REDUCTION OF DAIRY HERD REPLACEMENT COSTS

Thesis for the Degree of M. S.

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Eugene Harshman Carter

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This is to certify that the

thesis entitled

"Reduction of Dairy Herd Replacement Costs"

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EUGENE HARSHMAN CARTER

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Karl T. Wright
Major professor

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REDUCTION OF DAIRY HERD REPLACEMENT COSTS

By

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A THESIS

Submitted to the School of Graduate Studies of
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INTRODUCTION

Problem Statement: One of the important items in the cost of milk production is replacing the dairy herd. In 1947, Michigan dairymen in the Detroit area, as an average, had 3.6 heifers to freshen and purchased 1.5 cows for herds averaging 16.5 cows. These same dairymen lost money producing heifers for replacements. Although some have produced their own replacements at a small profit, most of them produced heifers at some loss. While many Michigan dairy farmers have purchased only a part of their replacement needs, some few have purchased all their replacements.

Need for the Study: The dairy enterprise is the most important single farm enterprise in Michigan. It is the major enterprise on most Michigan farms. Thus this dairy herd replacement problem is one of not few but many farmers in Michigan. Farmers and agricultural specialists have a great need for information relating to the reduction of dairy herd replacement costs.

Objectives of the Study: The purpose of this study was to learn how dairy herd replacement costs can be reduced. Specific objectives were the following:

(1) To determine the cost of producing a heifer,

(2) To study some factors related to youngstock costs and returns,

(3) To determine the cost of keeping a bull,

(4) To study some factors related to bull costs and credits,

(5) To compare the differences in costs of different methods of breeding.

PROCEDURE

Review of Literature: Letters were mailed to departments of agricultural economics in other states to obtain literature on the subject of dairy herd replacement costs. It was felt that much could be learned by reviewing the findings and the procedures used in other studies.

Replies from the letters were somewhat disappointing. Most of the information received from other states were letters containing opinions on the subject. No studies had been made recently on this subject.

Some ideas were obtained on procedure from the review of literature. However, in most cases, the findings were for different situations than exist in southeastern Michigan. As an example, farmers producing cream in other areas had skim milk available to feed to calves, whereas farmers in a fluid milk market, as a rule, had no skim milk available for calves. Resources that could be used in heifer production, in some cases, had a greater alternative use in a fluid milk market area than in a cream or manufactured milk area.

Although not too many ideas were obtained by reviewing literature from other states, it was felt that it was a worthwhile and a necessary step in the procedure of this study.

Methods Used in Research: There were a number of research methods used in this study. Enterprise cost accounts for the entire dairy herd (cows, youngstock, and bull) for the year of 1947 were used quite extensively. There were 85 cost records in total.

In addition to cost records a rather detailed questionnaire on management practices was prepared. Thirty-six of the 85 dairymen who had kept the cost accounts were interviewed in an effort to relate management practices to youngstock costs. Only 36 cooperators were interviewed because of limited time available for farm visits. It was believed that this number was sufficient to obtain the management data desired.

Information resulting from the interviews related to methods of heifer management and production. It involved a comparatively large amount of information from relatively few cases. This method was similar to the case study method. In some phases of the data, practices were so varied that statistical treatment was difficult.

The Sample: The 85 dairy cost cooperators were enrolled in the Detroit milk shed area from Michigan Milk Producers' Association membership on a voluntary basis. This sample represented approximately 10,000 members in the association. All the cooperators marketed their milk in Detroit. Most of the milk was transported to Detroit after being assembled at local country stations.

An attempt was made to get a representative sample from the standpoint of the cow herd. The herds were classified according to production per cow into high, medium, or low producing herds. Records from the Michigan Milk Producers' Association offices at Detroit were very helpful in regard to pounds of milk shipped and butterfat test. Herds averaging under 250 pounds fat per cow per year were considered to be low. Herds averaging 250 to 300 pounds were considered to be medium, and herds averaging over 300 pounds fat were considered to be high.

After the herds were classified according to fat production per cow, each group was then further classified into three sub-groups on the

basis of size of cow herd. The sub-classes small, medium, and large were used. A small herd was one averaging less than 10 cows. A medium size herd was one averaging 10 to 20 cows. A large herd was one averaging more than 20 cows.

The 85 cooperating dairymen for 1947 had herds averaging 16.5 cows in size. These herds averaged 301 pounds of fat per cow per herd.* The sample was biased somewhat by the factor of enrolling cooperators who were willing to keep the necessary accounts. This sample averaged about 10 percent higher on production per cow than did the entire membership of the Michigan Milk Producers' Association marketing milk in Detroit.

These cooperators kept enterprise cost records not only on the cows but also on the youngstock and bull or other breeding costs. Thus the sample regarding youngstock and breeding costs for this study was determined by production and size of cow herd. This is a study of replacement costs on herds selected to be representative from the standpoint of production and size.

The dairy cost cooperators for 1947 kept an average of 5.2 calves under one year of age, and an average of 6.1 heifers over one year of age or a total of 11.3 head of youngstock for these 16.5 cow herds. There were an average of 3.6 heifers freshened per farm during the year.*

Forty of the 85 cooperators kept one bull the entire year, 18 kept a bull for less than one year, and 12 kept more than one bull for the year. Thirteen practiced artificial breeding exclusively, and 15 used both bull and artificial breeding. One farmer bred by bull hire and artificial breeding, and one bred by bull hire only.

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* Vincent, W. H., DAIRY COSTS AND RETURNS IN DETROIT MILK SHED. Mich. Agr. Exp. Sta. Mimeo. F. M. 434.

There were two factors involved in selecting the sample for interviews. These were: (1) costs, and (2) quality of heifer produced. Inasmuch as the author was trying to relate methods of management to costs, it was deemed desirable to select some high-cost producers as well as some low-cost producers for interview. Since feed costs were the single largest item of expense, comprising over 54 percent of total costs, and since information on the questionnaire related in large part to feeding practices, the cost records were arranged on the basis of feed cost per head of youngstock.

As already indicated, these farmers were producing replacements of varying quality. Two producers could have similar feed costs, but one might be producing a heifer to go into a 350 pound butterfat producing herd, whereas the other might be producing a heifer to go into a 250 pound fat herd. To cope with this situation the following formula was devised to rank the producers, considering both cost and quality of animal produced:

$$\frac{\text{Average feed cost per head youngstock per year}}{\text{Average butterfat production per cow}} \times 100$$

To illustrate, if a cooperator had feed costs per head of youngstock in 1947 averaging $140.10, and his butterfat average for the cow herd was 311.2, his rank with the other cooperators would be 45.0:

$$\frac{\$140.10}{311.2} \times 100 = 45.0$$

The cost records were then rearranged on this basis.

The table on page 7 shows a rank correlation of feed costs per head of youngstock with feed costs weighted by the quality of animal produced. The results show a closeness of relationship.

Table 1-RANK CORRELATION OF FEED COSTS PER HEAD YOUNGSTOCK WITH FEED COSTS WEIGHTED BY QUALITY OF ANIMAL PRODUCED, 1947

Cooperator number	Feed costs per head		Feed costs ÷ butterfat herd av.		Deviations in rank	
	Cost	Rank	Cost / B.F. prod. x100	Rank	D	D^2
1	$336.30	85	119.5	85	0	0
2	228.99	84	84.6	84	0	0
3	214.71	83	63.8	83	0	0
4	140.36	82	39.3	80	2	4
5	140.10	81	45.0	82	1	1
6	139.22	80	36.8	79	1	1
7	127.32	79	34.6	77	2	4
8	123.47	78	44.1	81	3	9
9	108.01	76	35.5	78	2	4
10	106.39	74	28.7	69	5	25
11	98.01	73	30.6	73	0	0
12	95.70	72	28.3	67	5	25
13	91.30	71	25.9	63	8	64
14	83.28	70	30.5	72	2	4
15	79.31	69	26.6	65	4	16
16	77.40	67	28.4	68	1	1
17	75.98	66	31.0	74	8	64
18	72.62	62	27.7	66	4	16
19	56.37	40	13.9	22	18	324
20	48.99	31	13.4	20	11	121
21	45.99	27	14.3	23	4	16
22	45.38	25	13.0	14	11	121
23	45.25	24	13.3	17	7	49
24	40.56	18	12.1	11	7	49
25	38.45	17	13.4	19	2	4
26	38.41	16	12.4	12	4	16
27	35.59	14	13.7	21	7	49
28	35.37	13	13.1	15	2	4
29	35.16	12	9.1	5	7	49
30	34.80	11	12.1	10	1	1
31	31.92	10	12.5	13	3	9
32	30.13	9	9.2	7	2	4
33	28.66	7	9.8	8	1	1
34	23.98	4	6.9	2	2	4
35	19.19	2	7.4	3	1	1
36	12.58	1	4.6	1	0	0
						Σ 1060

$$R = 1.00 - \frac{6\Sigma D^2}{N(N^2 - 1)} = 1.00 - \frac{6 \times 1,060}{36(1296-1)}$$

$$= 1.00 - \frac{6,360}{46,620} = 1.00 - .136$$

$$R = .86$$

There was still the possibility of another problem in determining who were high or low cost producers. This possibility was the matter of how fast the producer was growing his heifers. The cost information available was for the period of one year. Whether a farmer was producing heifers to freshen at 30 months or at 26 months, for example, might affect replacement costs on a per head basis. No information was available from the cost records in regard to age of freshening. This was learned from the interviews. The relation of age of freshening to costs is discussed under MANAGEMENT PRACTICES.

The sample for interviews was affected somewhat by which farmers were willing to cooperate. A total of 46 letters were mailed to obtain cooperation on the interview. Twenty-three letters were sent to high cost producers, and 23 were sent to low cost producers. Eighteen high cost and 18 low cost producers were interviewed.

Methods of Analyzing Data: Some of the data presented were descriptive in nature. Much use was made of averages and ranges. However, most of the analyses pertained to relationships existing between costs and various factors on both youngstock and breeding costs.

Most of the analyzing of relationships was done by tabular analysis. It was felt that the number of records was too great to handle efficiently by correlation analysis. By using the tabular analysis method, no assumption was made as to whether linear or curvilinear relationships existed.

As already discussed, one rank correlation was used in analyzing the sample selected for interview.

In analyzing both youngstock and bull costs, the first step was to sort the records by costs per head. A great number of cost and income

items and such physical requirements as feed and labor were then compared for the different cost groups. By observing which cost items made up a comparatively large proportion of the total and by observing which cost items showed the greatest variations, it was determined which factors to sort by in studying the relationship of factors to costs.

Some of the information from the questionnaire was tabulated and averages shown. Some of the information was used to relate practices with costs.

EXPLANATION OF COST AND INCOME ITEMS USED IN YOUNGSTOCK AND BULL COST RECORDS

Youngstock Cost and Income Items

Feed: Purchased feed was entered by the cooperators at actual cost. Feed produced on the farm was charged at farm price. Milk fed to the youngstock was entered at farm price. Feed included concentrates (grains and protein supplements), hay, silage, pasture, and miscellaneous roughages such as beet tops and corn fodder.

Labor: Hired labor was entered at actual cost including board, lodging, and other furnishings. The operator entered what he considered to be a fair charge for both his own and his family's labor.

Calf Value at Five Days: In these enterprise cost accounts, calf value at five days' age (determined by the cooperator) was transferred from the cow account to the youngstock account. The value of the calf was entered as a credit to the cows and as a debit to the youngstock.

Interest: Interest was charged on average youngstock (or bull) investment at five percent. The investment was determined by averaging the beginning and ending inventories.

Building Use: Building use charge included depreciation costs, interest on the building investment at five percent, a charge made for taxes and insurance, and minor repairs. In the case of two-story barns, 70 percent of total building cost was charged for the ground floor. Then the proportion of the ground floor used to shelter youngstock was charged against the youngstock account. Building use for the bull was handled in like manner.

Bull Cost or Fees: Net bull costs (total costs minus credits) were allocated equally to the average number of cows and youngstock

over one year of age. Artificial breeding fees and bull fees paid were charged against the youngstock as these expenses were incurred.

Bedding: Home produced bedding was charged at farm price. Purchased bedding was charged at actual cost.

Other: Other cost items covered such miscellaneous items as halters for youngstock or rings for bulls.

Overhead: Overhead cost was an estimated charge of general farm business expenses that could not be charged directly to the dairy enterprise. Automobile and telephone expenses are examples of this type of charge. It was arrived at by taking five percent of the total of all the other expenses.

Net Increase: Net increase on youngstock is the excess of total credits over total debits for the year. Credit entries included sales, the value of bulls and heifers transferred to the bull or cow account, and ending inventory values. Debit entries included purchases and beginning inventory values. Calves at five days' age were charged in as a separate cost item.

Manure Credit: Manure credit was allocated to cows, youngstock, and bull as an income item since bedding was charged as a cost.

Net Return per Head Youngstock: Youngstock net return was determined by deducting total costs from total credits or income. Net return plus labor charge divided by the hours of labor gave the return per hour for all labor.

Other Bull Cost and Credit Items

Bull Depreciation: Bull depreciation represents the loss that occurs when a bull is sold during the year or when it is inventoried

at the end of the year for less than its beginning inventory value. It would also represent loss due to death. However, as an average for all herds with bulls, there was appreciation in value rather than depreciation in value.

Fees Received: Fees received were income paid to farmers for the use of their bulls.

Bull Appreciation: Appreciation in bull value represents the increase in value of the bull over the beginning inventory value. This might result either from selling the bull at a higher value or entering him on the ending inventory at a higher value. It was not uncommon for farmers to have comparatively young bulls which, at the beginning of the year, had not reached their full growth. During the year these farmers had the service of the bull while the bull was growing into more money. The bull put on weight, and prices remained at high levels.

Net Cost of Bull: Net bull cost was determined by deducting total credits from total costs. Net bull cost was then allocated equally to cows (average number for year) and heifers over one year (average number for year) in calculating the net bull cost per cow and heifer.

SUMMARY OF DAIRY COSTS AND RETURNS, 1947*

To more clearly understand the position of replacement costs in producing milk, a brief summary of enterprise costs for the cow herd, youngstock herd, and the entire dairy herd is given.

