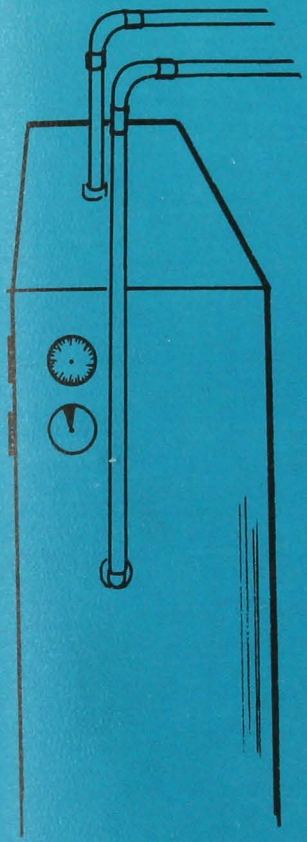
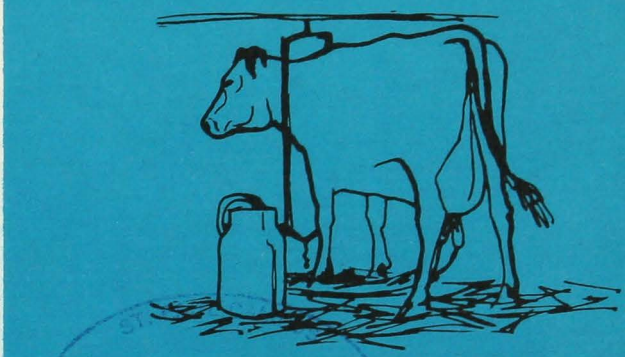
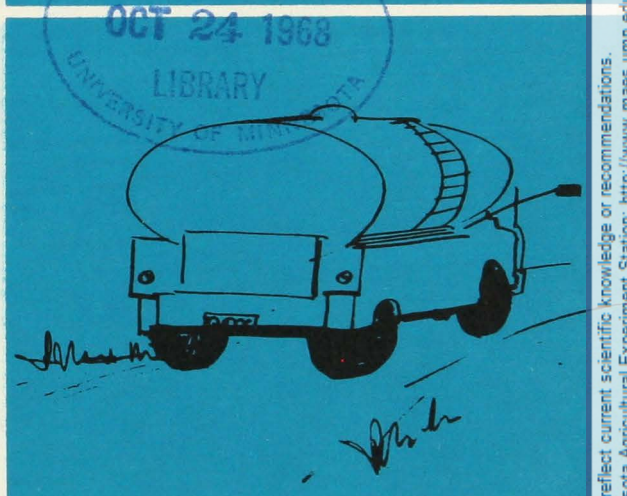






Alternative Dairy Technologies
A COMPARISON OF UNIT COST, NET RETURN, AND INVESTMENT

Boyd M. Buxton

Agricultural Experiment Station · University of Minnesota

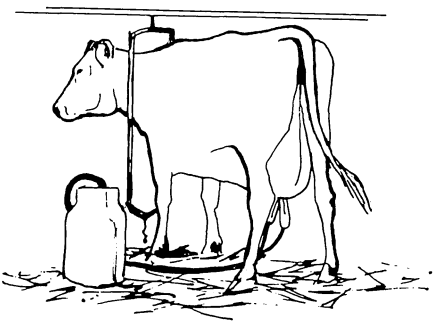
Contents	Page
Summary and Conclusions	3
Housing technologies	3
Milking technologies	4
Feeding programs	4
Field machinery	4
Alternative dairy housing technologies	6
Gross income	6
Unit cost	6
Net return	7
Investment	7
Alternative milking technologies	8
Gross income	8
Unit cost	9
Net returns	9
Investment	10
Alternative feeding programs	10
Gross income	10
Unit cost	10
Net return	11
Investment	11
Alternative size machinery	11
Appendix A — Dairy farm systems	12
Housing facilities	14
Stanchion barn	16
Loose housing loafing barn	16
Cold free stall housing	16
Warm free stall housing	16
Chore labor requirements	16
Milking technologies	16
Herringbone milking parlor	16
Side opening parlor	21
Milking in the stanchion barn	21
Feeding technologies	21
Labor and management	22
Seasonal hired labor	22
Appendix B — Field machinery	23
Appendix C — Crop and livestock budgets	24
Crop budgets	24
Livestock budgets	24
Dairy	24
Hogs	24
Appendix D — Dairy rations	26
Appendix E — Annual cost as percentage of investment	27

This bulletin was produced in cooperation with
Farm Production Economics Division
Economic Research Service
U.S. Department of Agriculture

The cost-price squeeze is a real problem to farmers, and the dairy farmer is no exception. Dairy producers are undergoing pressure to increase their production efficiency to improve or maintain their incomes. Many of them have shifted from dairying to more attractive farm enterprises, while others have left farming altogether. Still others are adjusting herd size and looking to new labor-efficient technologies to make the dairy enterprise more profitable.

New dairy technology, including alternative housing, milking, and feeding facilities, is playing a large role in adjustments designed to improve efficiency and farm income.

This study compares several alternative dairy housing, milking, and feeding facilities with respect to gross income produced, cost per dollar of gross income, net returns to the operator's labor and management, and investment capital requirements. The comparisons are made within the context of a complete farm organization so that differences in technologies used are reflected in their effect on a total farm situation.



Summary and Conclusions

Several complete dairy farm systems were synthesized (constructed on paper) from selected housing, milking, feeding, and field machinery components. With the use of linear programing, the farm organization with the lowest cost of producing about the highest possible gross income level with a specified supply of labor was determined for each farm system. The systems representing alternative dairy technologies were then compared on the basis of relative efficiency and profitability.

Housing Technologies

Results indicated a substantial difference in cost per dollar of gross income and net returns to the operator's labor and management between new stanchion barn housing and any of the three types of loose housing barns considered. Gross income was about $9,000 higher and net returns to the operator's labor and management about $2,700 higher on one-man farms with loose housing than on one-man farms with stanchion barns. Lower labor requirements per cow in loose housing allowed the one-man farm to increase the gross income level beyond the highest level attainable in stanchion barns. The greater efficiency in use of labor with the larger herd size more than offset the higher investments for loose housing (including milking parlor) compared with the stanchion barns.

The differences in costs among the three types of loose housing arrangements were much less than between the stanchion barn and any of the loose housing barns. Comparisons between the loose housing arrangements showed that the loose housing loafing barn had slightly lower costs than the cold free stall barn. Primarily because of higher investment costs, the warm free stall housing had higher unit costs per dollar of gross income and lower net income than either the loafing barn or cold free stall barn.

Milking Technologies

Results showed that the double-4 herringbone parlor had the lowest unit cost and the highest net return to the operator's labor of the seven milking arrangements considered. This system had the lowest labor requirement and almost the lowest investment costs per unit of output. The single-3 side opening parlor had a lower investment cost, but higher labor requirements offset this.

