	2437.	2437.	2437.	2437.
Fertilizer	5664.	5568.	5568.	5568.	5568.
Chemicals	2732.	2564.	2564.	2564.	2564.
Crop insur.	1121.	1104.	1104.	1104.	1104.
Mach. hire	2467.	4101.	4101.	4101.	4101.
Breeding	1767.	2793.	2799.	2799.	2799.
Vet. & med.	1514.	2394.	2399.	2399.	2399.
Lsk supplies	1767.	2793.	2799.	2799.	2799
Lvstk. mktg.	3029.	4788.	4798.	4798.	4798.
Gas, oil, dry	2555.	6612.	6612.	6612.	6612.
Farm taxes	880.	1668.	1668.	1668.	1668.
Farm insur.	1012.	2589.	2589.	2589.	2589.
Utilities	2136.	4420.	4420.	4420.	4420.
Fam. living	12000.	15000.	15000.	15000.	15000.
Inc. & SS tax	18729.	4850.	12450.	17950.	22750.
Min end bal	500.	500.	500.	500.	500.
Tot. outflow	65950.	83927.	93493.	102828.	107528.
Surp. or def	48001.	80391.	98680.	120587.	136322.
*** Capital purchases ***					
Br. lvsk pur	44500.				
Mach. purch.	11000.	11000.	11000.	11000.	11000.
Bldg. purch.	105136.				
Tot. cap pur	160636.	11000.	11000.	11000.	11000.
Surp. or def	-112635.	69391.	87620.	109587.	125322.
*** New credit ***					
FLB loan	93136.				
Bnk NRE loan	54500.				
Tot. new cred	147636.				
*** Debt payments ***					
FLB payment	9038.	15352.	15352.	15352.	15352.
Bnk NRE pymt	9894.	18568.	18568.	18568.	18568.
Tot. debt pay	18932.	33920.	33920.	33920.	33920.
Surp. or def	16069.	35471.	53760.	75667.	91402.
*AO int.	19.	0	0	0	0
AO prin. pay	893.	0	0	0	0
*** AO loan balances ***					
Beg AO bal	0	0	0	0	0
End AO bal	0	0	0	0	0
End cash bal	16550.	35971.	54260.	76167	91902.

	Rapid expansion new tie stall				
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
*** Cash inflows ***					
Beg cash bal	13031.	13087.	18227.	30915.	51271.
Corn	5000.				
Hay	2025.				
Lvstk milk	93895.	147768.	156202.	169155.	167783.
Total inflow	113951.	160855.	174429.	200070.	219054.
*** Cash outflows ***					
Hired labor	955.	10800.	10800.	10800.	10800.
Repairs	1519.	6540.	6540.	6540.	6540.
Purch. feed	3079.	4868.	4878.	4878.	4878.
Purch. corn			1929.	5764.	5764.
Seed	2524.	2422.	2437.	2437.	2437.
Fertilizer	5664.	5537.	5568.	5568.	5568.
Chemicals	2732.	2546.	2564.	2564.	2564.
Crop insur.	1121.	1098.	1104.	1104.	1104.
Mach. hire	2467.	4101.	4101.	4101.	4101.
Breeding	1767.	2793.	2799.	2799.	2799.
Vet. & med.	1514.	2394.	2399.	2399.	2399.
Lsk supplies	1767.	2793.	2799.	2799.	2799.
.Lvstk. mktg.	3029.	4788.	4798.	4798.	4798.
Gas, oil, dry	2555.	6612.	6612.	6612.	6612.
Farm taxes	880.	2435.	2435.	2435.	2435.
Farm insur.	1012.	4122.	4122.	4122.	4122.
Utilities	2136.	4420.	4420.	4420.	4420.
Fam. living	12000.	15000.	5000.	15000.	15000.
Inc. & SS tax	18729.	4050.	2900.	4350.	5500.
Min end bal	500.	500.	500.	500.	500.
Tot. outflow	65950.	87819.	88705.	93990.	95140.
Surp. or def	48001.	73036.	85724.	106080.	123914.
*** Capital purchases ***					
Br. lvsk pur	44500.				
Mach. purch.	11000.	11000.	11000.	11000.	11000.
Bldg. purch.	207309.				
Tot. cap pur	262809.	11000.	11000.	11000.	11000.
Surp. or def	-214808.	62036.	74724.	95080.	112914.
*** New credit ***					
FLB loan	195309.				
Bnk NRE loan	54500.				
Tot. new cred	249809.				
*** Debt payments ***					
FLB payment	12501.	25741.	25741.	25741.	25741.
Bnk NRE pymt	9894.	18568.	18568.	18568.	18568.
Tot debt pay	22395.	44309.	44309.	44309.	44309.
Surp. or def	12606.	17727.	30415.	50771.	68605.
AO int.	19.	0	0	0	0
AO prin. pay	893.	0	0	0	0
*** AO loan balances ***					
Beg AO bal	0	0	0	0	0
End AO bal	0	0	0	0	0
End cash bal	13087.	18227.	30915.	51271	69105.