Total costs per cow in 1947 averaged $360.70 on 85 herds averaging 16.5 cows. These 85 herds averaged 7,942 pounds milk per cow, 301 pounds fat per cow, 120 hours labor per cow, and a butterfat test of 3.78 percent. Total income per cow averaged $359.25, about $342 of which was for milk sold and used. The remaining income was for calf and manure credits.

With home produced feed charged at farm price and with operator and family labor charged at what the operator considered fair, net return per cow averaged -$1.44. The return on cows per hour for all labor averaged 94 cents. Total return to labor from the cow-herd, as an average, was about $1871.

These same 85 herds averaged 11.3 total head of youngstock. Total costs per head for 1947 averaged $114.67, and total returns averaged $98.23, leaving a net return per head of -$15.91. These figures are for the total youngstock herd. Some of the calves were less than a year old, some were heifers over a year, and others were heifers between two years and freshening. There was no return to labor from the youngstock herd.

Bull costs on 68 farms averaged $196.52 in 1947. This was net cost after allowing credit for manure, fees received, and appreciation

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* This discussion is based upon information in DAIRY COSTS AND RETURNS IN DETROIT MILK SHED by W. H. Vincent. Mich. Agr. Exp. Sta. Mimeo. F. M. 434.

in value. Bull costs were charged against both cows and heifers over a year. Therefore, breeding costs, whether by bull, artificial insemination, or bull fees paid, are included in the cow and youngstock accounts.

The production of heifers for replacements did not pay the farmer any return for his labor expended in 1947. When a heifer was transferred from the youngstock account to the cow account at time of freshening, a value was placed upon her by the cooperator. This value was charged against cows, but credited to the youngstock account. The same procedure was used in cases where bulls were produced on the farm. When the bull became of serviceable age, his value at that time was charged against the bull account, but credited to youngstock.

Considering the cows, bull, and youngstock as a dairy unit, total herd returns for these 85 farms averaged $1872. This allows for the net loss from the youngstock account and a small amount of bull income from three herds due to credits (mainly appreciation in bull value) over-balancing costs. Total herd returns to labor for these 85 herds is within one dollar of returns from the cows alone.

THE COST OF PRODUCING A HEIFER

Average Youngstock Cost and Income, 1947: Enterprise cost records were kept on the entire youngstock herd as a whole. Costs and returns for the heifers were not separated from the rest of the youngstock. In addition to the production of heifers, some of these 85 cooperators were producing and selling calves as breeding stock to other farmers, and some few occasionally sold veal. Table 2 shows average youngstock cost and income in 1947:

Table 2 - YOUNGSTOCK COST AND INCOME, 1947*

Item	Average
Calves under one year on farm	5.2
Heifers over one year on farm	6.1
Total number of youngstock	11.3
Average number of cows	16.5
Average number of heifers freshened	3.6
Price placed on heifers at freshening	$181
Hours labor per head youngstock in year	16
COSTS PER HEAD OF YOUNGSTOCK IN YEAR	
Feed	$ 62.03
Labor	15.77
Calf value at 5 days	11.29
Interest on youngstock	4.72
Building use	6.57
Bull cost or fees	4.03
Bedding	3.77
Other	.57
Overhead	5.44
Total	$114.19
INCOME PER HEAD OF YOUNGSTOCK IN YEAR	
Net increase	$ 96.67
Manure	1.61
Total	$ 98.28
Net return per head of youngstock	-$ 15.91
Return per hour all labor	-$ .01

* Vincent, W. H., DAIRY COSTS AND RETURNS IN DETROIT MILK SHED. Mich. Agr. Exp. Sta. Mimeo. F. M. 434.

These 85 herds, which averaged 16.5 cows, had 5.2 head of calves under one year of age and 6.1 head of heifers over one year of age, or a total of 11.3 head. An average of 3.6 heifers freshened per farm at an average value of $181. This value was placed on the heifers by the cooperating farmers. Sixteen hours labor per head per year were required in the care of the youngstock.

Total costs per head amounted to $114 as an average but ranged from $31 to $459 on individual herds. Feed, the single largest item of expense, comprised over 54 percent of all costs.

These cooperators in 1947 fed an average of 305 pounds of milk, five pounds of calf meal, and 472 pounds of concentrates per head of youngstock. As to roughage, they fed 2,973 pounds of hay, 1,019 pounds of silage, and 132 pounds of miscellaneous roughage in addition to pasture in the summer months.

Labor was the second largest cost item, making up nearly 14 percent, and calf value at five days was third, making up about 10 percent of total costs. Total costs exceeded total income by $15.91. The return per hour for all labor was -$ .01.

To get a better conception of the variation in youngstock costs, the standard deviation of the mean was calculated (see Table 3). The standard deviation of the mean average, $114, was $67. Approximately 68 percent of the herds, or 58 out of the 85, had yearly average youngstock costs between $47 and $181 per head.

An effort was made to check the values placed on heifers at freshening by the cooperators. The income from youngstock could be affected directly by how high or how low the cooperators valued freshened heifers. There was a close relationship between heifer values and cow values (see Table 4).

Table 3 - CALCULATION OF STANDARD DEVIATION OF MEAN ON TOTAL YOUNGSTOCK COSTS PER HEAD, 1947

Cooperator number	D	D^2	Cooperator number	D	D^2	Cooperator number	D	D^2
1	1	1	38	11	121	75	1	1
2	41	1,681	39	12	144	76	8	64
3	28	784	40	10	100	77	15	225
4	5	25	41	21	441	78	20	400
5	26	676	42	30	900	79	25	625
6	13	169	43	61	3,721	80	41	1,681
7	33	1,089	44	1	1	81	64	4,096
8	9	81	45	5	25	82	37	1,369
9	10	100	46	107	11,449	83	50	2,500
10	46	2,116	47	83	6,889	84	37	1,361
11	53	2,809	48	99	9,801	85	51	2,601
12	298	88,804	49	34	1,156			Σ 385,474
13	52	2,704	50	24	576			
14	12	144	51	20	400			
15	12	144	52	16	256			
16	19	361	53	19	361			
17	26	676	54	29	841			
18	31	961	55	31	961			
19	67	4,489	56	38	1,444			
20	29	841	57	103	10,609			
21	41	1,681	58	28	784			
22	117	13,689	59	12	144			
23	40	1,600	60	0	0			
24	51	2,601	61	2	4			
25	7	49	62	58	3,364			
26	16	256	63	345	119,025			
27	210	44,100	64	59	3,481			
28	3	9	65	7	49			
29	72	5,184	66	31	961			
30	52	2,704	67	49	2,401			
31	40	1,600	68	10	100			
32	7	49	69	34	1,156			
33	1	1	70	12	144			
34	7	49	71	1	1			
35	49	2,401	72	12	144			
36	24	576	73	46	2,116			
37	11	121	74	34	1,156			

$$\sigma = \sqrt{\frac{\Sigma d^2}{N}}$$

$$= \sqrt{\frac{385,474}{85}}$$

$$= \sqrt{4,535}$$

$$\sigma = \$67$$

Table 4 - RELATION OF COW VALUES TO VALUES PLACED ON FRESHENED HEIFERS, 1947

Item	Value per cow			
	Under $150	$150-$174.99	$175-$199.99	$200 and over
Number of herds	20	25	20	20
Average cow value	$129.03	$162.25	$186.56	$231.36
Average heifer value	$146.59	$170.78	$191.19	$203.28

Then the question arose as to the reliability of the cow values. Even though heifer values showed a close relationship to cow values, there was the possibility that the cows were not evaluated too closely with their producing ability. The records were then sorted by butterfat production per cow--herd average--to see whether heifer values were related to herd production.

There was no relationship between heifer values and butterfat production per cow (see Table 5). This suggests that the income shown in Table 2 might be slightly too high or slightly too low depending upon whether some of the cooperators undervalued or overvalued their heifers. It is more likely that it is slightly low, since the average value placed on freshened heifers averaged $181 per head.

Table 5 - RELATION OF HERD BUTTERFAT PRODUCTION TO VALUES PLACED ON FRESHENED HEIFERS, 1947

Item	Butterfat production per cow			
	Under 250	250-299.9	300-349.9	350 and over
Number of herds	11	31	29	14
Average butterfat production per cow	226	276	322	372
Average value freshened heifers	$185.43	$172.01	$184.27	$187.19

Calculation of Heifer Costs by Projection: Since the cost figures in this study are for one year, and since they are for the entire youngstock herd, it is difficult to figure the cost of raising a heifer to freshening age.

The average number of months to raise a heifer to freshening as reported by the 35 farmers interviewed (one farmer visited did not raise heifers) was 27.7 months. The average youngstock cost in 1947

was $114.19, or the average monthly cost was $9.52. On the basis of 1947 costs, it was costing $263.70 to raise a heifer to 27.7 months, or freshening.

The assumption has to be made that the proportions of calves under one year to heifers over one year within the youngstock herd remain essentially the same. This assumption seems warranted after checking average youngstock numbers of 1947 with other years that these cost accounts were kept. For 1947, calves under one year made up 54 percent of the youngstock. For 1946, these percentages were exactly the same.* For 1945, calves under one year made up 47 percent, and heifers over one year made up 53 percent of the youngstock.**

Calculation of Heifer Costs by Deduction: Another method of arriving at heifer costs was devised. This was by treating the sales of calves (for breeding purposes or for veal) as by-products or as incidental to the raising of heifers. The value of calf sales, bulls raised and kept on the farm, and ending inventory values were deducted from beginning inventory values, purchases, and total costs. The remaining amount is assumed to be the cost of the heifers. The calculations on page 20 show an average cost of $237.43 for 302 heifers that freshened on the 85 farms.

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* This was calculated from information given on page 9, DAIRY COSTS AND RETURNS IN DETROIT MILK SHED by E. H. Carter, Mich. Agr. Exp. Sta. Mimeo. F. M. 417.

** This was calculated from information given on page 9, DAIRY COSTS AND RETURNS IN SOUTHEASTERN MICHIGAN by E. H. Carter and K. T. Wright, Mich. Agr. Exp. Sta. Mimeo. F. M. 397.

Beginning inventory value	$ 82,140.00	
Purchases	6,693.00	
Total costs during year	109,372.37	
Total		$198,205.37
Ending inventory value	$101,545.00	
Sales	23,326.39	
Value of bulls kept	1,630.00	
Total		$126,501.39
Balance or remaining cost		$ 71,703.98

Total heifers freshened = 302

$\frac{\$71,703.98}{302}$ = $237.43 cost per freshened heifer

It will be noted that the heifer cost deducted in this manner is about $26 lower than that figure arrived at by the projection method. This might be explained by either one of two reasons. First, the 27.7 month period for freshening reported by the 35 dairymen interviewed might be too high for the entire 85 cooperators. This is unlikely, however. Secondly, there might well have been some profit made on some of the calves sold, particularly those sold for breeding purposes. This is the more likely reason for the $26 difference in method of figuring heifer costs.

FACTORS RELATED TO YOUNGSTOCK COSTS AND RETURNS

High and Low Total Return Herds: Before studying factors related to youngstock costs, it was considered desirable to compare youngstock profits or losses with cow profits or losses on the same herds. With separate enterprise accounts being kept on cows and youngstock, there loomed the possibility that dairymen might be offsetting youngstock losses in extra profits in the cow herd. On the other hand, they might be making profits in the youngstock herd at the expense of losses in the cow herd. As an example, if freshened heifers were valued either too high or too low, youngstock and cow profits would be affected directly.

Some study was then given to the labor return on the entire herd for the 15 high and the 15 low herds. The records were sorted by total labor return on the entire herd on a per cow basis (see Table 6). The 15 high herds showed profit on both youngstock and cows. The 15 low herds showed losses on both youngstock and cows. Furthermore, the 15 high herds had lower breeding costs. Three of these 15 had sufficient bull appreciation that they had a net profit from the bull rather than a net cost. The table shows that the 15 high labor return dairymen did a better job than the 15 low return dairymen not only on cows, but also on youngstock and breeding costs.

Table 6 - COMPARISON OF HIGH AND LOW TOTAL HERD RETURN PER COW FARMS, 1947

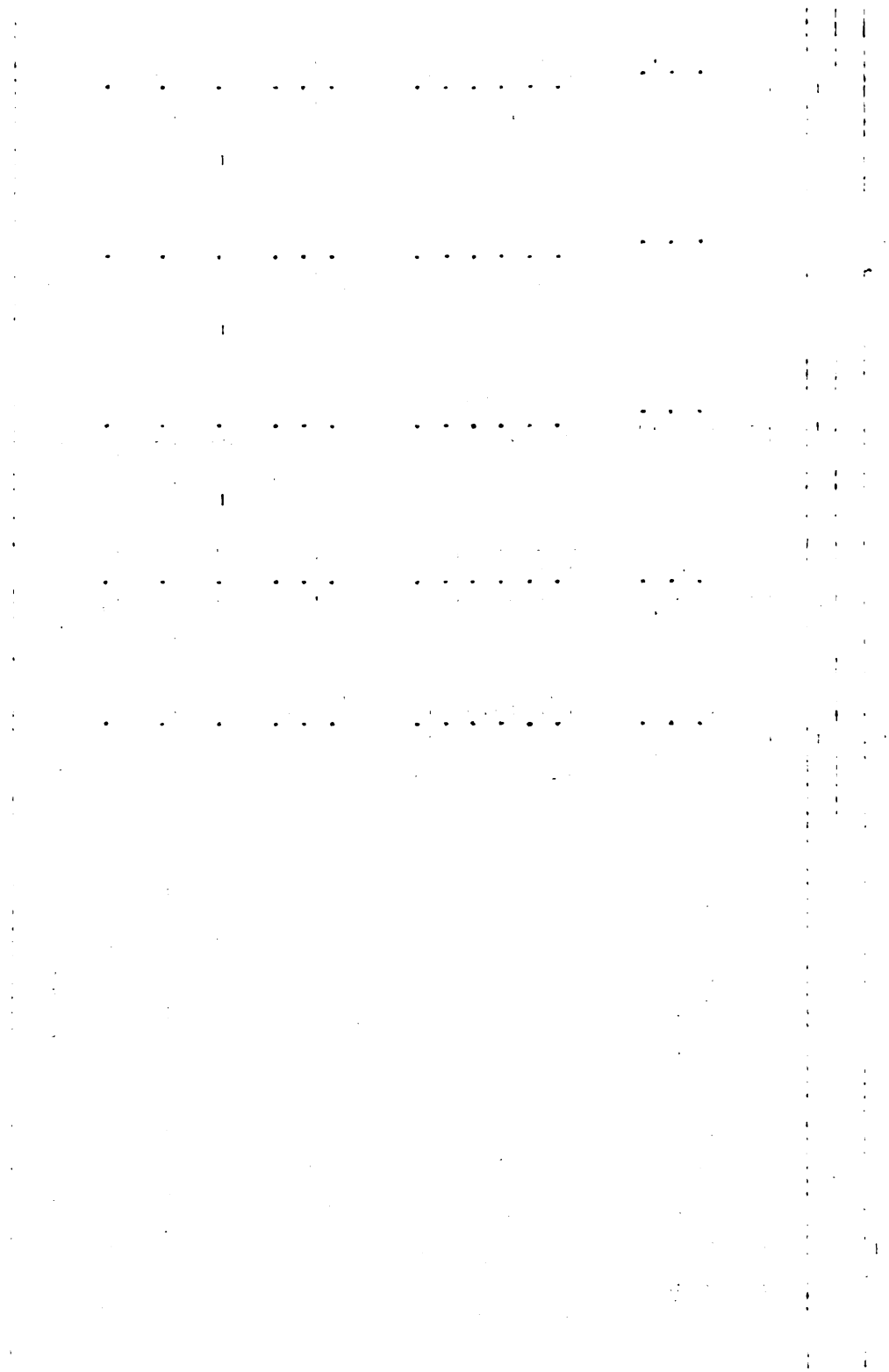
Item	Total labor return on herd per cow	
	Low 15 herds	High 15 herds
Cows per herd	17.2	13.7
Youngstock per herd under one year	5.7	4.5
Youngstock per herd over one year	6.9	5.6
Total	12.6	10.1
Total herd returns to labor per cow	$ 26.83	$ 210.11
Total herd returns to labor per farm	$462.88	$2,898.43
Net returns per cow on cow herd	-$ 96.14	$ 64.07
Net returns per head of youngstock on youngstock herd	-$ 26.76	$ 20.97
Breeding cost per cow or heifer	$ 9.03	$ 7.20
Butterfat production per cow (lbs.)	275	331