On two-man farms, the double-8 herringbone had a higher cost per dollar of gross income than the double-4 herringbone parlor, primarily because of its higher investment. The double-3 side opening and double-6 herringbone parlors had higher costs than the double-4 herringbone due to higher labor requirements per cow.

Feeding Programs

A baled hay-corn silage ration had a lower unit cost than a summer haylage-corn silage ration, even though the haylage ration had lower labor requirements. The high cost of purchased protein supplement, required with the haylage ration, more than offset the lower labor requirements. Also, the haylage-corn silage ration required more investment in feed storing facilities than the baled hay-corn silage ration.

Field Machinery

On one-man dairy farms the complement of small field machinery had a lower unit cost than the complement of large machinery. On three- and four-man farms the large machinery had lower unit costs. The labor saved with the large machinery more than offset the added cost of the increased investment on large farms but not on small one-man farms.

Overall Results

Results from this study demonstrated that the loose housing loafing barn or cold free stall barn, used in combination with a double-4 (75 cows or less) or a double-8 (more than 75 cows) herringbone milking parlor and baled hay ration, had the lowest unit cost and the highest net return of the farm situations considered.

In this study, only farm organizations typical of Minnesota dairy farms were considered. Some alternative farm organizations probably would influence the relative efficiency of the dairy technologies considered. For example, buying replacements and/or feed would free labor, allowing more efficient use of housing and milking facilities. These types of adjustments in dairy farming would result in dairy farm units quite different from those currently existing in Minnesota.

Alternative Dairy Technologies – A Comparison of Unit Cost, Net Return, and Investment

Boyd M. Buxton*

During the last few years new dairy technologies have been developed and are available to farmers. The new housing, milking, and feeding facilities have not been widely adopted and most milk is still produced with the more traditional stanchion barn arrangements. However, as existing barns are replaced, this new technology will become an important component of the remaining dairy farms.

The purpose of this study is to provide information on the relative unit costs and net returns of several alternative types of dairy housing, milking, and feeding technologies. Specifically, the objectives are to (1) estimate the cost per dollar of gross income produced and net returns on farm systems with alternative dairy technologies, and (2) compare these alternative technologies as to unit costs, net returns, least-cost farm organizations, and total investments.

The procedure used estimated the effects of alternative housing, milking, and feeding technologies on a total farm operation. For example, to compare alternative housing arrangements, farm operations were synthesized with identical technologies except for housing. Then the least-cost combination of resources and farm organization was estimated for each synthetic farm system using linear programing. The resulting unit costs and net returns of the two housing technologies were compared. The same procedure was used to compare alternative milking and feeding technologies. The technologies considered in this study are listed in table 1.

Table 1. Alternative dairy technologies compared in this study

Housing	Stanchion barn with gutter cleaner
	Loose housing loafing barn
	Cold free stall barn
	Warm confinement barn with liquid manure handling
Milking	Double-4 herringbone parlor
	Double-6 herringbone parlor
	Double-8 herringbone parlor
	Single-3 side opening parlor
	Double-3 side opening parlor
	Two-unit carry for stanchion barn
	Three-unit pipeline for stanchion barn
Feeding	Corn silage with summer haylage (mechanical feeding)
	Corn silage with baled alfalfa hay (mechanical feeding)

* Boyd M. Buxton is an agricultural economist, Farm Production Economics Division, Economic Research Service, U.S. Department of Agriculture, stationed at the University of Minnesota, St. Paul, Minn.

The results reported in this bulletin are part of a broader study dealing with the "Economies of Size in Minnesota Dairy Farming."[1]

Alternative Dairy Housing Technologies

Table 2 compares the results of four farm systems each using an alternative housing technology as follows:[2]

(1) Loose housing loafing barn (Farm System 15111).

(2) Cold free stall barn (Farm System 11111).

(3) Warm enclosed free stall barn with liquid manure handling (Farm System 17111).

(4) Stanchion barn (Farm System 18721).

The first three farm situations were identical except for the barn. All three had a double-4 herringbone milking parlor, an identical complement of field equipment and feeding ration, and one-man equivalent (2,500 hours) plus 1,250 hours of seasonal labor available. The farm system with the stanchion barn housing had the same field equipment and labor supply as the three farms with loose housing but used a pipeline milker and a baled hay-corn silage ration.

Gross Income

The farms with loose housing barns were able to expand to a gross income of $32,000 with the available labor supply. The farms with the stanchion barn, however, were limited to $23,000 gross income because of high labor requirements. The operator's labor (2,500 hours) was fully employed on all four farm systems in actual farming tasks or in supervisory time for hired labor. In the budgeting process, 0.2 hours of the operator's time, it was assumed, was needed for management and supervision for each hour of seasonal hired labor employed.

On all four farm systems, 60 percent of the gross income came from the dairy enterprise and 40 percent from the sale of corn grain.

Unit Cost

Cost per dollar of gross income was about the same with a loose housing loafing barn or a cold free stall barn. The farm system using the warm enclosed free stall housing had the lowest labor requirements of the four types of housing, but the substantially higher investment resulted in a higher unit cost than for the other loose housing arrangements.

---

[1] Boyd M. Buxton and Harald R. Jensen, "Economies of Size in Minnesota Dairy Farming." Minn. Agr. Expt. Sta. Bull. 488. 1968.

[2] For description of farm systems, see appendix table A-1.

Unit cost was highest with the stanchion barn primarily because the labor requirements with this type of barn greatly restricted herd size.

Net Return

The net return to operator's labor and management depends on both the unit cost and volume of gross income produced. The higher volume and lower unit cost of the loose housing compared with the stanchion barn arrangement results in more than $2,200 higher net return with the loose housing.

Investment

Table 2 tabulates the total investment in land, dairy facilities, livestock, and machinery for all four housing systems. The farms with warm free stall housing represented over $151,000 total investment, while farms with the loose housing loafing barn and cold free stall represented about $145,000 total investment. The farms with stanchion barn housing represented about $120,000 total investment.

Table 2. Minimum cost solutions of four farm situations using alternative dairy housing technologies

Item	Units	Housing alternatives: Loose housing loafing shed	Cold free stall	Warm enclosed free stall	Stanchion barn
Gross income	Dollars	32,000	32,000	32,000	23,000
Percentage from dairy	Percent	60	60	60	60
Total cost	Dollars	27,395	27,487	27,945	21,139
Net returns	Dollars	4,605	4,513	4,055	1,861
Unit cost*	Dollars	0.856	0.859	0.873	0.919
Farm organization:					
Cows in herd	Number	43	43	43	31
Total land	Acres	221	225	221	179
Corn silage	Acres	55	55	55	22
Corn grain	Acres	3	3	3	14
Corn for sale	Acres	142	124	142	102
Oats	Acres	5	5	5	10
Alfalfa	Acres	16	16	16	31
Soybeans	Acres	0	22	0	0
Total labor used	Hours	3,652	3,750	3,610	3,475
Seasonal labor used	Hours	1,152	1,250	1,110	975
Operator labor used	Hours	2,270	2,250	2,278	2,305
Management of hired labor	Hours	230	250	222	195
Total investment	Dollars	144,090	145,252	151,220	119,715
Land	Dollars	66,058	67,209	66,058	53,737
Dairy facilities	Dollars	29,380	29,391	34,639	21,816
Dairy herd	Dollars	15,965	15,965	15,965	11,475
Machinery	Dollars	32,687	32,687	34,558	32,687
Investment/cow in dairy facilities	Dollars	683	684	806	704

* Cost per dollar of gross income.