	Rapid expansion new free stall				
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
*** Cash inflows ***					
Beg cash bal	13031.	12271.	16794.	30073.	49095.
Corn	5000.				
Hay	2025.				
Lvstk milk	92247.	142737.	150029.	161792.	160586.
Total inflow	112303.	155008.	166823.	191865.	209681.
*** Cash outflows ***					
Hired labor	955.	10800.	10800.	10800.	10800.
Repairs	1519.	6126.	6126.	6126.	6126.
Purch. feed	3079.	4853.	4878.	4878.	4878.
Purch. corn			194.	4564.	4564.
Seed	2524.	2437.	2437.	2437.	2437.
Fertilizer	5664.	5568.	5568.	5568.	5568.
Chemicals	2732.	2564.	2564.	2564.	2564.
Crop insur.	1121.	1104.	1104.	1104.	1104.
Mach. hire	2467.	4101.	4101.	4101.	4101.
Breeding	1767.	2784.	2799.	2799.	2799.
Vet. & med.	1514.	2387.	2399.	2399.	2399.
Lsk supplies	1767.	2784.	2799.	2799.	2799
Lvstk. mktg.	3029.	4773.	4798.	4798.	4798.
Gas, oil, dry	2555.	6612.	6012.	6012.	6012.
Farm taxes	880.	2195.	2195.	2195.	2195.
Farm insur.	1012.	3643.	3643.	3643.	3643.
Utilities	2136.	4420.	4420.	4420.	4420.
Fam. living	12000.	15000.	5000.	15000.	15000.
Inc. & SS tax	18729.	4000.	2850.	4500.	5300.
Min end bal	500.	500.	500.	500.	500.
Tot. outflow	65950.	86651.	85187.	91207.	92007.
Surp. or def	46353.	68357.	81636.	100658.	117674.
*** Capital purchases ***					
Br. lvsk pur	44000.				
Mach. purch.	11000.	11000.	11000.	11000.	11000.
Bldg. purch.	175385.				
Tot. cap pur	230385.	11000.	11000.	11000.	11000.
Surp. or def	-184032.	57357.	70636.	89658.	106674.
*** New credit ***					
FLB loan	163385.				
Bnk NRE loan	54500.				
Tot. new cred	217385.				
*** Debt payments ***					
FLB payment	11419.	22495.	22495.	22495	22495.
Bnk NRE pymt	10122.	18568.	18568.	18568.	18568.
Tot debt pay	21541.	41063.	41063.	41063.	41063.
Surp. or def	11812.	16294.	29573.	48595.	65611.
AO int.	41.	0	0	0	0
AO prin. pay	1681.	0	0	0	0
*** AO loan balances ***					
Beg AO bal	0	0	0	0	0
End AO bal	0	0	0	0	0
End cash bal	12271.	16794.	30073.	49095	66111.