Comparison of High and Low Youngstock Cost Herds: To get some notion of the variation of individual costs and other physical factors, the records were sorted by total cost per head of youngstock (Table 7). It was thought that, by doing this, an examination of some of the factors associated with low or high cost herds would give some idea as to what factors to sort by in studying factors related to costs.

Results in the table suggested that some of the factors which might be related to youngstock costs are: feeding efficiency, labor efficiency, calf value charged at five days' age, breeding costs, quality of animal produced, and possibly the size of the youngstock herd. It was then decided to sort by these factors in an effort to study their relationship to youngstock costs. It was also decided to study the relation, if any, of breed, mortality, and management practices to youngstock costs.

Table 7 - COMPARISON OF CERTAIN FACTORS ON HIGH AND LOW YOUNGSTOCK COST HERDS, 1947

Item	Cost per head of youngstock				
	$31-$83	$84-$107	$109-$123	$125-$148	$151-$459
Number of herds	17	17	17	17	17
Number of youngstock under 1 year	6.8	4.6	5.3	4.1	4.8
Number of youngstock over 1 year	8.0	5.7	6.6	6.1	4.5
Total	14.8	10.3	11.9	10.2	9.3
COSTS PER HEAD YOUNGSTOCK					
Feed	$ 34.39	$ 52.16	$ 62.36	$ 69.69	$106.57
Labor	8.79	13.14	16.60	17.33	26.47
Calf value at 5 days	5.70	8.48	11.15	15.64	16.29
Breeding	2.75	2.60	4.19	4.97	6.18
All other	14.12	17.31	21.34	26.13	32.23
Total	$ 65.75	$ 93.69	$115.64	$133.76	$187.74
INCOME PER HEAD YOUNGSTOCK					
Appreciation	$ 65.21	$ 94.63	$ 96.55	$115.30	$126.47
Manure credit	.98	1.97	2.04	1.50	1.77
Total	$ 66.19	$ 96.60	$ 98.59	$116.80	$128.24
NET RETURNS PER HEAD YOUNGSTOCK	$ .43	$ 2.91	-$ 17.00	-$ 16.94	-$ 59.50
Breeding cost per head over 1 year	$ 5.11	$ 4.69	$ 7.55	$ 8.28	$ 12.79
Labor hours per head youngstock	9.5	13.59	16.5	18.1	25.0
Butterfat production per cow	283	304	293	311	315



Feed Costs: Feed costs per head, which ranged from $13 to $336 on individual herds, had a definite relationship to total youngstock costs (Table 8). The 17 herds with lowest feed costs per head averaged $66 total costs compared with $184 total costs for the 16 herds with highest feed costs per head. Feed costs comprised only 45 percent of total costs for the low group as compared to 63 percent for the high group.

Although total returns did average higher for the high feed cost group, total returns were not high enough to offset or pay for the higher costs. Net returns averaged -$68 per head for the high feed cost group compared to $9 for the low feed cost group. Somewhat higher producing heifers were produced by the high feed cost group but probably not enough higher to justify that much higher costs. Cost reduction opportunities by better feeding methods is discussed under MANAGEMENT PRACTICES.

Labor Efficiency: Much variation was shown in labor hours spent in the care of youngstock. This varied from about two to 75 hours per head. Dairymen spending the most hours per head had higher labor and total costs, and labor costs made up a higher proportion of total costs (Table 9). The lower labor hour dairymen had lower labor cost per $100 of youngstock income, higher returns per hour of labor, and higher net returns per head youngstock.

Labor efficiency offers one possibility of reducing costs for some dairymen. There is probably a greater possibility of reducing labor hours for older heifers than young calves. To do well, young calves quite often require much individual attention. For older heifers,

Table 8 - RELATION OF FEED COSTS PER HEAD YOUNGSTOCK TO COSTS AND RETURNS, 1947

Item	Feed costs per head youngstock			
	Under $40	$40-$59.99	$60-$79.99	$80 and over
Number of herds	17	30	22	16
Number of youngstock under 1 year	5.8	4.8	5.5	4.5
Number of youngstock over 1 year	6.4	6.4	6.8	4.7
Total	12.2	11.2	12.3	9.2
COSTS PER HEAD YOUNGSTOCK				
Feed	$ 30.03	$ 50.65	$ 71.02	$115.69
Total	$ 66.40	$102.55	$126.30	$183.79
Percent feed costs of total costs	45.2	49.4	56.2	62.9
TOTAL RETURNS PER HEAD YOUNGSTOCK	$ 75.68	$ 91.83	$112.85	$116.18
NET RETURNS PER HEAD YOUNGSTOCK	$ 9.28	-$ 10.72	-$ 13.45	-$ 67.61
Butterfat production per cow	286	303	295	326

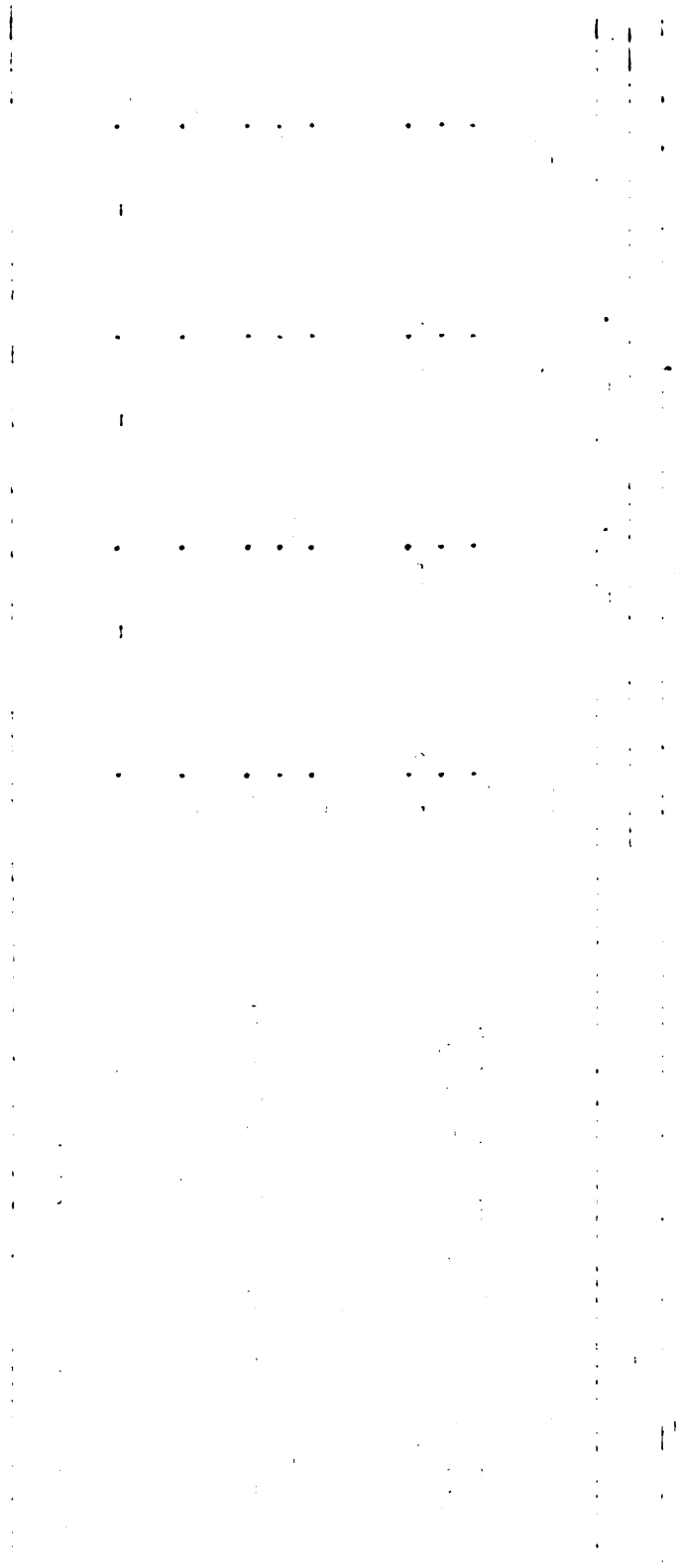
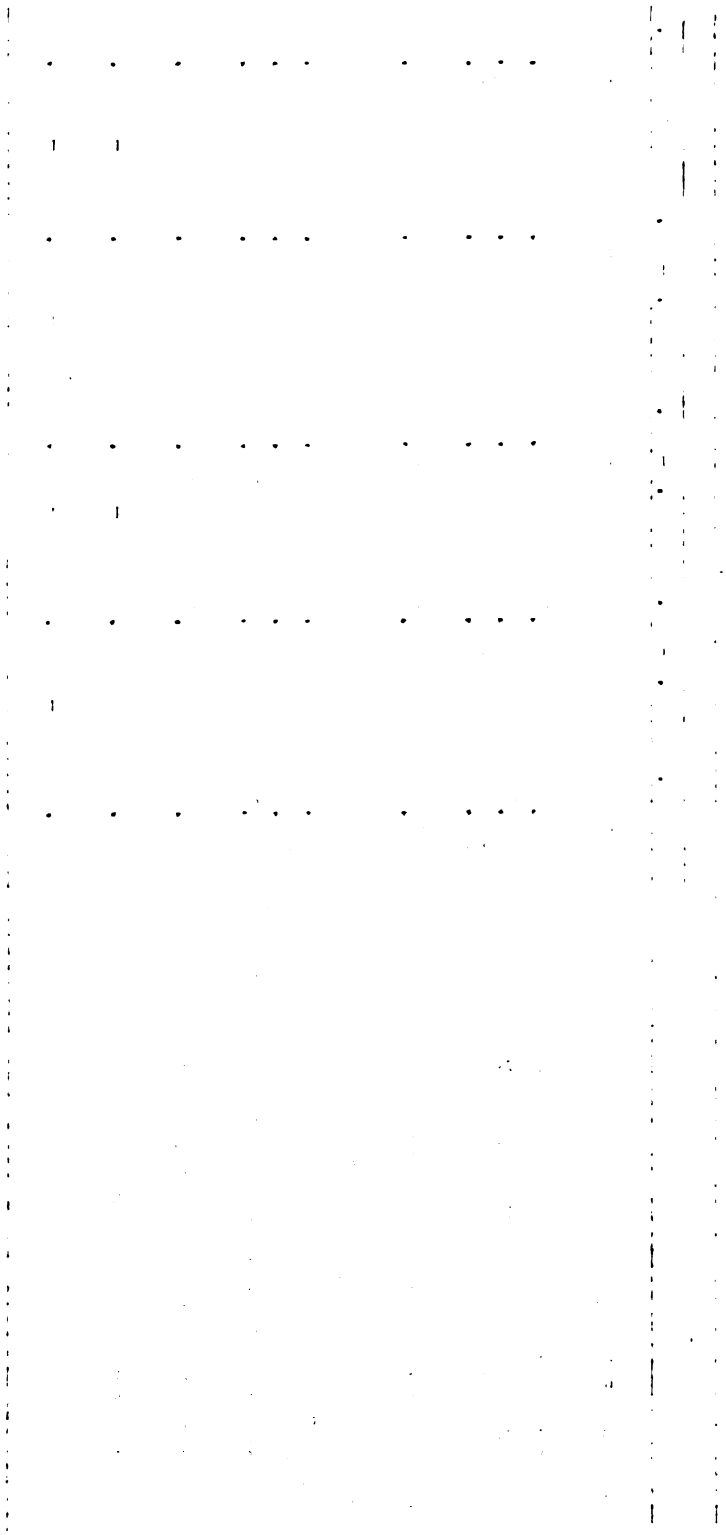


Table 9 - RELATION OF LABOR EFFICIENCY TO COSTS AND RETURNS, 1947

Item	Hours labor per head of youngstock				
	Under 8.5	8.5-11.8	11.9-16.1	16.2-25.0	Over 25.0
Number of herds	17	17	17	17	17
Number youngstock under 1 year	4.4	4.3	6.6	6.4	3.9
Number youngstock over 1 year	5.7	6.4	8.3	6.8	3.7
Total	10.1	10.7	14.9	13.2	7.6
Labor hours per head youngstock	6.0	9.9	13.4	20.6	33.8
COSTS PER HEAD YOUNGSTOCK					
Labor	$ 5.59	$ 9.46	$12.76	$ 20.65	$ 35.14
Total	$78.72	$113.37	$91.39	$131.33	$174.29
Percent labor costs of total costs	7.1	8.3	14.0	15.7	20.2
Labor cost per $100 youngstock income	$ 6.44	$ 9.19	$16.29	$ 18.47	$ 29.19
Return per hour labor	$ 2.28	$ .34	-$ .02	$ .05	-$ .56
NET RETURN PER HEAD YOUNGSTOCK	$ 8.08	-$ 6.09	-$13.06	-$ 19.57	-$ 53.90



the arrangement of feeding and water facilities to effect a minimum of labor hours offers possibilities of lower costs to some farmers.

