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NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION
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UNITED STATES DEPARTMENT OF AGRICULTURE
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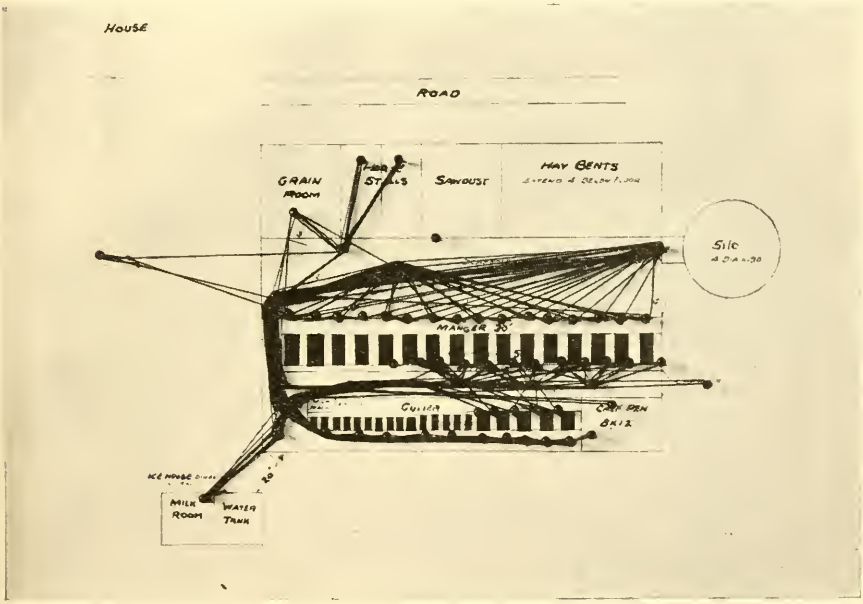
Efficiency Studies in Dairy Farming



String record of evening chores on one farm. The string indicates the travel of the operator.

By H. C. Woodworth, C. W. Harris, Jr.
and Emil Rauchenstein

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EFFICIENCY STUDIES IN DAIRY FARMING

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For the year ending March 31, 1932, the family labor incomes of 38 farmers in Grafton County varied from a loss of $964 to a gain of $1721. Thirteen farmers had family labor incomes ranging from $711 to $1721, 13 others ranged from $184 to $670, and the 12 lowest ranged from a loss of $964 to a gain of $162.

These differences are no greater than those usually found in similar studies in this and in other areas. Two years earlier the results of a farm management survey of 414 farms, reported in New Hampshire Agricultural Experiment Station Bulletin 260, showed a range in labor incomes from a loss of $2,679 to a gain of $5,138. Why such differences in net returns? A study of records in 1930 showed that some of the variations in returns are associated with differences in size of business as measured by farm acreage, crop acreage, number of cows, and productive man work units. Some of these are associated with differences in quality as measured by crop yields, pounds of milk sold per cow and grade of milk. Still other variations are associated with labor efficiency as measured by productive man work units per man or are due to some intangible personal factors, and to chance.

But underlying most of these factors are more fundamental ones which are more nearly of a causal nature. For example, high production per cow may go back to skillful feeding and care and to a careful and fortunate selection of breeding stock 10 and 20 years earlier. Inefficiency in the use of labor may be due to inconvenient arrangement of buildings and fields, and to a farm and herd too small for the available family labor.

This study was started for the purpose of going as far as possible into the causes of variations in farmers' net returns in order to determine to what extent improvements can be made by individual farmers under their respective conditions. Forty farmers who had

*Acknowledgment is made to the following dairymen for their patience in keeping records and for their co-operation in studying dairy problems:

E. H. Aldrich
William Blaisdell
Lawrence Caswell
Theodore Chamberlain
Dwight Child
Peter Dargie
Clyde Darling
W. V. Darling
Ernest Ellsworth
C. J. Frink
Ed. Glidden
Leon Hall
Raymond Hill
E. C. Hinman
Alfred Houston
Carl Howland
Fred C. Lee
Julius Lang
Roe McDanolds
G. Cavis Minot
Fred Morrill
Alonzo Morris
Henry Page
Harry Partridge
Hugh Poor
Lester Presby
George Putnam
William Putnam
K. G. Robinson
Perley Rutledge
Everett Smith
Homer Smith
Howard Smith
Norman Smith
Joseph Stearns
Ernest Stevens
Ernest Underhill
Henry Underhill
Stephen Underhill
Charles White
Minot Woods
Ollie Young
Maurice Young

been included in the farm management survey in 1930 cooperated in this study by keeping records of receipts and expenses and furnishing additional information as requested. Mr. C. W. Harris, Jr., was stationed at Woodsville for more than a year, supervising the record keeping and obtaining the additional data needed to interpret the financial records. Thirty-eight records were completed.