These systems (except the stanchion barn) all assumed a summer haylage-corn silage ration. The loose housing loafing barn and cold free stall barn, it should be pointed out, have potentially lower unit costs and higher net returns than indicated here, because both these housing arrangements need not use the summer haylage-corn silage feeding program, but can use the lower cost baled hay-corn silage feeding program.[3]

Two-, Three-, and Four-Man Farms

The same comparative efficiencies among the alternative housing technologies existed for two-, three-, and four-man farm systems. Therefore, no specific discussion of alternative housing technologies on larger farms is included in this bulletin. For further information on how farm size influences unit cost, net return, and total investment, see the reference listed in footnote 1, page 6.

Alternative Milking Technologies

Table 3 compares the results of four farm situations each using an alternative milking technology as follows:[4]

(1) Double-4 herringbone milking parlor with one-man milking (Farm System 25121).

(2) Double-6 herringbone milking parlor with two-man milking (Farm System 25221).

(3) Double-8 herringbone milking parlor with two-man milking (Farm System 25321).

(4) Double-3 side opening milking parlor with two-man milking (Farm System 25521).

These four farm situations were identical except for the milking parlor. All were two-man farms with loose housing loafing barns, baled hay-corn silage feeding rations, and identical complements of field equipment.

Gross Income

Gross income, limited by two-man equivalents (5,000 hours) plus 1,250 hours of seasonal labor, was about $50,000 for farm systems using the double-4 and double-8 herringbone parlors and $46,000 for farm systems using the double-6 herringbone and double-3 side opening milking parlors. On all four farms dairying contributed the specified minimum 60 percent of the gross income while crop sales accounted for the remaining 40 percent.

---

[3] The baled hay-corn silage ration was not considered for the warm enclosed free stall (confinement) barn. Comparisons of the two feeding programs are made on page 11.

[4] For description of farm systems, see appendix table A-1.

Unit Cost

Of the four milking technologies studied, the double-4 herringbone had the lowest unit cost, resulting from $50 less investment per cow and lower labor requirements compared with the double-8 herringbone parlor.

The lower labor requirements about offset the higher investment of the double-8 herringbone parlor compared with the double-3 side opening parlor. As a result, both had almost identical unit costs on two-man farms. However, on larger three- and four-man farms, the lower labor requirements outweighed the higher investment, and the double-8 herringbone parlor had lower unit costs than the double-3 side opening parlor.

Unit costs with the double-6 herringbone parlor were relatively high, primarily because two men milking in this parlor leaves one man semi-employed, resulting in low labor efficiency.

Net Returns

Net returns to the operator's labor and management were highest (about $9,400) with the double-4 herringbone parlor, resulting from the

Table 3. Minimum cost solutions for four farm situations using alternative milking technologies

Item	Unit	Milking alternatives			
		Double-4 herring-bone	Double-6 herring-bone	Double-8 herring-bone	Double-3 side opening
Gross income	Dollars	50,000	46,000	50,000	46,000
Percentage from dairy	Percent	60	60	60	60
Total cost	Dollars	40,636	39,468	41,311	37,993
Net returns	Dollars	9,364	6,532	8,689	8,007
Unit cost*	Dollars	.8127	.8580	.8262	.8259
Farm organization:					
Cows in herd	Number	67	62	67	62
Total land	Acres	389	385	389	361
Corn silage	Acres	47	43	47	43
Corn grain	Acres	32	29	32	29
Corn for sale	Acres	222	74	222	188
Oats	Acres	22	20	22	20
Alfalfa	Acres	66	61	66	61
Soybeans	Acres	0	158	0	20
Total labor used	Hours	6,083	6,250	6,160	6,250
Seasonal labor used	Hours	1,083	1,250	1,160	1,250
Full time labor used	Hours	4,283	4,250	4,268	4,250
Management of hired labor	Hours	717	750	732	750
Total investment	Dollars	219,092	216,184	222,562	205,890
Land	Dollars	116,820	115,634	116,820	108,501
Dairy facilities	Dollars	37,362	37,636	40,832	34,475
Dairy herd	Dollars	24,945	22,949	24,945	22,949
Machinery	Dollars	39,965	39,965	39,965	39,965
Investment/cow in dairy facilities	Dollars	558	607	609	556

* Cost per dollar of gross income.

combined effects of a lower unit cost and a higher volume of gross income possible with the given labor supply. Net returns for farm situations using the double-8 herringbone, double-3 side opening, and double-6 herringbone parlors were $8,700, $8,000, and $6,500, respectively (table 3).

Investment

Total investment was lowest for the farm situation with the double-3 side opening parlor primarily because of fewer acres of land and lower investment in dairy facilities. The farm situation built for 62 cows and replacements represented about a $206,000 investment. With the double-8 herringbone parlor, investment totaled about $223,000 when the total farm system was built for 67 milk cows and replacements.

Alternative Feeding Programs

Table 4 compares two farm situations each representing an alternative dairy feeding ration and its associated storage and handling equipment. The two feeding rations were the following: [5]

(1) Baled hay-corn silage ration (Farm System 25121).

(2) Summer haylage-corn silage ration (Farm System 25111).

Both rations were considered on identical two-man farms with loose housing loafing barn, double-4 herringbone milking parlor, and an identical complement of field machinery.

Gross Income

With identical quantities of labor, the farm system with the summer haylage-corn silage feeding program generated $4,000 more gross income than the farm situations with the baled hay-corn silage feeding program ($54,000 compared with $50,000). Less labor was required to produce and handle haylage and corn silage than baled hay. On both farms the specified minimum 60 percent of the gross income was from dairy and 40 percent from crop sales.

Unit Cost

Even though a higher level of gross income could be attained using the summer haylage-corn silage feeding program, cost per dollar of gross income was higher. The higher unit cost results from higher investment in silo storage per cow and the additional protein supplement required with the summer haylage-corn silage ration.[6]

---

[5] For description of both farm systems, see appendix table A-1.

[6] When corn silage is substituted for baled hay, protein supplement is added to maintain the level of digestible protein in the ration.