Size of Youngstock Herd: The size of the youngstock herd, which ranged from one to 38, apparently had at least some effect upon costs (Table 10). There was a tendency for building investment and labor costs to decrease as size of herd increased. However, since labor and building use comprise but about 20 percent of total cost, it is doubtful whether size of herd is as important as some other factors in affecting youngstock costs. Gross returns had a greater effect on net returns than did the size of herd in reducing costs.

Quality: In general, it did not cost much more to produce youngstock to replace high producing herds than it did to replace low producing herds (Table 11). For example, it cost dairymen $112 per year to raise youngstock to replace herds averaging 322 pounds of fat per cow per year compared to $102 to replace herds averaging 226 pounds fat. Costs per year for youngstock increased to $143 for those dairymen replacing herds averaging 372 pounds of fat, but that cost seems justified when considering the quality of the heifers being produced.

Some of the cooperators recognized this quality factor in producing heifers by keeping heifers to raise only from their very best cows. Some farmers made a practice of replacing about one-fourth of the cow-herd each year. To do this, they saved from 50 to 60 percent of their best heifers to raise, but not all of them.

Calf Value at Five Days: Calf value charged per calf varied from $2.00 to $34.00. Calf value charged was related to youngstock costs (Table 12). As calf value charged increased, there was a tendency for

Table 10 - RELATION OF SIZE OF HERD TO COST AND RETURNS, 1947

Item	Average number of youngstock			
	Under 6	6-9.9	10-13.9	14 and over
Number of herds	15	29	18	23
Number youngstock under 1 year	1.3	3.6	5.8	9.0
Number youngstock over 1 year	1.7	4.2	6.3	11.5
Total	3.0	7.8	12.1	20.5
LABOR				
Total hours per head	21.7	18.2	13.6	15.2
INVESTMENT PER HEAD				
Barn	$114.33	$ 81.07	$ 53.25	$ 65.12
COSTS PER HEAD				
Labor	$ 19.26	$ 18.31	$ 12.70	$ 15.53
Building use	11.00	8.37	5.51	5.72
Breeding	3.47	4.15	3.85	4.04
All other	119.04	90.97	87.22	83.05
Total	$152.77	$121.80	$109.28	$108.35
Total returns per head	$148.54	$120.51	$ 85.78	$ 87.93
Net returns per head	-$ 4.24	-$ 1.29	-$ 23.50	-$ 20.33

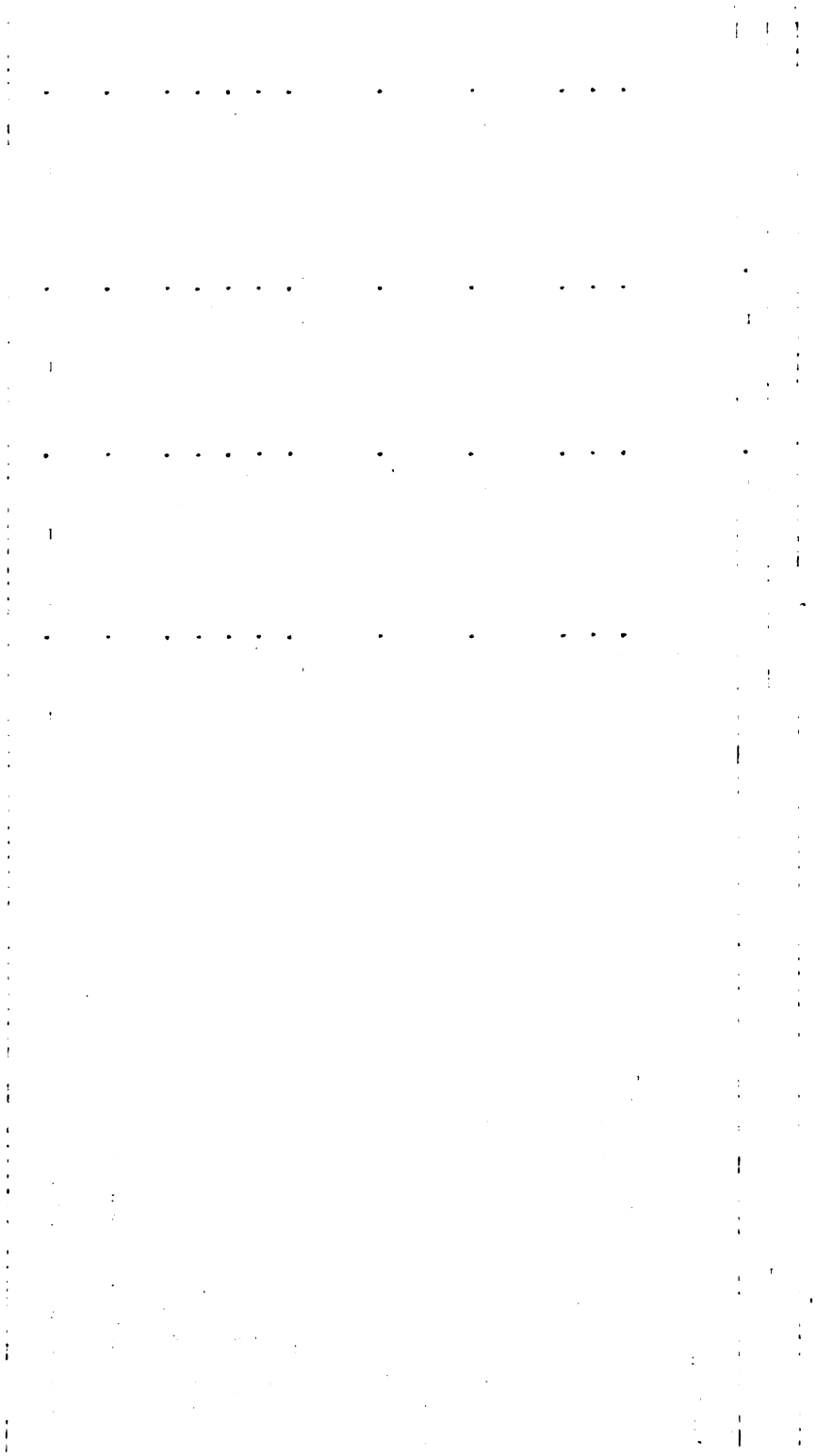


Table 11 - RELATION OF HERD BUTTERFAT PRODUCTION TO YOUNGSTOCK COSTS, 1947

Item	Butterfat production per cow			
	Under 250	250-299.9	300-349.9	350 and over
Number of herds	11	31	29	14
Butterfat production per cow	226	276	322	372
Number of youngstock under 1 year	4.8	5.2	5.5	4.5
Number of youngstock over 1 year	5.4	5.8	7.0	5.9
Total	10.2	11.0	12.5	10.4
COSTS PER HEAD YOUNGSTOCK				
Feed	$ 54.20	$ 55.81	$ 64.02	$ 76.34
Labor	13.48	15.12	16.06	18.01
Calf value at 5 days	10.55	12.23	9.13	15.24
Interest	4.67	4.52	4.47	5.72
Building use	6.92	6.20	5.74	9.08
Bull costs or fees	3.15	4.05	3.42	5.94
All other	9.48	9.02	9.02	12.97
Total	$102.46	$106.95	$111.87	$143.30

Table 12 - RELATION OF CALF VALUE AT FIVE DAYS TO COSTS AND RETURNS, 1947

Item	Calf value per calf at 5 days			
	Under $5.00	$5-$7.99	$8-$10.99	$11.00 and over
Number of herds	12	37	18	18
Calf value per calf	$ 3.84	$ 6.44	$ 9.22	$ 17.16
Number of youngstock under 1 year	6.1	4.7	6.0	4.5
Number of youngstock over 1 year	5.8	5.7	7.4	6.1
Total	11.9	10.4	13.4	10.6
COSTS PER HEAD YOUNGSTOCK				
Calf value at 5 days	$ 5.08	$ 8.35	$ 12.02	$ 20.65
Total	$115.02	$105.20	$115.59	$127.85
Percent calf value of total costs	4.4	7.9	10.4	16.2

total costs to increase, and the percentage that calf value was of total costs increased.

Evaluations of calves at this age were determined by the amount for which the cooperators could sell the calves. Size of the calf, breeding, and production records for the herd were all factors affecting calf value at five days' age.

Breeding Costs: Breeding costs showed much variation. This ranged from $0 to $25.88 per head of youngstock over a year. Six herds had no breeding costs charged against youngstock. Three of these bred their herds artificially but bred no heifers in 1947. Three herds had sufficient bull appreciation so as not to have any net bull costs; however, one of these three herds had artificial breeding costs charged against youngstock. Another herd had bull costs but none charged against the youngstock account.

Breeding costs showed a relationship to total youngstock costs (Table 13). The higher breeding cost herds had higher breeding costs per $100 of youngstock income. Breeding costs made up a larger proportion of total costs in the case of the higher breeding cost herds. More artificial insemination was practiced by the lower breeding cost herds.

Breed: The effect of breed upon youngstock costs was studied (Table 14). The 85 herds were classified into four groups according to breed--Holstein, Guernsey, Jersey, and mixed breeding. There were not enough Jersey herds to be sure of a high reliability in comparing Jersey with other breeds. Youngstock of Jersey breeding consumed less concentrates, hay, calf meal, milk, and somewhat less silage than herds of other breeding. Jersey herds had considerably less feed costs, calf value costs, and total costs than the other breeds.

Table 13 - RELATION OF BREEDING COSTS PER HEAD YOUNGSTOCK OVER ONE YEAR TO COSTS AND RETURNS, 1947

Item	Breeding costs per head youngstock over 1 year		
	Under $5.00	$5.00-$10.99	$11.00 and over
Number of herds	34	36	15
Breeding cost per heifer over 1 year	$ 2.76	$ 6.90	$ 17.94
Number of youngstock under 1 year	5.7	4.6	5.0
Number of youngstock over 1 year	6.7	5.9	5.7
Total	12.4	10.5	10.7
COSTS PER HEAD YOUNGSTOCK			
Breeding	$ 1.49	$ 3.88	$ 9.56
Total	$103.84	$107.53	$154.61
Percent breeding cost of total cost	1.4	3.6	6.2
Breeding cost per $100 youngstock income	$ 1.49	$ 4.29	$ 8.63
METHOD OF BREEDING			
Percent using bull	52.9	97.2	100.0
Percent using artificial breeding	35.3	2.8	0.0
Percent using both bull and art. breeding	5.9	0.0	0.0
Percent hiring bull	5.9	0.0	0.0

Table 14 - RELATION OF BREED TO YOUNGSTOCK COSTS AND RETURNS, 1947

Item	Holstein	Guernsey	Jersey	Mixed
Number of herds	45	12	6	22
Calves under 1 year	5.5	4.2	7.7	4.2
Heifers over 1 year	6.4	6.8	7.6	5.1
Total number of youngstock	11.9	11.0	15.3	9.3
FEED FED TO YOUNGSTOCK				
Concentrates per head youngstock (lb.)	573	364	232	302
Hay per head youngstock (lb.)	1,985	2,675	954	1,748
Silage per head youngstock (lb.)	1,272	577	532	1,015
Other roughage per head youngstock (lb.)	73	158	254	151
Calf meal per calf under 1 year (lb.)	48	108	2	24
Milk per calf under 1 year (lb.)	787	548	382	597
COSTS PER HEAD OF YOUNGSTOCK IN YEAR				
Feed	$ 69.63	$ 58.74	$ 40.23	$ 53.14
Labor	17.43	17.59	11.32	12.21
Calf value at 5 days	11.21	15.30	5.96	11.14
Interest	4.84	5.70	3.62	4.17
Building use	6.51	7.45	4.46	7.44
Bull cost or fees	3.69	5.61	4.38	3.57
Bedding	4.11	4.61	2.53	2.77
All other (including overhead)	6.36	7.48	4.23	4.33
Total	$123.78	$122.49	$ 76.72	$ 98.77
INCOME PER HEAD OF YOUNGSTOCK IN YEAR				
Net increase	$ 99.39	$103.63	$ 64.52	$ 98.11
Manure credit	1.71	1.67	1.08	1.54
Total	$101.10	$105.30	$ 65.60	$ 99.65
Price placed on heifers at freshening	$188.62	$187.50	$137.04	$173.55
Net return per head of youngstock	-$ 22.68	-$ 17.19	-$ 11.12	$ 0.88

Gross income was also considerably lower for the Jersey herds. Because of this and the lower total costs, net incomes were not greatly different from herds of the other breeds. Therefore, the breed of dairy cattle did not appear to affect, to any large extent, youngstock net returns.

Mortality: Mortality, no doubt, has an important influence in the cost of raising youngstock. It was a very difficult factor to measure in the cost records for 1947, because it reduced income rather than increased the costs. As long as a calf was alive, its costs were reported on a per head basis. If the calf died later, no effect was shown on the costs as such. The loss showed only as an inventory loss in the income account.

Twenty-two herds out of the 85 had calf losses after the calves had been transferred to the youngstock account (at five days' age). Mortality ranged from 0 to 44 percent on individual herds after the calves were transferred to the youngstock account. Calves born dead or calves that died before they reached the age of five days, which was not uncommon, were not reported by the cooperators.

An effort was made to compare net appreciation in herds with and without mortality reported. The records showed no great differences. It is probable that the calves died at such early ages that these losses were outweighed or hidden by other factors affecting youngstock income. However, mortality is an important factor in youngstock income, particularly in those herds with high mortality rates.