	Gradual expansion tie stall addition				
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
*** Cash inflows ***					
Beg cash bal	13031.	19222.	16712.	37735.	56590.
Corn	12500.				
Hay	3375.				
Lvstk milk	85035.	106961.	127006.	152074.	163973.
Total inflow	113941.	126183.	148718.	189809.	220563.
*** Cash outflows ***					
Hired labor	955.	6100.	6100.	10800.	10800.
Repairs	1519.	3306.	3306.	4069.	4069.
Purch. feed	3079.	3552.	4141.	4751.	4878.
Purch. corn				1299.	5764.
Seed	2524.	2524.	2280.	2437.	2437.
Fertilizer	5664.	5664.	5231.	5568.	5568.
Chemicals	2732.	2732.	2418.	2564.	2564.
Crop insur.	1121.	1121.	1051.	1104.	1104.
Mach. hire	2457.	3570.	3570.	4101.	4101.
Breeding	1767.	2038.	2376.	2726.	2799.
Vet. & med.	1514.	1747.	2037.	2337.	2399.
Lsk supplies	1767.	2038.	2376.	2726.	2799
Lvstk. mktg.	3029.	3494.	4073.	4673.	4798.
Gas, oil, dry	2555.	4602.	4602.	6012.	6012.
Farm taxes	880.	1409.	1409.	1726.	1726.
Farm insur.	1012.	2070.	2070.	2703.	2703.
Utilities	2136.	4209.	4209.	4420.	4420.
Fam. living	12000.	15000.	15000.	15000.	15000.
Inc. & SS tax	18729.	10200.	7050.	16000.	24700.
Min end bal	500.	500.	500.	500.	500.
Tot. outflow	65950.	75875.	73800.	95516.	109141.
Surp. or def	47991.	50308	74918.	94293.	111422.
*** Capital purchases ***					
Br. lvsk pur	13400.				
Mach. purch.	11000.	11000.	11000.	11000.	11000.
Bldg. purch.	70518.		42218.		
Tot. cap pur	94916.	11000.	53218.	11000.	11000.
Surp. or def	-46927.	39308.	21700.	83293.	100422.
*** New credit ***					
FLB loan	58518.		40000.		
Bnk NRE loan	23400.				
Tot. new cred	81918.		40000.		
*** Debt payments ***					
FLB payment	7865.	11833.	13202.	15940.	15940.
Bnk NRE pymt	8394.	11263.	11263.	11263.	11263.
Tot debt pay	16259.	23096.	24465.	27203.	27203.
Surp. or def	18732.	16212.	37235.	56090.	73219.
AO int.	10.	0	0	0	0
AO prin. pay	758.	0	0	0	0
*** AO loan balances ***					
Beg AO bal	0	0	0	0	0
End AO bal	0	0	0	0	0
End cash bal	19222.	16712.	37735.	56590	73719.

	Gradual expansion new tie stall				
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
*** Cash inflows ***					
Beg cash bal	13031.	15758.	3891.	16123.	29837.
Corn	12500.		5000.		
Hay	3375.				
Lvstk milk	85035.	106961.	127006.	152074.	163973.
Total inflow	113941.	122719.	135897.	168197.	193810.
*** Cash outflows ***					
Hired labor	955.	6100.	6100.	10800.	10800.
Repairs	1519.	5757.	5757.	6520.	6520.
Purch. feed	3079.	3552.	4141.	4751.	4878.
Purch. corn				1299.	5764.
Seed	2524.	2524.	2280.	2437.	2437.
Fertilizer	5664.	5664.	5231.	5568.	5568.
Chemicals	2732.	2732.	2418.	2564.	2564.
Crop insur.	1121.	1121.	1051.	1104.	1104.
Mach. hire	2467.	3570.	3570.	4101.	4101.
Breeding	1767.	2038.	2376.	2726.	2799.
Vet. & med.	1514.	1747.	2037.	2337.	2399.
Lsk supplies	1767.	2038.	2376.	2726.	2799.
Lvstk. mktg.	3029.	3494.	4073.	4673.	4798.
Gas, oil, dry	2555.	4602.	4602.	6012.	6012.
Farm taxes	880.	2175.	2175.	2492.	2492.
Farm insur.	1012.	3602.	3602.	4235.	4235.
Utilities	2136.	4209.	4209.	4420.	4420.
Fam. living	12000.	15000.	15000.	15000.	15000.
Inc. & SS tax	18729.	4400.	700.	6000.	4450.
Min end bal	500.	500.	500.	500.	500.
Tot. outflow	65950.	74824.	72199.	90265.	93640.
Surp. or def	47991.	47895.	63698.	77932.	100170.
*** Capital purchases ***					
Br. lvsk pur	13400.				
Mach. purch.	11000.	11000.	11000.	11000.	11000.
Bldg. purch.	172692.		42218.		
Tot. cap pur	197092.	11000.	53218.	11000.	11000.
Surp. or def	-149101.	36895.	10480.	66932.	89170.
*** New credit ***					
FLB loan	160692.		40000.		
Bnk NRE loan	23400.				
Tot. new cred	184092.		40000		
*** Debt payments ***					
FLB payment	11329.	22225.	23594.	26332.	26332.
Bnk NRE pymt	8394.	11263.	11263.	11263.	11263.
Tot debt pay	19723.	33488.	34857.	37595.	37595.
Surp. or def	15268.	3407.	15623.	29337.	51575.
AO int.	10.	16.	0	0	0
AO prin. pay	758.	1891.	0	0	0
*** AO loan balances ***					
Beg AO bal	0	0	0	0	0
End AO bal	0	0	0	0	0
End cash bal	15758.	3891.	16123.	29837	52075.