Early in the summer of 1931 a record of the production, receipts, and expenses was obtained from each farmer for the previous year, so that by April, 1932, three consecutive years of production and financial records were available on each of the 38 farms. In addition a field map was made of each farm for the 1931 crop year, plans were drawn of the barn arrangement, feed records were carefully checked, labor records were taken on the more important operations, including some detailed time and motion studies on chores; pasture and crop conditions were noted, and general notes were kept about each farm.

In this detailed study of 38 farms no attempt has been made to determine statistically the influence of the different factors on income. Following a general survey of over 400 farms in this same area the findings of which concur with those of hundreds of similar investigations in other states, this study by a detailed examination of individual farms seeks to determine how individual farmers attained or failed to attain high rank in such factors as production per man and production per cow.

It is evident that on any one farm, the influence of a favorable factor such as good production per cow may be wholly or partially offset by unfavorable factors. The relationship of all the separate factors to each other and to income is very complicated, and while variations in any one separately may not indicate the entire story, to study one at a time is the simplest procedure. However, one must have constantly in mind that the relationships of each separate item studied to other factors is extremely complicated and difficult to measure.

In the following pages the objective is to study and account for variations from farm to farm in such factors as milk production per cow, crop production and production per man.

Weather Conditions During the Period of This Study

During the 1931 crop year rainfall was generally favorable for good pasture and crop yields. Similar conditions prevailed during the preceding two years. The winter of 1931-1932 was unusually open, although this probably did not affect milk production.

SUMMARY OF THE FARM BUSINESS FOR THREE YEARS

Changes in prices of products bought and sold by Grafton County farmers during the three consecutive years under consideration are clearly shown in the farm business summaries.

Table 1 shows the average results of the 38 farms on which records were obtained for the three consecutive years. The value of land and buildings was kept constant for the whole period but repairs and depreciation were included under expenses. The total capital remained on the average at practically a constant figure.

TABLE 1. *Summary of farm business on 38 farms for three years. (April 1, 1929, to March 31, 1932.) Same farms throughout.*

	1930		1931		1932	
Farm Capital:	*Dollars*		*Dollars*		*Dollars*	
Real estate	6,916		6,916		6,916	
Livestock	2,620		2,704		2,611	
Farm motors	419		416		486	
Milking machine	169		163		168	
Other farm machinery	1,139		1,087		1,068	
Feed and supplies	198		273		274	
Total		11,461		11,559		11,523
Receipts:						
Dairy and milk	3,917		3,566		2,506	
Eggs	158		124		64	
Livestock and meat	751		558		593	
Crop sales	225		259		181	
Miscellaneous sales	398		259		412	
Increase in value of livestock	273		57		—	
Increase in value of feed and supplies	99		91		—	
Total		5,821		4,914		3,750
Expenses:						
Livestock purchases	509		399		188	
Feed	1,461		1,097		764	
Bedding	34		27		18	
Labor hired	615		522		472	
Extra compensation charge	103		82		89	
Repairs farm motors and depreciation	136		91		114	
Milking machine repairs and depreciation	29		32		22	
Other farm machinery repairs and depreciation	180		166		131	
Building repairs	36		102		80	
Depreciation	94		89		89	
Gasoline and oil	104		108		107	
Miscellaneous expenses	505		369		334	
Taxes	298		260		246	
Insurance	51		48		39	
Decrease value of livestock	—		—		199	
Decrease value of feed and supplies	—		—		6	
Total		4,155		3,392		2,898
Farm income		1,666		1,522		858
Interest at 5%		573		578		576
Family labor income		1,093		944		282
Supplies used in household:						
Milk and milk products	89		64		44	
Poultry, eggs and meat	56		69		60	
Garden and potatoes	113		65		35	
Wood	174		107		100	
Total produce		432		305		239
Family income		1,525		1,249		521
Additional factors:						
Pounds of grain fed per cow		1,772		1,678		1,197
Pounds of milk sold per cow		5,606		5,158		4,968
Number of cows (average)		23.6		24.6		24.9
Price of milk		$3.07		$2.68		$1.91
Pounds of grain per 100 pounds of milk sold		31.6		32.5		24.1

For the year ending March 31, 1930, the price of dairy products was favorable to the producer and the receipts for milk averaged $3,917 per farm.