Because it was believed that the mortality picture was somewhat incomplete in the 1947 cost records, a section was devoted to this in

the questionnaire. Information was obtained as to total death rates and cause of death. This is discussed further under MANAGEMENT PRACTICES.

MANAGEMENT PRACTICES

General: Thirty-six farmers were interviewed regarding management practices used in raising heifers for cow replacements. One of the farmers interviewed purchased his replacements leaving 35 records available for the study of management practices.

The farm interviews were made in April and May of 1949. Cost records for the dairy cooperators studied were for the year 1947. Most of the information obtained from the interviews referred to management policies, which ordinarily do not change drastically from one year to the next. In some few exceptional cases where management policies had changed, the information obtained was for the methods used in 1947.

The information secured on death losses and number of cases of disease related to 1948. It was felt that data for 1948 would be more accurate than similar data for 1947.

Total youngstock costs in 1947 for the 18 low-cost herds averaged less than half that for the 17 high-cost herds (Table 15). The low-cost herds had feed costs about a third and labor costs about half those of the high-cost herds.

Table 15 - COMPARISON OF YOUNGSTOCK COSTS, 1947, ON FARMS VISITED

Item	18 low feed cost herds	17 high feed cost herds
Number youngstock under 1 year	5.5	6.0
Number youngstock over 1 year	7.2	5.5
Total	12.7	11.5
YOUNGSTOCK COSTS PER HEAD		
Feed	$34.86	$103.68
Labor	10.75	22.19
All other	26.25	44.93
Total	$71.86	$170.80

Age of Freshening: The average age of freshening for the herds visited varied from 23 months to 36 months. It was believed that this might have an influence on heifer costs. Study indicated that the heifers in the low-cost herds freshened at 28.1 months and ranged from 23 to 36 months' age. Heifers in the high-cost herds freshened at 27.3 months and ranged from 24 to 30 months' age. The average age of freshening for all 35 herds visited was 27.7 months.

The 35 records were grouped into thirds on the basis of age of freshening (Table 16). The third freshening at a younger age averaged $147.60 of youngstock cost per year and 25.08 months to freshen compared to $103.22 of youngstock cost per year and 31.36 months to freshen for the third freshening at an older age.

Table 16 - RELATION OF AGE OF FRESHENING TO COSTS

Item	Age of freshening		
	Low third	Middle third	High third
Number of herds	12	12	11
Months to freshen	25.08	27.00	31.36
Annual cost per head of youngstock	$147.60	$107.15	$103.22
Cost of freshened heifer	$308.42	$241.09	$269.76

The calculated cost of producing a heifer was greatest in the group that freshened at 25.08 months, but it was less for the 27 month group than for the 31.36 month group. The age of freshening did not appear to be an important factor affecting costs of a freshened heifer.

Milk Feeding Practices: The feeding of milk was managed in many different ways. The 18 low cost dairymen separated new born

calves from the cows quicker, but left the calves with their mothers more days before hand feeding (Table 17). The main reason given for separating the calf from the cow after a short interval of time was to prevent the calf from getting too much milk and thus preventing scours. However, many of those cooperators who left their calves with the cow for longer intervals of time believed that the most danger from scours occurred when the calf was separated soon after birth, became very hungry, and then gorged himself with milk when put back with the cow.

Table 17 - COMPARISON OF MILK FEEDING PRACTICES ON HIGH AND LOW FEED COST HERDS

Item	18 low herds	17 high herds
Average number hours before new born calf separated from cow	42	64
Average number days calf left with cow before hand feeding*	6.	4.25
Number of dairymen using nurse cow method**	1	2
Number of dairymen using hand feeding method	17	16
Number of dairymen using open pail	16	14
Number of dairymen using nipple pail	1	2
Number of dairymen sterilizing feeding utensils	4	4

* For those herds practicing hand feeding milk
** One dairyman used both methods.

Most of the dairymen in both cost groups preferred hand feeding milk over the nurse cow method. Reasons given for the preference of hand feeding included:

(1) It was easier to determine how much milk the calf was getting.

(2) The calf sometimes injured the cow's udder.

(3) The calf might become a sucking cow as a result of using the nurse cow method.

(4) Nurse cows, by holding their milk for their calves, are more difficult to manage.

(5) Barns were not set up or equipped for the nurse cow method.

(6) Nurse cow method works best where there is a large number of calves (can put two or three calves about same age on one cow).

Reasons given for the preference of the nurse cow method included: (1) sanitation, (2) less labor involved, (3) it was possible to utilize a three-teated or any other cow difficult to milk with the milking machine, and (4) cooperators had had good results with that method.

Most cooperators in both groups used an open pail rather than a nipple pail. The reason given most often for using the open pail was that they had never tried any other method. Some thought that the nipple pail would be more difficult to keep sanitary. One cooperator thought the nipple pail might cause the calf to be a sucking cow. The most important reason given for the use of the nipple pail was that it permitted the calf to get his milk at a slow rate, thus keeping digestive disorders at a minimum.

About the same proportion in each cost group sterilized feeding utensils.

Although differences existed within each cost group, the two groups, when averaged, showed similarities in methods of hand feeding milk and sterilizing of utensils. The low-cost group did not leave new born calves with the cows quite as long before separating as did the high-cost group. However, the low-cost group did leave the calves with the cow longer before hand feeding milk.

Hay Feeding Practices: Most all of the cooperators visited fed good quality hay. Most of them fed either legume or a legume-grass mixture of hay.

Over half of the cooperators in each group selected only the highest quality of hay for their young calves (Table 18). They selected the greenest, brightest, finest, and leafiest hay for young calves. Some fed only second cutting hay.

Some of the dairymen visited made it a practice of feeding hay left over from the cows' mangers to heifers at least a year old. This practice occurred more among low-cost cooperators.

Although differences existed within each cost group as to methods of feeding hay, the two group averages were not greatly different.

Table 18 - COMPARISON OF HAY FEEDING PRACTICES ON HIGH AND LOW FEED COST HERDS

Item	18 low herds	17 high herds
Number of dairymen who selected only the highest quality hay when feeding calves	10	11
Number of dairymen who fed hay to calves without especially selecting highest quality	8	6
Number of dairymen feeding hay left over from cows' mangers to heifers over one year	8	3

Pasture Practices: All the dairymen visited except one pastured the heifers. His reasons for not pasturing heifers were that if they were under 12 months' age, he wanted them close to the buildings to grain them. If they were over 12 months' age, it was difficult to manage the breeding of them on pasture, and there was the difficulty of their jumping fences.

The heifers of the 18 low-cost herds were turned to pasture at about a month younger age than were the heifers of the 16 high-cost herds (Table 19). Most of the high-cost farmers fed no grain on pasture. Most of the low-cost farmers fed grain to the younger heifers on pasture. A small proportion of both groups fed grain to all heifers, regardless of age. Over half of the low feed cost group grain-fed heifers on pasture according to age of heifer.

Table 19 - COMPARISON OF PASTURE FEEDING PRACTICES ON HIGH AND LOW FEED COST HERDS

Item	18 low herds	16 high herds*
Average age when heifers first turned to pasture (months)	6.6	8.
Number of dairymen feeding grain to all heifers on pasture	2	3
Number of dairymen feeding grain to none of heifers on pasture	6	11
Number of dairymen feeding grain to part of heifers under certain age on pasture	10	2
Number of dairymen who changed to pasture abruptly	14	9
Number of dairymen who continued grain, dry roughage, or both for few days after turning to pasture	4	7

* One dairyman did not pasture any of his heifers.

Comparison of Calf Mortality and Disease of High and Low Cost Herds: Of the 35 farms visited, 7.9 percent of all calves in 1948 were either born dead or died at an early age (Table 20). Of total calf mortality, 38.6 percent was due to calves born dead. Another 26.3 percent died from injuries at birth, premature birth, or were born weak and died. Scours accounted for 19.3 percent of all deaths, and pneumonia accounted for seven percent of total calf mortality. Other causes of death accounted for 8.8 percent of calf deaths.

Ten percent of all calves born in 1948 had scours. One percent had colds, and 0.6 percent had pneumonia. One-fifth of the herds visited had some Bang's disease in the cow herd, but 71.4 percent vaccinated their calves against Bang's.

Table 20 - COMPARISON OF CALF MORTALITY AND DISEASE ON HIGH AND LOW FEED COST HERDS, 1948

Item	18 low herds	17 high herds	All herds
Av. no. calves born per farm	20.3	20.8	20.6
Av. no. death losses per farm	1.50	1.76	1.63
Percent death loss	7.4	8.5	7.9
CAUSE OF DEATH			
Percent born dead	44.5	33.3	38.6
Percent died from injuries at birth	18.5	6.7	12.3
Percent born premature and died	3.7	16.7	10.5
Percent died scours	14.8	23.3	19.3
Percent died pneumonia	3.7	10.0	7.0
Percent born weak and died	7.4	—	3.5
Percent died from other causes	7.4	10.0	8.8
Total	100.0	100.0	100.0
DISEASE			
Percent calves had scours	10.7*	9.3	10.0
Percent calves had colds	.8	1.1	1.0
Percent calves had pneumonia	0.0	1.1	.6
Percent of dairymen who had some Bang's disease in cow herd	16.7	23.5	20.0
Percent of dairymen vaccinating calves against Bang's disease	66.7	76.5	71.4

* Almost half of the cases occurred on one farm.

The high-cost herds had greater mortality than the low-cost herds. There was a higher mortality from scours, pneumonia, and premature births in the high-cost group compared to the low-cost group. There was a greater percentage of mortality due to calves born dead and injuries at birth in the low-cost group.

It is interesting to note that in the high-cost group more deaths were attributed to causes more nearly under the control of the farmer (scours, pneumonia, and premature births resulting from Bang's disease) than in the low-cost group. More deaths occurred from causes not as much under the control of the farmer (born dead, injured at birth, and born weak and died) for the low as compared to the high-cost group. More Bang's disease in cow herds was reported for the high cost group.

In brief, there was somewhat higher mortality, more mortality due to causes more nearly under the control of the farmer, and more Bang's disease in the high-cost herds.

Comparison of Breeding Methods on Low and High Cost Herds: More of the low-cost dairymen bred artificially and fewer bred by bull as compared with the high-cost dairymen (Table 21). There was no significant difference in age of freshening for the two groups.

Table 21 - COMPARISON OF BREEDING METHODS ON HIGH AND LOW FEED COST HERDS

Item	18 low herds	17 high herds
Percent of herds bred artificially	38.9	23.5
Percent of herds bred by bull	55.5	70.6
Percent of herds bred both artificially and by bull	5.6	5.9
Average age of freshening (months)	28.1	27.3

For the entire 35 cooperators visited, 11 bred by artificial insemination, and 22 bred by bull (Table 22). Two farmers used both methods of breeding. Nearly twice as many breeding services were required to get heifers bred on herds practicing artificial breeding

as compared to herds breeding with a bull. This very likely contributed to the greater variation in age of freshening for the artificially bred herds.

Table 22 - RELATION OF METHOD OF BREEDING TO NUMBER OF BREEDING SERVICES AND VARIATION IN AGE OF FRESHENING

Item	Artificially	Bull
Number of herds	11	22
Av. number of breeding services to get a heifer with calf	2.26	1.39*
Variation in age of freshening (months)	5.6	4.75*

* Bull ran with heifers on two farms. These records were eliminated.

Problems in Raising Heifers: The 35 farmers interviewed were asked to state their greatest problems in raising heifers. More replies were given on disease and sanitation than on any other management problem (Table 23). Among the diseases, scours at an early age was more important than any other single problem.

Next in importance was feeding management. The two greatest problems in feeding were overfeeding milk and switching from milk to grain.

Other problems of importance included getting the heifers bred, slow growth, and selecting quality calves that would become high producers.

Why Dairymen Prefer Raising their Replacements: Thirty-four of the 36 farmers selected for interview preferred raising heifers for cow replacements, one preferred purchasing herd replacements, and one farmer had no particular preference of buying or raising replacements.

Table 23 - GREATEST PROBLEMS OF DAIRYMEN IN RAISING HEIFERS

Problems	1st	2nd	3rd	4th	5th	Total
1. DISEASE AND SANITATION - Total	14	16	2	-	2	34
Scours	10	5	-	-	1	16
Colds and pneumonia	-	2	1	-	-	3
Overcrowded quarters	2	1	-	-	1	4
General health	1	4	1	-	-	6
Sanitation in general	-	1	-	-	-	1
Calves suck each other	1	2	-	-	-	3
Bang's disease in older heifers	-	1	-	-	-	1
2. FEEDING - Total	8	2	2	1	-	13
Overfeeding milk	4	-	-	-	-	4
Switching from milk to grain	2	1	-	1	-	4
Getting enough animal protein in ration	1	-	-	-	-	1
Needs more pasture	1	-	-	-	-	1
Has to turn out to pasture too young--not enough barn-fed roughage	-	1	-	-	-	1
Correct feeding on pasture	-	-	1	-	-	1
Stop feeding grain at too young age	-	-	1	-	-	1
3. BREEDING HEIFERS - Total	2	4	3	1	-	10
Getting them with calf	2	2	2	1	-	7
Neighbor's bull jumps fence and breeds heifers	-	2	-	-	-	2
Sterility	-	-	1	-	-	1
4. OTHER - Total	11	3	1	1	-	16
Slow growth	2	1	-	-	-	3
Attention to small details of management the first six months	2	-	1	-	-	3
Too much labor required	1	1	-	-	-	2
High cost of raising heifers	1	-	-	-	-	1
Lose too much valuable milk in feeding it to calves	1	1	-	-	-	2
One heifer out of four or five is not a high producer	2	-	-	-	-	2
Getting heifer calves from the best cows	1	-	-	-	-	1
Heifers become wild when pastured	1	-	-	-	-	1
Maternity care to the cow	-	-	-	1	-	1

For those dairymen who preferred raising their replacements, the first reason given more often than any other for raising their replacements was that they felt that they did not know the quality of purchased cows (Table 24). Many believed that they could raise replacements superior to cows that they could buy.

Other important reasons for preferring to raise replacements were financial reasons, avoiding the risk of purchasing diseased cows, and a definite program of heifer selection based upon breeding and production records.