Table 4. Minimum cost solutions for two farm situations using alternative feeding programs

Item	Unit	Feeding program: Baled hay-corn silage	Feeding program: Summer haylage-corn silage
Gross income	Dollars	50,000	54,000
Percentage from dairy	Percent	60	60
Total cost	Dollars	40,636	44,883
Net returns	Dollars	9,364	9,117
Unit cost*	Dollars	.8127	.8312
Farm organization:			
Cows in herd	Number	67	73
Total land	Acres	389	371
Corn silage	Acres	47	92
Corn grain	Acres	32	4
Corn for sale	Acres	222	240
Oats	Acres	22	9
Haylage-alfalfa	Acres	66	26
Soybeans	Acres	0	0
Total labor used	Hours	6,083	6,070
Seasonal labor used	Hours	1,083	1,070
Full time labor used	Hours	4,283	4,286
Management of hired labor	Hours	717	714
Total investment	Dollars	219,092	215,956
Land	Dollars	116,820	111,474
Dairy facilities	Dollars	37,362	40,438
Dairy herd	Dollars	24,945	26,940
Machinery	Dollars	39,965	37,104
Investment/cow in dairy facilities	Dollars	558	554

* Cost per dollar of gross income.

Net Return

Net return to the operator's labor and management was slightly higher on the farm system using the baled hay-corn silage feeding program. Its lower unit cost more than offset the advantage of the higher gross income volume of the summer haylage-corn silage feeding program.

Investment

Total investment for the farm system using the baled hay-corn silage feeding program was about $4,000 higher than for the farm system using the summer haylage-corn silage feeding program ($219,092 compared with $215,956).

Alternative Size Machinery

Three complements of field equipment are considered in this study.

Each complement represents a different size tractor and field equipment as follows: [7]

(1) Machine group I: 3-plow tractor.

(2) Machine group II: 4-plow tractor.

(3) Machine group III: 5-plow tractor.

Cost per dollar of gross income was lowest for machine group I — up to $50,000 gross income. Between $50,000 and $57,000 gross income, unit cost was lowest for machine group II; while above $57,000, unit cost was lowest for machine group III. At low gross income levels, the lower labor requirements for machine group III compared with machine group I did not offset the higher investment. The net effect therefore, was higher unit costs and lower net returns to the operator's labor and management for machine group III than for machine group I.

The unit costs and net returns of the three machine groups were quite similar on two-man farms (table 5). With the two-man equivalents of labor, gross incomes with machine groups I, II, and III were limited to $50,000, $54,000, and $60,000 levels of gross income, respectively. Lower labor requirements for the larger machine group offset the higher investment, resulting in slightly lower unit cost for the larger machine groups compared with the smaller machine groups. The combined higher gross income volume produced and lower unit cost resulted in $2,500 higher net returns for machine group III than for group I.

Therefore, on the larger two-man farms and on three- and four-man farms, the labor saved by employing machine group III, rather than groups I or II, more than offset the higher investment and resulted in lower unit cost, higher volume of output, and higher net return to operator's labor and management.

Appendix A

Dairy Farm Systems

Appendix A presents the estimated investment and labor requirements associated with each dairy technology. Table A-1 summarizes the farm systems used to evaluate the alternative dairy technologies.

Investment Requirements. Estimated investment for housing, milking, and feeding facilities assume new structures and equipment. Data are presented so that total investment can be estimated for various herd sizes. This is done by expressing total investment for each type of housing in a simple mathematical form. For example, estimated investment for a new

[7] For itemized list of field machinery in each group, see appendix table B-1.

Table 5. Minimum cost solutions for farm situations using alternative complements of field machinery

Labor	One-man farm		Two-man farm			Three-man farm		Four-man farm	
Machine group	I	III	I	II	III	I	III	I	III
Farm system number*	15121	15123	25121	25122	25123	36321	36323	46321	46323
Gross income (dollars)	30,000	30,000	50,000	54,000	60,000	70,000	80,000	94,000	105,000
Percentage from dairy (percent)	60	60	60	60	60	60	60	60	60
Total cost (dollars)	25,367	26,838	40,636	43,497	48,131	56,416	63,075	75,008	80,806
Net returns (dollars)	4,633	3,162	9,364	10,503	11,869	13,584	16,925	18,992	24,194
Unit cost (dollars)†	.8456	.8946	.8127	.8055	.8022	.8059	.7884	.7980	.7696
Milk cows (number)	40	40	67	73	81	94	108	127	141
Total land (acres)	234	234	389	421	467	545	623	734	817
Labor used (hours)	3,746	3,656	6,083	6,179	6,250	8,498	8,598	8,750	11,000
Total investment (dollars)	148,518	163,907	219,092	234,592	263,003	290,293	323,664	379,857	416,934
Land (dollars)	70,092	70,092	116,820	126,165	140,184	163,549	186,013	220,274	245,323
Dairy facilities (dollars)	27,911	26,948	37,362	40,215	43,050	51,856	56,468	63,888	68,892
Dairy herd (dollars)	14,967	14,967	24,945	26,940	29,934	34,923	39,911	46,896	52,884
Machinery (dollars)	35,548	51,900	39,965	41,272	49,835	39,965	41,272	48,799	49,835

* For description of farm systems see appendix, table A-1.
† Cost per dollar of gross income.

stanchion barn (excluding milking and feeding facilities which are estimated separately) is expressed in the following manner:

$$I = \$4{,}534 + \$292.87\ X$$

Where:

I = estimated total investment.

$4,534 = the part of total investment that does not depend on herd size.[8]

$292.87 = additional investment that depends on herd size.[9]

X = number of adult cows in the milking herd.

Therefore, the estimated investment for a new stanchion barn, built for 30 milk cows and replacements, is $4,534 plus $292.87 times 30 milk cows, or $13,164.10 (table A-2).

Table A-1. Synthetic farm systems used to evaluate unit costs, net returns, and total investments of alternative dairy technologies

Codes for synthesized farming systems*				
Housing	Milking	Feeding	Machinery	
15111	25121	25121	15121	36321
11111	25221	25111	15123	36323
17111	25321		25121	46321
18721	25521		25122	46323
			25123	

* Codes for synthesized farming systems refer to the following:

First digit: Full-time labor on the farm
- 1 — Owner-operator
- 2 — Owner-operator plus one full-time hired man
- 3 — Owner-operator plus two full-time hired men
- 4 — Owner-operator plus three full-time hired men

Second digit: Type of housing facilities
- 1 — Cold free-stall barn
- 5 — Loose-housing with bedded loafing area
- 7 — Warm free-stall barn with liquid manure
- 8 — Two-story stanchion barn

Third digit: Type of milking facilities
- 1 — Double-4 herringbone parlor
- 2 — Double-6 herringbone parlor
- 3 — Double-8 herringbone parlor
- 5 — Double-3 side opening parlor
- 7 — Three-unit pipeline for stanchion barn

Fourth digit: Type of feeding
- 1 — Corn silage with summer haylage ration
- 2 — Corn silage with baled alfalfa hay ration

Fifth digit: Field machinery group
- 1 — Group I
- 2 — Group II
- 3 — Group III

Housing Facilities

In the four types of housing considered, adequate space was provided for adult cows and all replacements. One maternity pen was provided for every 20 adult cows. Individual calf stalls were provided for calves up to 2 months old, when they were placed in group pens holding

[8] This is the investment required for both ends of the barn, regardless of the length of the stanchion barn.