	Gradual expansion new free stall				
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
*** Cash inflows ***					
Beg cash bal	13031.	15477.	4686.	18024.	36071.
Corn	12500.		5000.		
Hay	3375.				
Lvstk milk	84032.	105236.	125583.	150358.	162241.
Total inflow	112938.	120713.	135269.	168382.	198312.
*** Cash outflows ***					
Hired labor	955.	6100.	6100.	10800.	10800.
Repairs	1519.	5618.	5618.	6250.	6250.
Purch. feed	3079.	3552.	4141.	4751.	4878.
Purch. corn				281.	5764.
Seed	2524.	2524.	2280.	2437.	2437.
Fertilizer	5664.	5664.	5231.	5568.	5568.
Chemicals	2732.	2732.	2418.	2564.	2564.
Crop insur.	1121.	1121.	1051.	1104.	1104.
Mach. hire	2467.	3570.	3570.	4101.	4101.
Breeding	1767.	2038.	2376.	2726.	2799.
Vet. & med.	1514.	1747.	2037.	2337.	2399.
Lsk supplies	1767.	2038.	2376.	2726.	2799.
Lvstk. mktg.	3029.	3494.	4073.	4673.	4798.
Gas, oil, dry	2555.	4602.	4602.	6012.	6012.
Farm taxes	880.	2014.	2014.	2245.	2245.
Farm insur.	1012.	3282.	3282.	3744.	3744.
Utilities	2136.	4289.	4289.	4428.	4428.
Fam. living	12000.	15000.	15000.	15000.	15000.
Inc. & SS tax	18729.	4400.	800.	5400.	4750.
Min end bal	500.	500.	500.	500.	500.
Tot. outflow	65950.	74204.	71679.	87639.	92932.
Surp. or def	46988.	46509.	63590.	80743.	105380.
*** Capital purchases ***					
Br. lvsk pur	13400.				
Mach. purch.	11000.	11000.	11000.	11000.	11000.
Bldg. purch.	151310.		30800.		
Tot. cap pur	175710.	11000.	41800.	11000.	11000.
Surp. or def	-128722.	35509.	21790.	69743.	94380.
*** New credit ***					
FLB loan	139310.		28000.		
Bnk NRE loan	23400.				
Tot. new cred	162710.		28000.		
*** Debt payments ***					
FLB payment	10604.	20050.	21003.	22909.	22909.
Bnk NRE pymt	8394.	11263.	11263.	11263.	11263.
Tot debt pay	18998.	31313.	32266.	34172.	34172.
Surp. or def	14990.	4196.	17524.	35571.	60208.
AO int.	13.	0	0	0	0
AO prin. pay	891.	1162	0	0	0
*** AO loan balances ***					
Beg AO bal	0	0	0	0	0
End AO bal	0	0	0	0	0
End cash bal	15477.	4686.	18024.	36071	60708.

Financial Analysis

As discussed previously, the two important areas in analyzing an investment are the investment's liquidity affects and its long range profitability. For each of the alternatives investigated in this study, monthly cash flow statements were constructed for the first five years of the planning span. No serious cash flow problems occurred in any of the alternatives. This result was not unexpected because dairying, unlike many other farm enterprises, produces a steady stream of funds which aids in reducing liquidity problems.

The criterion used to determine long range profitability is the after-tax internal rate of return (IRR). The IRR is the discount rate (or opportunity cost of money) which equates the stream of forthcoming after-tax cash flows to the original investment cost. Cash flows include all cash inflows relating to the enterprise and all cash outflows for expenses, family living, and taxes, but not financing.

If the IRR for an investment is greater than the loan rate on funds borrowed for the investment, the investment will yield some profit in an accounting sense. However, assuming there is a limited supply of investment funds available to the investor, an investment will be profitable in an economic sense only if its IRR is greater than the IRR from any alternative use of those funds since these alternatives represent the opportunity cost of the funds for any particular investment.

In the two cases where additions to the present facilities are being made, the difference between the cash flows for the benchmark 40-cow situation and for the expanded situations was used in determining the IRR. Returns from the additional 40 cows are being related to the investment costs associated with the additional 40 cows. In alternatives where all new facilities are constructed, the opportunity cost of the present 40-cow herd must be included as part of the investment cost. The prices used are as follows: cows — $1,000, bred heifers — $800, heifers — $500, and calves — $100.

In all instances, the investment has some value at the end of the planning span which is considered a cash inflow in year 30. Facilities are valued at 15 percent of the original value and cattle at the following prices: cows — $1,000, bred heifers — $800, heifers — $500, and calves — $100.

The stream of after-tax returns for each alternative is listed in Table 19. The IRR for each alternative, along with sensitivity analysis for varying changes in original investments, are found in Table 20.