Reasons given for purchasing replacements by the farmer who preferred purchasing and by the farmer who had no particular preference included: (1) increasing the size of herd, (2) can buy better quality than can produce, (3) cheaper to buy than to raise, (4) inadequate facilities or insufficient feed or labor to raise heifers, and (5) heifers raised are not always high producers. Important points observed in buying replacements included: (1) disease tested cows, (2) purchase from a farmer going out of business, (3) purchase from a farmer with a large surplus of cows, (4) purchase within a close radius of where the cooperator lived, and (5) price placed on the cow.

There was an average of 3.6 heifers freshened and 1.5 cows purchased per farm in 1947 on the 85 farms keeping dairy cost records. The cows were purchased at an average price of $216.88. This compares with $237.43 cost per freshened heifer, according to the deduction method of calculation discussed earlier. This method of figuring heifer costs takes into consideration income and possible profits made from youngstock other than heifers kept for replacements. The $237.43 figure is the cooperator's net cost tied up in the freshened heifer.

Total herd replacement costs per farm on heifers raised and cows purchased amounted to $1,180.07. If all cooperators had eliminated their youngstock enterprises and had purchased all replacements, the additional 3.6 cows purchased per farm would have cost $780.77. This compares with net costs of $854.75 tied up in the heifers kept for replacements. If the cooperators could have purchased cows free of disease and cows equal to their heifer replacements in quality, there would have been a net savings of $73.98 per farm.

Table 24 - WHY DAIRYMEN RAISE THEIR REPLACEMENTS

Reasons	1st	2nd	3rd	4th	5th	Total
1. QUALITY - Total	16	19	13	8	-	56
Quality of heifers raised is superior	5	12	4	1	-	22
Quality of cows purchased unknown	9	3	4	4	-	20
Price too high for quality of cow purchased	2	4	5	3	-	14
2. FINANCIAL - Total	5	4	6	3	1	19
Less cash outlay	1	-	4	1	-	6
Less expensive to raise	3	1	-	1	-	5
Cheap surplus feed utilized by heifers	-	-	2	1	1	4
Home grown feed costs less	-	2	-	-	-	2
Expense of raising less noticeable	1	1	-	-	-	2
3. DISEASE						
Avoid purchasing diseased cows	6	9	2	1	-	18
4. HERD IMPROVEMENT PROGRAM - Total	5	-	6	2	-	13
Superior sire or artificial breeding	4	-	4	2	-	10
Production records	1	-	2	-	-	3
5. OTHER - Total	2	2	-	-	-	4
Good young cows for sale scarce	1	-	-	-	-	1
Enjoys raising heifers--a hobby	1	-	-	-	-	1
Strange animals purchased cause fighting in the herd	-	1	-	-	-	1
Raising heifers a good investment	-	1	-	-	-	1

How to Reduce Heifer Costs: Most of the farmers interviewed believed that reduction of heifer costs might be done in better feeding practices (Table 25). A number of farmers thought that more and better quality roughage (barn-fed and pasture) offered possibilities in reduction of costs. Most of the farmers giving this roughage possibility qualified their answer in some way. One thought that higher quality hay and silage without grain after ten months was one possibility. One believed that more grass silage would lower costs. Another stressed the importance of utilizing as many pasture seasons as possible in the production of the heifer.

Table 25 - FARMERS' OPINIONS ON HOW TO REDUCE HEIFER COSTS

Methods	1st	2nd	Total
1. FEEDING - Total	18	3	21
Feed more and better quality roughage (barn-fed and pasture)	8	1	9
Feed a ration for rapid growth	4	1	5
Use cheaper feed	2	-	2
Use cheap pasture for long season	1	-	1
Use home-grown feed instead of calf ration	1	-	1
Feed less whole milk, more pellets and skim milk	1	-	1
Feed less grain	1	-	1
Reduce milk feeding to calves	-	1	1
2. LABOR - Total	9	-	9
More convenient arrangement of feed and water facilities to save labor	7	-	7
Raise a group of heifers at same age to save labor	1	-	1
Building arrangement to save labor	1	-	1
3. QUALITY - Total	4	2	6
Raise only well bred heifers	2	1	3
Use better sires or artificial breeding	1	-	1
Save only the best heifers	1	-	1
Raise a good heifer even though it might cost more	-	1	1
4. DISEASE AND SANITATION - Total	5	1	6
Sanitation to reduce disease or insect pests	2	1	3
Keep healthy even if requires more labor	2	-	2
Regular feeding to keep healthy	1	-	1

Some of the farmers thought that reducing labor requirements and labor costs was the best way to lower heifer costs. Other possibilities given by the cooperators included the raising of only high quality heifers and the reduction of disease to keep calves healthy through more sanitation.

THE COST OF KEEPING A BULL

At least one bull for at least a part of the year was kept on 70 of the 85 farms. Forty cooperators kept one bull for the 12 months. Eighteen cooperators kept a bull less than 12 months, and 12 cooperators kept more than one bull for the year.

To determine the average cost of keeping a bull, the 40 records of one bull for the year were selected for study. It was believed that records on bulls for a fractional part of a year could not be used satisfactorily. For example, one could not take a three-month period during pasture season, when feed and labor costs might be lower, and multiply by four to give an equivalent 12-month record.

The average net bull cost on 40 bulls in 1947 was $213.06 (Table 26). Total cost amounted to $262.07, half of which was for feed. Total credits amounted to $49.01, over two-thirds of which was bull appreciation in value during the year. Eighty hours were required in the care of the bull for the year.

These 40 herds averaged 17.2 head of cows and 5.8 head of youngstock over one year in age. Net bull cost was prorated to the cows and youngstock over one year to give an average breeding cost of $9.28 per head.

Table 26 - BULL COSTS AND CREDITS, 1947

Item	Average
Number of herds	40
Cows per herd	17.2
Youngstock over one year per herd	5.8
Total	23.0
Hours labor per bull in year	80
COSTS PER BULL	
Feed	$130.79
Labor	77.65
Interest	10.96
All other	42.67
Total costs	$262.07
CREDITS PER BULL	
Manure	$ 10.35
Fees received	1.19
Bull appreciation	37.47
Total credits	$ 49.01
NET BULL COST	$213.06
NET BULL COST PER COW AND HEIFER	$ 9.28

FACTORS RELATED TO BULL COSTS AND CREDITS

Comparison of High and Low Bull Cost Herds: The records were grouped into thirds on the basis of net bull cost per cow and heifer to compare certain factors (Table 27). The reason for this was to get an idea of variation and relative importance of the items of cost and credit.

Some of the items showing considerable variation were feed costs, labor costs, appreciation in bull value during the year, and number of cows and heifers bred. Other possible factors affecting bull costs and credits, not indicated in Table 27, were breed and the number of bulls kept. It was decided to try to make some analysis of all these factors.

Table 27 - COMPARISON OF CERTAIN FACTORS ON HIGH AND LOW BULL COST HERDS, 1947

Item	Bull cost per cow and heifer		
	Low third	Middle third	High third
Number of herds	13	14	13
Cows per herd	18.9	16.1	16.7
Youngstock over 1 year per herd	6.9	4.9	5.6
Total	25.8	21.0	22.3
Hours labor per bull in year	62	72	106
COSTS PER BULL			
Feed	$104.70	$107.83	$181.61
Labor	54.83	67.95	110.92
Interest	9.32	10.51	13.08
All other	28.65	30.73	69.55
Total costs	$197.50	$217.02	$375.16
CREDITS PER BULL			
Manure	$ 10.55	$ 8.77	$ 11.86
Fees received	.46	1.67	1.38
Bull appreciation	78.63	23.26	11.61
Total credits	$ 89.64	$ 33.70	$ 24.85
NET BULL COST	$107.85	$183.31	$350.31
NET BULL COST PER COW AND HEIFER	$ 4.18	$ 8.72	$ 15.74

Feed Costs: Feed costs were closely related to net bull costs (Table 28). The high third feed cost bulls had feed costs and total costs over twice as great as the low third feed cost bulls.

The higher feed costs were not necessarily reflected in higher bull appreciation for the year in this particular grouping. The low third group on feed costs had more bull appreciation than the high third group. The high third group had twice as high breeding costs per cow and heifer as did the low third group in spite of the fact that there were considerably more cows and heifers of breeding age in the high cost group.

Table 28 - RELATION OF FEED COSTS TO BULL COSTS PER COW AND HEIFER, 1947

Item	Feed cost per bull		
	Low third	Middle third	High third
Number of herds	13	14	13
Cows per herd	13.1	20.9	17.3
Youngstock over 1 year per herd	4.7	6.2	6.4
Total	17.8	27.1	23.7
COSTS PER BULL			
Feed	$ 78.83	$120.61	$193.72
Total	$174.21	$236.47	$377.49
Percent feed cost of total cost	45.2	51.0	51.3
CREDITS PER BULL			
Appreciation	$ 42.08	$ 36.84	$ 33.52
Total	$ 53.77	$ 47.51	$ 45.85
NET BULL COST	$120.44	$188.97	$331.64
NET BULL COST PER COW AND HEIFER	$ 6.73	$ 6.99	$ 14.02

Bull Appreciation: Whether a bull appreciated in value during the year had a bearing on net bull costs. On three herds, there was sufficient bull appreciation to result in no bull costs charged against the cows or youngstock.

Net bull costs on bull appreciation herds averaged less than half that on herds with no bull appreciation (Table 29). Net bull costs per cow and heifer bred for the bull appreciation herds averaged $5.90 compared to $11.03 for the herds with no bull appreciation.

Table 29 - RELATION OF BULL APPRECIATION TO BULL COSTS PER COW AND HEIFER, 1947

Item	Bull appreciation per bull	
	None	Some
Number of herds	25	15
Cows per herd	17.9	16.0
Youngstock over 1 year per herd	6.2	5.0
Total	24.1	21.0
TOTAL COSTS PER BULL	$278.39	$234.86
CREDITS PER BULL		
Appreciation	-	$ 99.91
Total	$ 11.65	$111.27
Percent appreciation of total credits	-	90
NET BULL COST	$266.74	$123.59
NET BULL COST PER COW AND HEIFER	$ 11.03	$ 5.90

Labor Efficiency: Hours spent in the care of the bull varied from 21 to 192. Labor costs averaged three to four times as high for dairymen who spent the most hours in bull care as for those dairymen who spent the least hours (Table 30). Labor costs made up 19 percent of total costs for the low third group compared with 34 percent for the high third group.

Net bull cost for the year and net bull cost per cow and heifer averaged over twice as high for the high third labor hour group compared with the low third labor hour group.

Table 30 - RELATION OF LABOR EFFICIENCY TO BULL COSTS PER COW AND HEIFER, 1947

Item	Hours labor per bull		
	Low third	Middle third	High third
Number of herds	13	14	13
Hours labor per bull in year	40	73	127
Cows per herd	17.6	16.7	17.4
Youngstock over 1 year per herd	5.4	5.1	6.8
Total	23.0	21.8	24.2
COSTS PER BULL			
Labor	$ 36.73	$ 73.62	$122.92
Total	$191.32	$237.01	$359.81
Percent labor cost of total cost	19.2	31.1	34.2
CREDITS PER BULL			
Appreciation	$ 49.78	$ 27.02	$ 36.41
Total	$ 61.75	$ 36.26	$ 50.00
NET BULL COST	$129.57	$200.75	$309.81
NET BULL COST PER COW AND HEIFER	$ 5.64	$ 9.21	$ 12.80

Number of Cows and Heifers Bred: There was a variation from 10.9 to 54.5 among these 40 herds in number of cows and heifers of breeding age. Net bull costs per animal bred averaged lower for the third largest herds (Table 31).

Table 31 - RELATION OF NUMBER OF COWS AND HEIFERS BRED TO BULL COSTS PER COW AND HEIFER, 1947

Item	Number of cows and heifers bred		
	Low third	Middle third	High third
Number of herds	13	14	13
Cows per herd	11.2	16.1	24.4
Youngstock over 1 year per herd	2.9	5.5	8.9
Total	14.1	21.6	33.3
TOTAL COSTS	$235.75	$226.57	$326.70
TOTAL CREDITS	$ 82.62	$ 27.51	$ 38.55
NET BULL COST	$153.13	$199.06	$288.15
NET BULL COST PER COW AND HEIFER	$ 10.82	$ 9.23	$ 8.66

Total bull costs were a third higher on the large herds. In addition to this, total bull credits were less than half as great for the larger as compared to the smaller herds. Hence net bull costs were nearly twice as high in the large as in the small herds. However, in spite of these higher costs, size of herd over which to spread bull costs resulted in lower breeding costs per animal for the large herds.

Breed: Of the 40 herds studied, 17 were Holstein, eight were Guernsey, and three were Jersey. Twelve other herds were of mixed breeding. There were not enough herds keeping Guernsey and Jersey bulls for one year to make a reliable statistical comparison.

Study of the records indicated that there was a tendency for Holstein bulls to consume more concentrates and hay and to have higher feed costs than either Guernsey or Jersey bulls. Credits per bull, especially appreciation, tended to be greater for both the Holstein and Guernsey bulls than for the Jersey bulls, partially offsetting higher feed costs. Other factors, particularly labor efficiency and size of herd to be bred, appeared to be more important in determining net bull cost per cow and heifer than the breed of the bull.

Number of Bulls: Net bull costs were highest on those farms that kept the most bulls (Table 32). Even though net bull costs were higher on the 12 herds having more than one bull, net cost per animal bred was less than on those herds having just one bull because more cows and heifers were bred. The number of bulls was important in determining net bull cost, but the number of animals bred was more important in determining breeding cost per cow or heifer.

Of the 18 cooperators who kept a bull less than 12 months, 10 also practiced artificial breeding. Of the 40 farmers keeping a bull

12 months, four used artificial breeding. Only one of the 12 farmers keeping more than one bull used artificial insemination. While bull cost per animal bred was only $4.37 for that group keeping a bull less than a year, additional artificial breeding costs and bull fees made a total breeding cost of $6.31 per animal bred.