[9] This is the additional investment required to build a stanchion barn with enough additional length to house one more cow and her replacements.

Table A-2. Estimated fixed and variable (additional per cow) investments and annual costs in dollars for four alternative housing systems

Housing facility	Stanchion		Loose Housing		Cold free stall		Warm free stall	
	Fixed	Additional per cow	Fixed	Additional per cow	Fixed	Additional per cow	Fixed	Additional per cow
Buildings								
Barn	$1,439	$214.00	$508	$ 98.77	$ 508	$ 75.94	$1,131	$194.18
Loose housing for heifers	0	14.85	....	....	....	....	508	13.69
Calf and maternity barn	....	....	846	15.10	846	15.10	....	....
Milkhouse	1,071	0	....	....	....	....	....	....
Paving and curbing	....	....	0	35.12	....	33.16	0	30.23
Liquid manure tank	....	....	....	....	....	....	144	34.04
Equipment								
Barn cleaner	1,174	8.14	....	....	....	....	....	....
Stalls and pens	0	30.00	0	4.80	0	25.50	0	24.30
Well and waters	850	5.88	1,300	6.40	1,300	6.40	870	4.40
Fences and gates	0	20.00	655	4.20	655	4.20	35	0
Total investment								
75 cows or less	4,534	292.87	3,309	164.39	3,309	160.30	2,688	300.84
More than 75 cows	....	....	7,309	164.39	7,309	160.30	5,430	300.84
Annual cost*								
75 cows or less	794.88	47.42	438.97	22.69	446.89	22.42	365.88	42.01
More than 75 cows	....	....	969.90	22.69	987.45	22.42	739.00	42.01

* Includes depreciation, interest, taxes, insurance, repairs, and maintenance.

about 10 calves. Heifers from 12 months old until they freshen (28 months old) were housed with the dry cows.

Stanchion barn. This type of housing is similar to the conventional two-story stanchion barns in Minnesota. It is equipped with a three-unit pipeline milking machine, bulk tank cooler, and gutter cleaner. A silo unloader is in an upright silo. Baled hay is fed from the mow; silage and grain are fed with a cart.

Loose housing. This arrangement houses the herd in an open loafing shed and on straw or other bedding material. A separate insulated barn is provided for young calves and maternity animals.

Cold free stall barn. This type of housing has about the same investment as loose housing. The higher investment per cow for free stalls is offset by a lower investment per cow for the main pole frame barn; free-stall housing requires less building space per cow than the loose housing arrangement.

Warm free stall housing. This type of housing houses the milking herd in an insulated free stall barn. It also provides space for young calves, maternity pens, and a double-4 herringbone milking parlor. Older heifers are housed in a separate shed.

Roughage is stored in upright silos and fed through mechanical bunks constructed down the center of the warm barn. A silage, corn grain, and protein supplement ration is fed from September to May. During the summer, haylage is put up in silos and fed in mechanical bunks. Grain is fed in the milking parlor year-round.

Labor requirements for each type of housing were broken down into the chore activities listed in table A-3. Labor was divided into "fixed" and "additional per milk cow" components, like investment.

A total labor requirement for both the loose housing loafing barn and cold free stall barn was listed for two feeding programs: baled hay-corn silage and summer haylage-corn silage rations.

Milking Technologies

Five milking parlors and two stanchion barn milking systems were considered. Milking technologies were of three basic designs: herringbone, side opening, and stanchion barn.

Herringbone milking parlor.[10] The main feature of the herringbone parlor is the angle parking of cows. They are brought into the parlor in batches and a milking unit is placed on each cow. While the first batch of cows is being milked, a second batch is brought into the opposite side of the parlor and prepared for milking.

Estimated total investment and annual cost for the building, stalls, and milking equipment for the three herringbone milking parlors are summarized in table A-4. Milking labor is summarized in table A-5.

[10] See Morris M. Lindsey, *The Herringbone Milking System*, U.S. Dept. Prod. Agr. Res. Rept. No. 45, Sept. 1960.

Table A-3. Weekly labor requirements per adult cow and replacements for chore activities (excluding milking) for four housing systems, winter and summer*

Chore	Cold free stall				Warm enclosed free stall (Liquid Manure)			
	Winter		Summer		Winter		Summer	
	Fixed	Additional per cow	Fixed	Additional per cow	Fixed	Additional per cow	Fixed	Additional per cow
	hours				hours			
1. Baled hay feeding	0.8500	.0365	1.0300	.0380	0.0	.00	0.0	.00
2. Silage feeding†	0.0308	.0399	0.0308	.0399	0.0308	.0399	0.0308	.0399
3. Calf care and feeding	1.8400	.0216	—0.9600	.0645	1.8400	.0216	—0.9600	.0645
4. General cleaning	0.3900	.0690	0.9200	.021	0.0	.00	0.0	.00
5. Bedding the herd	0.5882	.0143	0.0212	.0004	0.5882	.0143	0.0212	.0004
6. Care of fresh cows and new calves (general health)	0.2100	.0080	0.2600	.0105	0.21	.0080	0.2600	.0100
7. Grain grinding	1.1800	.0090	0.1600	.0230	0.0	.00	0.1600	.0230
8. Manure handling	0.0	.1466	0.0	.1466	0.0	.0980‡	0.0	.0980‡
9. Artificial breeding	0.0	.0114	—0.09	.0080	0.0	.0114	—0.0900	.0080
10. Cleaning bulk tank§	0.875	.00	0.8750	.00	0.875	.00	0.8750	.00
11. Minor repairs including fences and other misc. work	1.8300	.00	1.5000	.00	1.83	.00	1.5000	.00
12. Grain feeding	.....	....	.....	....	.....	....	.....	....
Total baled hay ration	7.7940	.3563	3.7470	.3519	.....	....	.....	....
Total haylage ration**	5.7640	.3108	2.7170	.3134	5.3740	.1932	1.7970	.2438
Herd divided¶								
Total baled hay ration	8.7000	.3614	4.6527	.3565	.....	....	.....	....
Total haylage ration	6.6697	.3159	3.6227	.3185	.....	....	.....	....

Footnotes to table appear on page 19.