Table 20. A sensitivity analysis of the after-tax internal rate of return on investment alternatives by changes in the investment for each of the alternatives.*

Alternative	Investment cost	Change in investment cost −20	−10	No change	+10	+20
		-----internal rate of return-----				
Rapid tie stall (add)	$149,636	19.0	17.0	15.4	14.4	12.8
Rapid tie stall (new)	308,609	17.0	15.5	14.0	12.8	11.5
Rapid free stall (new)	276,685	17.5	15.7	14.2	13.0	12.0
Gradual tie stall (add)	83,918	16.0	14.4	13.2	11.5	10.6
Gradual tie stall (new)	242,892	16.0	14.4	13.1	12.0	11.1
Gradual free stall (new)	221,510	17.1	15.5	14.1	13.0	12.0

*Assumes zero change in tax situation.

The after-tax internal rate of return was used as the profitability measure, allowing for easy comparisons between investment alternatives. All alternatives could be termed profitable in an accounting sense; that is, the interest rate on the borrowed funds is below the lowest IRR of 13.1 percent, which was for the gradual expansion to a new tie stall facility.

When facilities are added on to the present facilities, the IRR for rapid expansion tie stall addition is 15.4 percent as opposed to 13.2 percent for the gradual expansion tie stall operation. This suggests that rapid expansion in this situation would be most profitable.

When new facilities must be constructed, the IRR for the rapid expansion tie stall and free stall operations and the gradual expansion free stall operation are all approximately 14 percent,

Table 19. Annual after-tax returns to investment and management for each alternative.

Year	Alternative: Benchmark 40-cow	Rapid tie stall addition	Change from benchmark 40-cow	Rapid tie stall new	Rapid free stall new	Gradual tie stall addition	Change from benchmark 40-cow	Gradual tie stall new	Gradual free stall new
1	$17,508	$ 35,153	$17,645	$ 21,635	$ 19,965	$ 35,152	$17,645	$ 21,634	$ 20,628
2	22,312	51,551	29,238	34,141	30,278	18,796	−3,517	6,313	5,214
3	32,329	50,409	18,090	41,689	39,034	3,698*	−28,631	−8,219*	2,296*
4	23,541	54,037	30,496	49,357	44,777	44,268	20,727	36,001	36,911
5	27,742	47,865	20,123	46,835	42,771	46,122	18,380	44,525	43,501
6	26,942	50,265	23,323	44,835	38,321	43,022	16,080	38,125	36,001
7	26,942	50,265	23,323	41,502	37,571	43,022	16,080	36,182	34,820
8	34,579	57,902	23,323	49,139	45,208	50,659	16,080	43,819	42,457
9	34,579	57,902	23,323	49,139	45,208	50,659	16,080	43,819	42,457
10	34,579	57,902	23,323	49,139	45,208	50,659	16,080	43,819	42,457
11	34,579	59,692	25,113	50,929	46,998	52,449	17,870	45,609	44,247
12	34,579	59,692	25,113	50,929	46,998	52,449	17,870	45,609	44,247
13	34,579	59,692	25,113	50,929	46,998	52,449	17,870	45,609	44,247
14	34,579	59,692	25,113	50,929	46,998	52,449	17,870	45,609	44,247
15	34,579	59,692	25,113	50,929	46,998	52,449	17,870	45,609	44,247
16-29	40,460	65,573	25,113	56,810	52,879	58,330	17,870	51,490	50,128
30	40,460	127,500	87,040	187,613	178,694	119,536	79,076	180,812	174,661

*In gradual expansion situations, the investment occurring in year 3 is treated as a cash outflow in year 3 in determining the internal rate of return.

suggesting that all are equally profitable investments. The IRR for the gradual expansion tie stall is 13.1 percent which indicates this would be the least profitable means of expansion for the alternatives studied.

It appears that even though production and other management factors are most adversely affected when expanding to free stall facilities, a farm operator needs to look closely at other investment considerations in addition to the loss of income resulting from depressed milk production. The investment cost differences between comparable tie stall and free stall operations result in the two alternative systems being approximately equally profitable for the situations discussed in this study.

Changes in the initial investment costs, while changing the IRR for each alternative, did not alter the above comparisons.

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Industry Contacts

Acorn Equipment Company, P.O. Box 207, Stevens Point, Wisconsin 54481.

Bergman Silo, Maple Plain, Minnesota 55359.

Bush, Elmer, Livestock Systems Contractor, Jordan, Minnesota 55352.

Dairy Equipment Company, P.O. Box 8050, Madison, Wisconsin 53708.

The De Laval Separator Company, 5724 North Pulaski Road, Chicago, Illinois 60646.

Lester's of Minnesota, Lester Prairie, Minnesota 55354.

Wick Agri Buildings, Box 38, Mazomanie, Wisconsin 53560.