Table 32 - RELATION OF NUMBER OF BULLS PER FARM TO BULL COSTS PER COW AND HEIFER, 1947

Item	Number of bulls per farm per year		
	Less than one	One	More than one
Number of herds	18	40	12
Average number bulls per farm	.5	1.0	1.6
Cows per herd	14.2	17.2	22.6
Youngstock over 1 year per herd	4.5	5.8	9.3
Total	18.7	23.0	31.9
Hours labor on bull (or bulls) per farm	50	80	110
BULL COSTS PER FARM			
Feed	$ 57.67	$130.79	$190.19
Labor	47.14	77.65	107.94
Interest	3.18	10.96	21.21
All other	27.04	42.67	77.74
Total	$135.02	$262.07	$397.08
BULL CREDITS PER FARM			
Manure	$ 4.50	$ 10.35	$ 12.85
Fees received	.28	1.19	.42
Bull appreciation	48.49	37.47	115.12
Total	$ 53.27	$ 49.01	$128.39
NET BULL COST PER FARM	$ 81.75	$213.06	$268.69
NET BULL COST PER COW AND HEIFER	$ 4.37	$ 9.28	$ 8.40

COMPARISON OF DIFFERENT BREEDING METHODS

Comparison of Breeding Costs on Farms Using Bull, Artificial Insemination, and a Combination of Bull and Artificial Insemination: In an effort to compare the costs for different breeding methods, the records were grouped according to method used in breeding. Various combinations of breeding methods were employed by the 85 cooperators. Quite often, methods used in breeding the cows differed from methods used in breeding the heifers. To simplify this comparison of breeding costs, analysis was made only of the methods used in breeding the cows.

Of the 85 cooperators, 54 bred by bull exclusively. Some had one bull for 12 months, some had one bull for less than 12 months, and others had more than one bull for 12 months. Fifteen cooperators practiced artificial insemination exclusively. Twelve used both bull and artificial insemination. These three methods accounted for 81 of the 85 cooperators.

Net bull costs were prorated equally to the cows and heifers over one year. Only the cows' share of bull costs were charged against the cows. In the case of either artificial breeding fees or bull fees paid, these were charged against the cows or heifers as indicated by the cooperators.

Total breeding cost per cow averaged $8.99 for those breeding with a bull compared to $4.49 for those using artificial insemination (Table 33). Those cooperators breeding artificially had incurred small entry fees at the time they joined the artificial breeding cooperative. Those cooperators employing both breeding methods averaged $5.57 bull cost per cow and $2.69 artificial insemination cost per cow for a total breeding cost per cow of $8.26. The size of the cow herd averaged

larger on the herds bred by bull than on the herds bred by artificial insemination.

Table 33 - COMPARISON OF DIFFERENT METHODS OF BREEDING, 1947

Item	Methods of breeding		
	Bull	Bull and artificial	Artificial
Number of herds	54	12	15
Average number bulls per farm	1.08	.67	-
Number cows per farm	17.8	16.2	13.5
Number youngstock over 1 year per farm	6.1	5.7	7.6
Total	23.9	21.9	21.1
TOTAL BULL COSTS PER FARM	$279.72	$182.66	-
TOTAL BULL CREDITS PER FARM	$ 64.85	$ 60.67	-
NET BULL COST PER FARM	$214.87	$121.99	-
Net bull cost per cow	$ 8.99	$ 5.57	-
Artificial insemination cost per cow	-	2.69	$4.49
Total breeding cost per cow	$ 8.99	$ 8.26	$4.49

As already mentioned, those farmers breeding their cows artificially averaged only $4.49 cost per cow. The customary service charge, however, was $5.00. This difference occurred because farmers quite often did not breed those cows which they were culling, and breeding costs on the heifer replacements had previously been charged against the youngstock account.

The other four cooperators not included in Table 33 used various other combinations of breeding methods. One used bull, artificial breeding, and paid bull fees averaging $12.55 per cow. Another paid bull fees and kept a bull for two months averaging $4.59 breeding cost per cow. Both bull fees and artificial fees were paid by one cooperator who averaged $9.31 cost per cow. There was only one farmer

who bred cows by paying bull fees exclusively. He averaged $1.13 per cow.

Effect of Size of Herd on Cost Advantage of Bull and Artificial Insemination: As indicated in Table 33, the average net bull cost per farm on 54 farms, where no other methods of breeding were employed, was $214.87. An average of 23.9 animals were bred at an average cost of $8.99. On the farms using artificial insemination exclusively, it cost $4.49 per cow. It can be readily seen that it would take a dairy herd of considerable size before keeping a bull would be more economical than breeding artificially. Most Michigan farmers do not have the size of herd required to afford keeping a bull at 1947 costs.

As indicated, when the size of dairy herd increases, from a cost viewpoint, it becomes less advantageous to use artificial breeding. During a period of declining prices, it would also become less advantageous, from a cost viewpoint, to use artificial breeding. The cost of artificial insemination would not likely decline as much as the cost of keeping a bull. In comparing artificial breeding with bull costs, one has to assume that the resources marketed by the bull (feed, labor, buildings) can be put to other uses as profitable as marketing them through the bull.

Factors Other Than Costs: There are other important factors to consider in comparing bull costs with artificial breeding costs. The inheritance factors for high milk production should be considered for the two breeding methods. Although there are many superior farm bulls, the average farm bull is probably a less valuable animal than those bulls selected for artificial insemination. The milk production

ability of the heifer replacements is probably a more important factor in reducing dairy costs than are breeding costs.

Another point to consider is that a bull can be a dangerous animal to have on the farm. A number of people have been injured and even killed by bulls. Safety to the farm family is a factor which should not be overlooked.

SUMMARY

Dairymen are confronted with the problem of annually replacing about 31 percent of the dairy herd. In 1947, it cost an average of $854.75 to produce 3.6 heifers and $325.32 to buy 1.5 cows or a total of $1,180.07 per farm for replacement needs on 85 herds averaging 16.5 cows.

There are at least two methods of figuring the costs of raising a heifer to freshening. If the sales of calves for breeding stock or veal are considered as incidental to raising heifer replacements, an average of $237.43 cost per heifer was tied up in the freshened heifers.

If the average monthly cost per head of youngstock and the average age of freshening are used to compute heifer costs, it was costing $263.70 per freshened heifer in 1947. In using this method of calculation, the assumption has to be made that the proportion of calves under one year of age and heifers over one year in the youngstock herd remain essentially the same.

Some of the more important factors related to the efficient production of youngstock included feeding efficiency, labor efficiency, and the quality or producing ability of the heifer raised. Other factors having a bearing upon costs were calf value charged at five days' age and breeding costs. The breed and the size of the youngstock herd did not greatly affect youngstock costs.

Thirty-six farmers (35 of whom raised calves) were visited in an effort to relate management practices to costs. About half were high-cost and half were low-cost producers. The data indicated that the age of freshening was not as important as other factors in determining freshened heifer costs. There was more variation within the

high and low-cost groups as to methods of feeding milk than there was between the two group averages. The same was true for hay feeding methods. The low-cost group did more grain feeding on pasture according to age of heifer than did the high-cost group.

About eight percent of all calves on the 35 farms raising calves were either born dead or died at an early age. Total calf mortality was higher in the high-cost group, and more of that mortality was due to causes more nearly under the control of the farmer than in the case of the low-cost group.

The farmers' greatest problem in raising heifers was disease. Scours at a young age was given as the greatest disease problem. This problem is related to milk feeding management. Other problems were proper feeding and breeding management.

Most farmers preferred raising rather than buying replacements. The most important reasons were that the quality of heifer replacements raised was superior, there was a definite program of heifer selection based upon production records and superior sires, the quality of the cows they were buying was unknown, raising heifers involved less cash outlay, and there was the risk of bringing disease into the herd with purchased cows.

Opinions of the farmers on opportunities for heifer cost reduction included better feeding practices, reduction of labor hours spent with the youngstock herd, raising only well-bred heifers, and more sanitation to reduce disease. Better feeding practices included the feeding of more and higher quality hay, more use of pasture, and longer pasture seasons.

Several of these dairymen believed that the more convenient arrangement of feeding and water facilities for older heifers could reduce labor hours and labor costs.

It cost an average of $213.06 on 40 farms to keep a bull one year after allowing for credits--manure, fees received, and appreciation in value. This net cost on the basis of per cow and heifer over one year of age averaged $9.28.

Some factors related to low bull costs were feeding efficiency, labor efficiency, appreciation in bull value during the year, and number of cows and heifers bred.

Farmers using a bull had higher breeding costs per cow than farmers using artificial insemination. The cost advantage of artificial insemination becomes less as the number of cows and heifers bred becomes higher. The cost of keeping a bull would probably decline more than artificial breeding costs during a period of declining prices.

In comparing bull with artificial breeding costs, there are other factors to consider. One is the milk producing ability of the heifer replacements. Another is the risk of injury to members of the farm family by having a bull on the farm.

APPENDIX

Farm Mgt. Dept., M. S. C. Mich. Milk Producers Ass'n

INVENTORIES

Name_____ Address_____ Date_____

County_____ Township_____ Section_____

DAIRY CATTLE

Name or number	Age	Beginning of year	End of year	Name or number	Age	Beginning of year	End of year
1.		$	$	19.		$	$
2.				20.			
3.				21.			
4.				22.			
5.				23.			
6.				24.			
7.				25.			
8.				26.			
9.				27.			
10.				28.			
11.				29.			
12.				30.			
13.				Total			
14.				Bulls			
15.							
16.				Heifers (over 1 year) No.			
17.				Calves (under 1 year) No.			
18.				Other cattle No.			

BUILDINGS

Description	Beginning of year	End of year
Dairy barn*	$	$
Milk house		
Bull shed or pen		
Separate calf pens		
Total		

EQUIPMENT

Description	Beginning of year	End of year
Milking machine	$	$
Milk cooler		
Milk cans		
Pails and strainer		
Cream separator		
Cooling tank		
Hot water heater		
Forks, shovels, stools		
Electric fencer		
Total		

*Share of floor space used by: Cows____% Bulls____% Young stock____%

Farm Mgt. Dept., M. S. C. Mich. Milk Producers Ass'n

MONTHLY DAIRY COSTS

Name_____ Address_____ Month of_____ 19____

1. CONCENTRATE MIX (*Only*)

Concentrate mix	Amount (lbs.)	Average price	Total value
Corn		$	$
Oats			
Barley			
Grinding			
Mineral			
Salt			
Total		XXXXXXXX	

Concentrate use		
Item	Amount	Value
On hand first of month		$
Mixed or bought		
Total		
On hand end of month		
Used		
Share to:		
Cows		
Bulls		
Young stock		
Other stock		

2. FEED SUMMARY (*Concentrate Mix, Other Grains, Roughage and Pasture*)

Kind	Average price	Cows		Bulls		Young stock	
		Amount	Value	Amount	Value	Amount	Value
Conc. mix lb.	$		$		$		$
Other grain lb.							
Hay T.							
Silage T.							
Pasture							
Total	XXXXXXXX	XXXXXXXX		XXXXXXXX		XXXXXXXX	

3. LABOR RECORD

Worker	Rate*	Cows		Bulls		Young stock	
		Hr. per mo.	Value	Hr. per mo.	Value	Hr. per mo.	Value
Hired help	$		$		$		$
Farmer							
Family							
Total	XXXXXXXX						

*For hired help rate per hour: Cash wages per month $_____ Value of items supplied (list them)_____

_____ Total Wage $_____

Hours worked in a typical week-day_____ X _____ days in month = _____ hours

Hours worked in a typical Sunday _____ X _____ Sundays in month = _____ hours

Divide total monthly wage $_____ by total hours in month_____ for rate per hour_____.

Monthly wage for you $_____ Hours you worked in month_____ your rate per hour_____.

Average daily time spent on cows: Milking_____ minutes. Feeding_____ minutes.

4. PURCHASES AND SALES OF DAIRY CATTLE

Date	Cow purchases	No.	Value	Date	Cow sales	No.	Value
			$				$
	Heifers freshening				Cows butchered		
					Cows died		XXXXXXXX
	Total				Total		
Cows on farm at first of month			XXXXXXXX	Cows on farm at end of month			XXXXXXXX
	Total number		XXXXXXXX		Total number		XXXXXXXX
	Bull purchases				Bull sales		
	Calf purchases				Calf sales		

Average number of cows for month_____. Calves born during month_____. Number of dairy heifers at beginning of month over 1 year_____under 1 year_____. Number of bull calves at beginning of month over 1 year_____under 1 year_____

5. DAIRY PRODUCTS SOLD AND USED

Milk					Cream and skimmilk				
Sold Date	Pounds	Test	Net receipt*		Sold Date	Pounds	Test	Price	Net receipt*
			$					$	$
					Used: House				
					Fed				
Used: House		XXXXXX			Total		XXXXXX	XXXXXX	
Fed		XXXXXX			Calves at 5 days age				
Total		XXXXXX			Manure				
Subsidy payment (rate)					Total income				

*Hauling and fees are to be deducted. Enter other expense items below.

6. MISCELLANEOUS EXPENSES OF DAIRY CATTLE

Date	Item**	Cows	Bulls	Young stock
		$	$	$
	Bedding (price per ton $)			

**Dairy equipment repairs and supplies, expenses on barn, share of electric bill, veterinary, medicine, breeding fees, testing dues, and other dairy expenses.

ANNUAL DAIRY COST SUMMARY

Name _____ Milk: Av. B.F. test ___ % Production per cow _____

County _____ Butterfat: Total production _____ per cow

COWS: Breed _____ Av. no.