Table A-3 (continued). Weekly labor requirements per adult cow and replacements for chore activities (excluding milking) for four housing systems, winter and summer*

Chore	Stanchion barn				Loose housing (loafing area)			
	Winter		Summer		Winter		Summer	
	Fixed	Additional per cow	Fixed	Additional per cow	Fixed	Additional per cow	Fixed	Additional per cow
	hours				hours			
1. Baled hay feeding	1.4700	.0499	1.4700	.0499	0.8500	.0365	1.0300	.038
2. Silage feeding†	0.9237	.0852	0.9237	.0852	0.0308	.0399	0.0308	.0399
3. Calf care and feeding	0.0	.2872	0.0	.2584	1.8400	.0216	—0.96	.0645
4. General cleaning	0.0	.00	0.0	.00	0.3900	.0690	0.92	.021
5. Bedding the herd	1.0800	.0422	—0.19	.0085	2.0590	.0501	0.1481	.0027
6. Care of fresh cows and new calves (general health)	0.2600	.0105	0.2600	.0105	0.2600	.0105	0.2100	.0083
7. Grain grinding	0.0	.0414	0.0	.0414	1.1800	.0090	0.1600	.0230
8. Manure handling	2.2600	.0674	2.2600	.0674	0.0	.00‡‡	0.0	.00‡‡
9. Artificial breeding	0.0	.0114	—0.0900	.0084	0.0	.0114	—0.09	.0084
10. Cleaning bulk tank§	1.8100	.0000	1.8100	.0000	0.875	.0000	0.8750	.00
11. Minor repairs including fences and other misc. work	2.6900	.0610	3.5000	.0130	1.8300	.00	1.5	.00
12. Grain feeding	0.9900	.0498	0.9900	.0498	.....	....	.....	....
Total baled hay ration	11.4837	.7060	10.9337	.5925	9.3148	.2480	3.8239	.2058
Total haylage ration**	.....	....	.....	.....	7.2848	.2025	2.7939	.1678
Herd divided¶								
Total baled hay ration	.....	....	.....	.....	10.2205	.2531	4.7296	.2109
Total haylage ration	.....	....	.....	.....	8.1905	.2076	3.6996	.1729

Footnotes to table appear on page 19.

Footnotes to Table A-3

* Unless specifically footnoted, labor requirements were obtained from the following source: Earl I. Fuller and Harald R. Jensen, "Alternative Dairy Chore Systems in Loose Housing," Univ. of Minn. Agr. Exp. Sta. Bull. 457, Feb. 1962, pp. 34-40.

† Ralph G. Kline and William F. Hall, "An Economic Analysis of Silage Storing and Feeding," Va. Agr. Exp. Sta. Bull. 511, Mar. 1960, p. 37.

‡ See Gunnor Oygard, "A Review of Recent Studies of Liquid Manure Handling and the Use of Slatted Floors," "Dairy Systems in Northwestern Europe," 1960-65, pp. 3-4, and "Farm Journals Ltd.," Autumn 1965, The National Trade Press Ltd., Fleet St., London, pp. 27-28.

§ C. F. Bortfeld, P. L. Kelly, and V. E. Davis, Jr., "Cost of Operating Bulk Milk Tanks," Kans. State Coll. Agr. Exp. Sta. Bull. 383, Nov. 1956, p. 9.

**For systems considered with both baled hay and haylage ration the following changes in labor requirements are made:

(1) Zero fixed and variable labor for "feeding baled hay" chore using haylage ration.

(2) Zero fixed and variable labor for "grain grinding" chore for winter season using haylage ration.

All other chore labor requirements are the same for both baled hay and haylage rations.

¶ Changes in the labor requirement for divided herd compared to single herd are:

(1) Add 0.0308 hour per week to fixed labor and 0.0051 hours per week to variable labor for "silage feeding."

(2) Add 0.875 hour per week to fixed labor for "cleaning the bulk tank."

‡‡Add 2.31 hours per cow in labor period 2.

Table A-4. Investments and annual cost for alternative milking parlors

Item	Double-4 herring-bone	Double-6 herring-bone	Double-8 herring-bone	Single-3 side opening	Double-3 side opening
Building*	$3,294	$4,229	$4,696	$2,890	$4,310
Milking stalls†	1,157	1,690	2,224	880	1,759
Milking equipment†					
Rec. vessel panel assembly	700	700	700	700	700
Vacuum pump	325	672	672	219	672
Milk pipeline glass	186	240	300	227	227
Vacuum pipeline	48	72	95	36	72
Milking units‡	330	495	660	248	495
Hot water heater	127	127	127	127	127
Space heater	250	300	300	250	300
Cleaning kit	10	10	10	10	10
Concentrate feeding system†	737	793	849	582	729
Bulk tank cooler§	3,240	3,240	3,240	3,240	3,240
Total investment	10,404	12,568	13,873	9,409	12,641
Annual cost	1,724	2,087	2,303	1,566	2,100

* Ray Hoglund, J. S. Boyd, and W. W. Snyder, "Herringbone and Other Milking Systems — Operations and Investment." Quarter Bull., Mich. Agri. Exp. Sta., Vol. 41, No. 3, Feb. 1959. Cost based on 777, 995, 1105, 680, 1014 square feet at $4.25 per sq. ft. for double-4 herringbone, double-6 herringbone, double-8 herringbone, single-3 side opening and double-3 side opening parlors, respectively. Cost includes the milk room.

† Cost data obtained from dealers.

‡ Based on 4, 6, 8, 3 and 6 milking units for the double-4 herringbone, double-6 herringbone, double-8 herringbone, single-3 side opening and double-3 side opening respectively.

§ This investment in bulk tank is for a 46 cow herd. For larger herds, the investment is higher ($3,815 for a 65 cow herd).

Table A-5. Labor requirements for alternative milking technologies

Milking system	Men milking	Total milking labor (hours per week) Fixed	Additional per cow
Stanchion:*			
2-bucket	1	6.2	0.82
3-unit pipeline	1	11.7	0.44
Herringbone:†			
Double-4	1	6.43	0.4512
Double-6	2	8.07	0.6390
Double-8	2	9.90	0.4165
Side opening:‡			
3-in-line	1	5.57	0.5716
Double-3	2	5.57	0.6289

* Includes time to (1) prepare to milk, (2) milk, (3) cleanup, and (4) feed grain. Source: E. I. Fuller, and L. D. Rhoades, "Management Memos — Dairy Series," Vol. 1, No. 1A, Department of Agri. Econ., Univ. of Mass., Amherst, Mass.

† M. M. Lindsey, "The Herringbone System," Prod. Res. Rept. No. 45, ARS, USDA, Sept. 1960.

‡ Includes time for preparation, milking, and cleanup. Source: R. L. Chambliss, Jr., "Labor and Capital Requirements in Herringbone and other Elevated-stall Milking Parlors," Va. Agr. Exp. Sta. Bull. 539, VPI, Blacksburg, Va. July 1962.

Side opening parlor. The main feature of the side opening parlor is that each cow can be milked individually since cows enter and exit independently. This system allows the operator to give special attention to individual cows.

Estimated investment and annual cost for the building, stalls, and milking equipment are summarized in table A-4. Labor estimates are presented in table A-5.

Milking in the stanchion barn. The two milking arrangements considered for the stanchion barn were the (1) two-unit carry system and (2) three-unit pipeline system.

Estimated investments and annual costs of both stanchion barn arrangements are listed in table A-6. Labor requirements are presented in table A-5.

Feeding Technologies

To mechanize feeding in confinement housing, a ration was selected so that all the roughage requirements could be fed through mechanical bunk feeders. Therefore, a summer haylage-corn silage ration was assumed. Herds in loose housing loafing barns or cold free stalls can be fed baled hay in bunks adjacent to an outside storage area. For these systems, a baled hay-corn silage ration was also examined.

Table A-7 lists the estimated investment and annual cost of facilities required for both feeding programs.[11]

[11] Rations for both feeding programs are described in appendix D.

Table A-6. Investment and annual cost for two stanchion barn milking technologies*

Item	Two-unit carry		Three-unit pipeline	
	Fixed	Variable	Fixed	Variable
Receiving vessel panel assembly	...	....	$ 700	0
Vacuum pump	$ 186	0	219	0
Two milking units (pail type)	383	0	...	....
Three milking units (for pipeline)	...	....	248	0
Vacuum line	25	$ 7.59	25	$ 7.59
Milk pipeline (glass)	...	....	207	12.36
Hot water heater	126	0	126	0
Space heater	250	0	250	0
Cleaning kit and wash vat	100	0	100	0
Bulk tank	1,843	30.35	1,843	30.35
Total investment	$2,913	$37.94	$3,718	$50.30
Annual cost†	$ 442.91	$ 5.04	$ 580.64	$ 7.15

* Cost data obtained from equipment dealers.
† Based on a percent of total investment (table E-1 in appendix E).

Table A-7. Investment and annual cost for two alternative feeding programs*

Technology and item	Investment	
	Fixed	Additional per cow
1. Feeding technology for baled hay feeding ration:		
Silo	$ 964	$71.23
Silo unloader	1,557	0
Mechanical bunks	336	17.45
Baled hay storage	0	44.07
Corn crib for ear corn	126	33.78
Total investment	$2,983	$166.53
Annual cost	$ 527.75	$33.52
2. Feeding technology for summer haylage feeding ration:		
Silo	$ 964	$129.11
Silo unloader	1,557	0
Mechanical bunk	336	17.45
Corn crib for ear corn	126	5.97
Total investment	$2,983	$152.53
Annual cost	$ 527.75	$20.73

* Investments estimated from dealer prices.

Labor and Management

One full-time man was assumed to be the owner-operator of the farm, and two-, three-, and four-man farms have one, two, and three full-time hired men, respectively.

The owner-operator could contribute a net of 2,500 hours per year for crop and livestock activities.

A hired man could add 2,500 hours to the labor supply, but this requires 500 hours of additional management and supervisory time by the operator. Therefore, the net addition of each full-time hired man was 2,000 hours.

Seasonal hired labor. Seasonal labor could be hired during any part of the year. Supervision and management of seasonal labor also required 0.2 hours of the operator's time for each hour of seasonal labor hired. Total seasonal labor could not exceed 1,250 hours in any year.

Appendix B

Field Machinery

With the exception of a combine for oats and soybean harvest, a full complement of machinery was assumed for each farm system.[12]

Three machine groups representing different tractor and equipment size were considered. Table B-1 lists, by size, the tractors and equipment assumed for each machine group, along with the total investment and annual cost. The estimated life of new tractors was 15 years or 12,000 hours, whichever came first.

Variable equipment costs (including fuel, oil, filters, repairs, maintenance, and lubrication) were charged directly to the farm enterprise using the equipment. Fixed costs (including depreciation, interest, taxes, and insurance) were subtracted from gross returns.

[12] Costs for harvesting oats and soybeans were figured on a custom basis.

Table B-1. Three field machinery complements — machinery groups I, II, and III

	Machinery group		
	I	II	III
Tractors	.....	.....	5-b (new)
	.....	4-b (new)	4-b (new)
	3-b (new)	3-b (new)	3-b (new)
	2-b (new)	2-b (new)	2-b (new)
	2-b (new)	2-b (used)	2-b (new)
Equipment			
Plow	3-14″ bottoms	4-14″ bottoms	5-14″ bottoms
Disk	9′10″	12′2″	14′6″
Harrow	18′	24′	30′
Corn planter	2-row	2-row	4-row
Cultivator	2-row	2-row	4-row
Spray attachment for corn planter	2-row	2-row	4-row
Grain drill	10′	12′	14′
Mower	7′	7′	7′
Rake	7′	7′	7′
Conditioner	7′	7′	7′
Baler	PTO	PTO	PTO
Elevator	32′	44′	52′
Forage harvester	1-row	2-row	2-row
Forage blower	50′	50′	50′
Sprayer	16′	24′	32′
Wagons (2)	140 bu. cap.	(3) 140 bu.	(3) 140 bu.
Wagon boxes (with hoist)	(2)	(3)	(3)
Fertilizer distributor	8′	10′	12′
Cornpicker	2-row	mounted 2-row	mounted 2-row
Scraper blade	6′	6′	6′
Manure loader	42″ bucket	42″ bucket	42″ bucket
Manure spreader	140 bu.	140 bu.	140 bu.
Feed grinder and mixer	PTO	PTO	PTO
Pickup truck	½ T	½ T	½ T
Truck and stock rack	1½ T	1½ T	1½ T
Liquid manure pump	8′	8′	8′
Liquid manure wagon	1,400 gal.	1,400 gal.	1,400 gal.
Total investment	$35,500	$43,400	$51,900
Annual cost*	$ 4,220	$ 5,030	$ 5,961

* Includes depreciation, interest, taxes, and insurance.

Appendix C

Crop and Livestock Budgets

Crop Budgets

Cropping alternatives on synthetic farm systems include corn silage, corn grain, oats, alfalfa, haylage, and soybeans. Corn silage, oats, haylage, and alfalfa were only used for the livestock enterprise and could not be sold from the farm.

All land was capable of raising any of the crop alternatives with limited rotation restrictions.

Table C-1 presents the total variable cost per acre as well as the labor requirements for crop alternatives for three machinery groups. Gross income was only calculated for crops that could be sold from the farm, but yields are listed for all crops. The assumed seeding, fertilizer, and chemical rates are suggested practices in southeastern Minnesota.[13]

Livestock Budgets

Along with dairy, hogs were included as a livestock alternative in the synthetic farm systems. This section outlines budgets for these enterprises.

Dairy. Budgets were the same for all farm systems except for (1) the annual cost of housing, feeding, and milking facilities and (2) labor requirements. Items in the budget common to all farm situations are listed in table C-2. To obtain total fixed and additional cost per adult milk cow for a particular farm situation, the costs of the assumed housing, milking, and feeding facilities must be added to the items listed in table C-2 on lines 3, 4, and 5, respectively. Labor requirements also depend on the housing and milking facilities assumed on dairy farms and vary between farm situations.