COSTS	Total	Per Cow
Feed	$	$
Labor ____ hrs.		
Cow depreciation		
Interest on invest.		
Building use		
Equipment use		
Breeding cost		
Misc: Electricity		
Vet. and Med.		
Bedding		
Other		
Overhead (5%)		
Total	$	$
INCOME		
Milk sold	$	$
Milk used		
Total		
Subsidy		
Calf value		
Manure credit		
Cow appreciation		
Total	$	$
Net Return		
Return per hour		

COSTS AND INCOME PER UNIT OF PRODUCT

Item	Milk (per cwt.)	Butterfat (per lb.)
Costs: Feed	$	$
Labor		
Other		
Total		
Income: Milk		
Other		
Total	$	$
Net Return		

YOUNGSTOCK: No. under 1 yr. ___ over 1 yr. ___

COSTS	Total	Per Head
Feed	$	$
Labor ____ hrs.		
Calf value		
Interest on invest.		
Building use		
Equipment use		
Breeding cost		
Misc: Electricity		
Vet. and Med.		
Bedding		
Other		
Overhead (5%)		
Total	$	$
INCOME		
Appreciation	$	$
Manure credit		
Total	$	$
Net Return		
Return per Hour		

BULLS: Average no. _____

Feed	$	$
Labor ____ hrs.		
Bull depreciation		
Interest on bull		
Building use		
Equipment use		
Misc: Bedding		
Other		
Overhead (5%)		
Total	$	$
Manure credit		
Other income		
Total	$	$
Net Cost for Year		
Cost per Service		

FEED AND LABOR AMOUNTS AND VALUES

	COWS			BULLS			YOUNGSTOCK		
	Amount			Amount			Amount		
FEED	Per Head	Total	Value	Per Head	Total	Value	Per Head	Total	Value
Conc. mix.			$			$			$
Other grain									
Hay									
Silage									
Other rough.									
Pasture									
Milk to Y.S.									
Total									
LABOR									
Hired help									
Farmer									
Family									
Total									

CATTLE INVENTORIES, PURCHASES, SALES, AND APPRECIATION OR DEPRECIATION

Ending inventory	no.	$		no.	$		End. inv'ty.	$
Sales							Sales	
Total credits							Heifers, Bulls	
Beginning inventory							Total Cr.	
Purchases							Beg. inv'ty.	
Heifers freshening				Bulls kept			Purchases	
Total debits							Total Dr.	
Appreciation								
Depreciation								
Interest on av. investment at 5%		$			$			$

BUILDINGS AND EQUIPMENT INVENTORIES AND CHARGES

Item	Barn	Milkhouse			Equipment	Barn Usage:		
Beg. inv'ty.	$	$	$	$	$	Cows	%	%
End. inv'ty.						Bulls	%	%
Depreciation						Y.S.	%	%
Interest (5%)						Barn use charge:		
Taxes, ins. (2%)						Cows	$	$
Rep. and new						Bulls	$	$
Total cost						Y.S.	$	$

I. FEEDING SCHEDULE - Per Heifer Per day

Age	Wt.	# Milk	# Calf Starter	Grain		Hay	Silage	Other Roughage
				Home grown	Herd ration			
6 mo								
10 mo.								
24 mo.								
Fresh.								

II General
1. Breed _____

III Milk Feeding A. At Birth
1. How many hours before calf separated from cow? _____
2. Number of days calf left with cow _____

B. Nurse Cow
1. Do you use the nurse cow method? _____
2. If so, number of calves to suck one cow? _____
3. Is the nurse cow a less valuable animal? _____ In what way? _____
4. Is the nurse cow a low tester? _____ High tester? _____
5. How many times per day does the calf suck? _____ When? _____
As regular intervals? _____

C. Hand Feeding
1. Do you hand feed rather than use the nurse cow method? _____
2. If so, do you use open pail? _____ Nipple pail? _____ Nipple & Bottle? _____
Why do you use this method of hand feeding milk? _____
3. Do you heat the milk? _____ What temperature? _____ Until calf is what age? _____
4. How many times per day do you feed the milk? _____ At regular intervals? _____
5. Do you use high test milk? _____ Low test milk? _____
6. Do you dilute milk? _____ What proportions? _____

IV Water for Calves
1. Do you heat water for calves? _____ To what temperature? _____ Until calf is what age? _____

V Hay Feeding
1. Legume___ Legume-Grass___ Grass-Legume___ Grass___ Other _____
2. Quality: Excellent___ Good___ Fair___ Poor___
3. In feeding, do you select the highest quality hay for the calves? _____
4. Do you feed hay without especially selecting the best quality for the calves? _____
5. Do you feed hay to the calves which is left over from the cows' mangers? _____

VI Pasture Feeding
1. Age when heifers first turned to pasture _____
2. Grain feeding on pasture
(a) all heifers _____
(b) only the heifers under _____ months
(c) none of the heifers _____
3. Hay feeding on pasture
(a) all heifers _____
(b) only the heifers under _____ months
(c) none of the heifers _____
4. When heifers 12 months old or older are turned on pasture,
(a) they continue to receive dry roughage and grain for few days _____
grain only _____ dry roughage only _____
(b) pasture only _____
5. Kind of pasture preferred (operator)
(a) heifers under 1 yr.: leg.__ leg.-grass__ grass-leg.__ grass__ other _____
(b) heifers over 1 yr.: leg.__ leg.-grass__ grass-leg.__ grass__ other _____

VII Sanitation A. Hand Feeding Milk

1. In hand feeding milk, do you sterilize utensils? _____ when? _____
how? _____ what material? _____

B. Pens

1. Does the young calf have an individual pen? _____ until calf is what age? _____
2. Average space for 1 mo. old calf _____ sq. ft.
Average space for 2-3 mo. old calf _____ sq. ft.
Average space for all calves _____ sq. ft.

C. Bedding and Cleaning

1. How many times per day do you bed? _____
2. How many times per day do you clean pens? _____
3. Any device used to help keep pens dry? _____

D. Other

1. Does grain feeding follow milk feeding? _____
Does milk feeding follow grain feeding? _____
After milk feeding, are young calves separated by some means to prevent sucking each other? _____ How? _____

VIII Disease

1. How many death losses last year? _____ Total calves born? _____
Approximate % death losses? _____
How many losses from scours? _____ digestive? _____ contagious? _____
How many losses from pneumonia? _____
How many losses from other causes? _____ cause? _____
2. How many calves had scours last year? _____ pneumonia? _____ colds? _____
3. Do you vaccinate calves against Bang's disease? ____ age of vaccination? _____
4. Any Bang's disease in cow herd? _____ How many cows infected last year? _____
5. Do you isolate sick calves? _____

IX Breeding

1. Age heifers generally bred _____ Average age of freshening _____
2. Approximate no. of breeding services _____
(a) artificial _____
(b) natural _____
(1) bull runs with heifers _____
(2) hand-mated _____
3. Variation in age of first freshening _____

X Season of calf birth

1. What time of year do you prefer that calves come? _____
Why? _____

XI Shelter A. General

1. Housed in same barn as cows? _____
adjacent to cows? _____
non-adjacent to cows? _____
2. Housed in cheaply constructed shed _____
3. Housed in specially built calf barn _____
4. Housed otherwise _____

B. Calf Pens

1. Are pens ventilated? _____
2. Are pens located free from drafts? _____

C. Maternity Pens

1. How many maternity pens? _____
2. Maternity pens free of drafts? _____
3. Maternity pens cleaned after used? _____
4. Maternity pens disinfected after used? _____

D. Yearling Heifers

1. Stand with cows _____
2. In different part of barn _____
3. In different barn _____

XII Hazards

1. List in order of importance, the greatest hazards, from a management viewpoint, of raising heifers:
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____
   f. _____

III Herd replacement methods

1. How many cows did you buy last year? _____
2. How many first calf heifers freshened last year? _____
3. Do you prefer buying replacements? _____
   Reasons (a) Starting a herd _____
   (b) Increasing size of herd _____
   (c) To improve the herd _____
   (d) Can buy better quality than can produce _____
   (e) Cheaper to buy than to raise _____
   (f) To adjust production _____
   (g) Insufficient feed, facilities, or labor for raising heifers _____
   (h) Other reasons _____
4. What do you try to observe in buying replacements?
   a. Reputable dealer _____
   b. Udder trouble _____
   c. Disease tested _____
   d. Production records _____
   e. Purchase from farmers with a large surplus of cows _____
   f. Purchase from a farmer going out of business _____
   g. If from a distance, purchase only animals selected by a competent judge of dairy stock _____
   h. Other _____
5. Do you prefer raising replacements? _____
   Reasons (a) Financial
   (1) less cash outlay _____
   (2) cash expense of raising less noticeable _____
   (3) unsaleable surplus feed used by heifers _____
   (4) home grown feed costs less _____
   (b) Less chance of bringing disease into herd _____
   (c) Quality
   (1) Quality of heifers raised is superior _____
   (2) Quality of cows purchased unknown _____
   (3) Quality of cows purchased not commensurate with price _____
   (d) A definite program of herd improvement
   (1) Production records _____
   (2) Superior sire _____

IV Reduction of heifer costs

1. If you could rent pasture for $5.00 per head for pasture season in northern Michigan, would you truck heifers there for pasture season? _____
2. In cases where dairymen lose nearly as much raising heifers as they make on cows, what do you think should be done? _____
3. How do you think cost of raising heifers might be reduced? _____

BIBLIOGRAPHY

BIBLIOGRAPHY OF REFERENCES CITED

(1) Carter, E. H.
1947. DAIRY COSTS AND RETURNS IN DETROIT MILK SHED. Mich. Agr. Exp. Sta. Mimeo. Bul. 417, 11 pp., illus.

(2) Carter, E. H. and Wright, K. T.
1946. DAIRY COSTS AND RETURNS IN SOUTHEASTERN MICHIGAN. Mich. Agr. Exp. Sta. Mimeo. Bul. 397, 11 pp., illus.

(3) Vincent, W. H.
1948. DAIRY COSTS AND RETURNS IN DETROIT MILK SHED. Mich. Agr. Exp. Sta. Mimeo. Bul. 434, 12 pp., illus.

BIBLIOGRAPHY OF REFERENCES NOT CITED

(1) Ahalt, Arthur M. and Hamilton, A. B.
1942. COST AND ADVISABILITY OF RAISING DAIRY HEIFERS. Md. Agr. Exp. Sta. Bul. A17, pp. 145-180, illus.

(2) Barlow, Frank D. Jr. and McGough, Morris L.
1948. DAIRY FARMING IN THE NORTH LOUISIANA UPLAND COTTON AREA--ORGANIZATION, COSTS, AND RETURNS. La. Agr. Exp. Sta. Bul. 435, 32 pp., illus.

(3) Brown, A. J.
1946. AN ANALYSIS OF PRICES OF VEAL CALVES. Ky. Agr. Exp. Sta. Bul. 483, 59 pp., illus.

(4) Brown, A. J.
1946. SEASONAL VARIATION IN PRICES OF VEAL CALVES. Ky. Exp. Sta. Bul. 490, 35 pp., illus.

(5) Byers, George B. and Besh, Ted S.
----. YOUNG DAIRY STOCK COSTS 20 HERDS KENTUCKY - 1933. Ky. Agr. Ext. Mimeo., 5 pp., illus.

(6) Byers, George and Besh, Ted
----. YOUNG DAIRY STOCK AND HERD BULL COSTS IN SHELBY, JEFFERSON, MARION, BOURBON, AND CARROLL COUNTIES, KENTUCKY. 1931. Ky. Agr. Ext. Mimeo, 3 pp., illus.

(7) Byers, George B., Besh, Ted, and Collins, Jesse
----. YOUNG DAIRY STOCK COSTS 19 HERDS SHELBY, JEFFERSON, MARION, CLARK, BOURBON, AND FAYETTE COUNTIES, KENTUCKY - 1932. Ky. Agr. Ext. Mimeo., 6 pp., illus.

(8) Byers, George B. and Harris, George M.
----. YOUNG DAIRY STOCK COSTS 24 HERDS KENTUCKY - 1934-35. Ky. Agr. Ext. Mimeo., 7 pp., illus.

(9) Corbet, Ralph A.
1947. RAISING DAIRY CALVES AND HEIFERS. Me. Agr. Ext. Bul. 300, 20 pp., illus.

(10) Cunningham, L. C.
1944. COST OF RAISING DAIRY HEIFERS IN NEW YORK. Cornell Agr. Exp. Sta. Bul. 807, 10 pp., illus.

(11) Dow, George F.
1932. COSTS AND RETURNS IN PRODUCING MILK, RAISING HEIFERS, AND KEEPING BULLS IN MAINE, Me. Agr. Exp. Sta. Bul. 361, 175 pp., illus.

(12) Engene, S. A. and Pond, G. A.
1946. A PRELIMINARY REPORT OF DATA SECURED IN 1941, 1942, 1943, 1944, and 1945 ON THE FARM ACCOUNTING ROUTE IN NICOLLET COUNTY, MINNESOTA. Minn. Div. of Agr. Econ. Mimeo. 158, 34 pp., illus.

(13) Engene, S. A., Pond, G. A., and Anderson, A. W.
1941. A PRELIMINARY REPORT OF DATA SECURED IN 1940 ON THE FARM ACCOUNTING ROUTE IN WINONA COUNTY, MINNESOTA. Minn. Div. of Agr. Econ. Mimeo. 125, 33 pp., illus.

(14) Grinnell, H. C.
1938. DAIRY HERD REPLACEMENTS IN SOUTHERN NEW HAMPSHIRE. N. H. Exp. Sta. Bul. 302, 27 pp., illus.

(15) Herman, H. A.
1947. RAISING THE DAIRY CALF. Mo. Agr. Exp. Sta. Bul. 377, 28 pp., illus.

(16) Knott, J. C., Hodgson, R. E., and Ellington, E. V.
1932. RAISING DAIRY CALVES WITH DRIED SKIM MILK. Wash. Agr. Exp. Sta. Bul. 273, 19 pp., illus.

(17) McGough, Morris L. and Barlow, Frank D. Jr.
1948. DAIRY FARMING--NORTH LOUISIANA UPLAND COTTON AREA--ECONOMIC STUDY. La. Agr. Exp. Sta. Mimeo. Cir. 88, 149 pp., illus.

(18) Miller, L. F. and Herrmann, Roy
1948. COSTS IN KEEPING A BULL COMPARED WITH ARTIFICIAL BREEDING. Pa. Agr. Exp. Sta. Bul. 499, 6 pp., illus.

(19) Mosher, M. L., Reiss, F. J., Hughes, E. M., and Jepson, H. L.
1945. THREE YEAR REPORT OF THE FARM BUREAU FARM MANAGEMENT SERVICE ON 150 FARMS IN NORTHEAST ILLINOIS, 1942, 1943, 1944. Ill. Ext. Ser. Mimeo. AE2342, 24 pp., illus.

(20) Selby, H. E. and Kuhlman, G. W.
1934. COST AND EFFICIENCY IN RAISING DAIRY HEIFERS IN OREGON. Ore. Agr. Exp. Sta. Bul. 324, 38 pp., illus.

(21) Staples, C. H. and Lush, R. H.
1934. COST OF RAISING DAIRY HEIFERS. La. Col. Cir. 9, 9 pp., illus.

(22) Weaver, Earl, Johnson, L. A., and Smiley, E. S.
1948. RAISING DAIRY CALVES Mich. Ext. Bul. 105, 20 pp., illus.