Hogs. The budget assumed a central farrow, confinement finish system.[14] Two litters were farrowed each year during the first and third quarters. The hog activity involved two complete production cycles including the feeding out of the litter to market weight, disposal of cull sow, and care of the replacement gilt. From each eight-pig litter, one was retained for replacement and seven marketed when 6 months old (225 pounds). Three months after farrowing, the 400-pound sow was sold.

[13] "1964 Crop Production Guide for Minnesota," Minn. Ext. Serv. Pam. 194.

[14] See Don C. Taylor, *Income Improving Adjustments and Normative Supply Responses for Hogs and Beef in Southwestern Minnesota*, unpublished Ph.D. thesis, Department of Agricultural Economics, University of Minnesota, August 1965, p. 24.

Table C-1. Total variable cost, hours of labor, yields, and gross income per acre from alternative crop enterprises*

Item	Machinery group							
	Group I		Group II		Group III			
	Total variable cost	Labor	Total variable cost	Labor	Total variable cost	Labor	Yield	Gross income
	Dollars	Hours	Dollars	Hours	Dollars	Hours		Dollars
Corn for silage	22.61	9.306	21.95	7.389	21.77	6.548	16 ton	....
Corn for grain	20.58	4.302	20.40	3.636	19.64	2.800	90 bu.	90.90
Haylage	20.36	5.791	20.36	5.661	20.36	5.602	7.65 ton	....
Alfalfa hay (baled)	19.12	7.249	18.89	7.119	18.89	7.060	3.65 ton	....
Soybeans†	23.49	2.374	23.46	2.020	23.44	1.676	34 bu.	74.46
Oats (bale straw)‡	23.63	3.044	23.55	2.735	23.55	2.531	69.1 bu.	....

* Includes costs for seed, fertilizer, weed control, lime, crop insurance and fuel oil, lubrication, and repairs for machinery. A 6-percent charge is made for out-of-pocket costs tied up for more than 1 month. The formula used is: $W = 0.06\ tu$.

Where: W = working capital charge
t = percent of year capital tied up
u = amount of out-of-pocket cost

† Includes charge for custom harvest.

‡ Includes charge for custom harvest. In addition to 35.5 bushels of oats, 0.625 tons of straw were obtained per acre of oats. Includes machine cost for preparing, baling, and handling straw.

Table C-2. Estimated gross income and production requirements per adult cow in the herd for dairy enterprise[a]

Item	Fixed	Amount	Price	Value
1. Gross income				
Milk receipts		120 (cwt)	$3.20	$384.00
Sale of calves[b]				22.88
Sale of cull cows[c]				39.48
Total				$446.36
2. Variable costs				
Breeding fees[d]	0			5.00
Veterinary and medicine[e]	0			10.71
Dairy herd improvement assn.	$38.76			2.64
Interest on cattle[f]	0			18.53
Taxes on cattle[g]	0			5.06
Hauling and marketing[h]	0			19.14
Minerals and salt[i]	0			2.72
Sub-total	$38.76			$63.80
3. Housing facilities[j]	——			——
4. Milking facilities[j]	——			——
5. Feeding facilities[j]	——			——
Total	——			——

[a] Budget only includes items that are the same for all synthetic farms. Annual cost per cow for housing, milking and feeding facilities, and labor requirements depends on the type of synthetic farm situation.
[b] Assumes 0.45 2-week old bull calf at $17.50; 0.12 heifer 1 month old at $35; and 0.02 heifer 12 months old at $135 are sold for each adult cow in the herd.
[c] Assumes a 5 percent death loss for calves and a 25 percent replacement rate for adult cows. Each cull cow was valued at $168.
[d] Basic rate for southeastern Minnesota. Source: Edmund Graham, Dept. of Animal Science, Univ. of Minn.
[e] Source: C. D. Kearl, "Farm Cost Accounts," A. E. Res. 100, Cornell Univ., N.Y., Nov. 1962, p. 10.
[f] Assumes 5 percent interest on value of one adult cow and her replacements ($370.50).
[g] Assumes a 2.45 mill rate on assessed value where true and full value equals 30 percent of market value and assessed value equals 20 percent of true and full value. Source: Edmond W. Gahr, Minn. Dept. of Taxation, St. Paul, Minn.
[h] Estimates from information obtained from Twin City Milk Producers Association, St. Paul, Minn.
[i] Assumes 34 pounds of trace mineralized salt at $0.05 for each adult cow in the herd. Source: John Donker, Dept. of Animal Science, Univ. of Minn.
[j] Cost is not the same for all synthetic farms since costs of housing, milking, and feeding facilities vary on hypothetical farms. This cost is added in the budget when considering a specific farm situation.

Appendix D

Dairy Rations

Table D-1 summarizes the total annual feed requirement assumed in the baled hay-corn silage and summer haylage-corn silage rations. Figures represent total feed for the milk cow and her replacements.

Table D-1. Total feed per adult cow per year including her replacements for two feeding rations*

	Total feed per cow and replacements (pounds)	
Feed	Baled hay-corn silage	Summer haylage-corn silage
Milk replacer	72	72
Calf starter	172	172
Concentrate (corn grain)	2,989	529
Supplement	0	1,169
Corn silage	22,394	40,586
Haylage	0	5,335
Baled hay (alfalfa)	7,262	273

* Includes 14, 6, and 7 percent extra silage, baled hay, and haylage, respectively, for loss and waste.

Appendix E – Annual Cost as Percentage of Initial Investment

Table E-1. Annual cost as percentage of initial investment for selected dairy facilities

	Repairs and maintenance	Interest*	Depreciation†	Taxes‡	Insurance§	Total
Fencing and gates	2.50%	2.50%	6.67%	2.00%	1.36%	15.03%
Building	1.50	2.50	6.67	2.00	1.36	14.03
Mechanical bunks	3.00	2.75	9.00	2.00	1.36	18.11
Milking equipment	5.00	2.75	6.00	2.00	1.36	17.11
Pipe stalls	0.50	2.50	6.67	2.00	1.36	13.03
Stalls and equipment	1.00	2.50	6.67	2.00	1.36	13.53
Silos	1.20	2.50	6.67	1.82	0.74	12.93
Silo unloaders	5.00	2.50	9.00	2.00	1.36	19.86
Building (milking parlor)	5.00	2.50	6.67	2.00	1.36	17.53
Waterers	3.00	2.50	6.67	2.00	1.36	15.53
Well	1.50	2.50	6.67	2.00	...	12.67

* Calculated on average value of assets.

† 6.67 assumes 15-year depreciation with no salvage value.
6.00 assumes 15-year depreciation with 10 percent salvage value.
9.00 assumes 10-year depreciation with no salvage value.

‡ Estimated from information from the Minn. Dept. of Taxation.

§ Rate based on information from Fire Underwriters, St. Paul, Minn.