Two years later the return from the same source was only $2,506, or 36 per cent lower, the largest drop occurring between the 1931* and 1932* financial statements. Total receipts went down in about the same proportion, or from $5,821 in 1930* to $3,756 in 1932, a decline of 35.5 per cent.

Expenses as a whole declined less than receipts. The total per farm dropped from $4,155 in 1930 to $2,898 in 1932, or 31.8 per cent. The sharpest reductions occurred in livestock and feed purchases each of which were reduced more than 48 per cent, due partly to price declines and partly to lighter feeding. The price paid for dairy feed in 1930 averaged $50 per ton compared with $32 in 1932. Other expenses such as taxes, insurance, repairs and depreciation on buildings and equipment did not go down much. These items kept total expenses from falling proportionally as much as total receipts.

The sharp reduction in receipts and a smaller proportional reduction in expenses caused a drop in the average net farm income from $1,666 in 1930 to $858 in 1932, a drop of nearly 52 per cent. Five per cent interest on the total capital was subtracted from the net farm income on each farm in order roughly to estimate the return for labor and management and to put large and small farms on a more nearly comparable basis. The remainder is called "family labor income." It differs from "labor income" in that family labor has not been included in the expenses. On these farms a comparatively small amount of family labor is used and its value is difficult to determine. A fair estimate would be $15 per farm. Naturally the family labor income dropped to almost nothing in 1932 in view of the many nearly constant items of expense subtracted from rapidly falling receipts. Only $282 remained as family income in 1932 compared with $1093 in 1930.

While interest on the capital investment has been considered in calculating family labor income, this item is an out-of-pocket expense only where there is indebtedness. It is to be noted that the operator has the use of a house and consumes farm products. The amounts of dairy and poultry products, meats, vegetables, potatoes and wood used were approximately the same for each of the three years. Due to the changes in values, however, the average total worth of farm products used in the home was $432 in 1930, $305 in 1931 and $239 in 1932.

Feeding practices were changed to some extent, apparently as a result of the drop in milk prices from $3.07 per 100 pounds in 1930 to $1.91 in 1932. During this period the average annual amount of grain fed per cow decreased from 1,772 pounds to 1,197 pounds. (Table 1).

VARIATIONS IN MILK PRICES

The highest yearly average price per 100 pounds of milk received by any one of the 38 farmers was $2.42; the lowest, $1.37. (Table 2.) In each of these extremes the butterfat test was the same, yet the difference in price was $1.05 per hundred. On a farm selling 150,000

*1930, 1931, 1932 refer to years ending March 31, 1930, 1931 and 1932, respectively.

TABLE 2. *Variations in the price received for milk by 38 farms for the year ending March 31, 1932. Farms arrayed in the order of average price received for milk.*

Farm rank	Average price per cwt. all milk sold	Grade of milk	Average price per cwt. of rated milk	Average price per cwt. of premiums	Average price per cwt. of surplus	Per cent butterfat	Per cent of possible rated milk sold as rated milk	Per cent of total milk sold as surplus	Trucking charges per cwt.	Pounds of grain fed per cow	Family labor income	Pounds of milk sold per cow
	Dollars		Dollars	Dollars	Dollars				Dollars		Dollars	
1	2.42	A	2.07	.38	1.46	4.0	92.35	2.71	–	1090	1423	4839
2	2.34	A	2.00	.39	1.56	4.15	96.41	5.61	–	735	318	3596
3	2.31	A	2.09	.39	1.45	4.17	98.03	16.72	.15	1060	603	4922
4	2.27	A	2.00	.29	1.38	3.91	76.10	2.97	–	535	217	3580
5	2.25	A	2.08	.34	1.31	4.55	92.75	15.35	.14	1366	1174	4055
6	2.24	A	1.91	.40	1.20	3.49	98.35	7.33	.15	2811	926	10445
7	2.16	A	2.00	.38	1.31	3.66	99.00	20.54	–	2556	1721	6311
8	2.16	A	1.92	.30	1.18	3.55	93.87	7.78	–	2166	779	7067
9	2.15	A	1.86	.31	1.01	3.52	98.70	1.36	–	2200	1643	6315
10	2.13	A	1.96	.29	.99	4.16	80.26	10.01	–	1344	829	4667
11	2.11	A	1.97	.19	1.02	3.87	99.36	4.56	–	1374	−774	4751
12	2.10	A	1.85	.33	1.47	3.53	90.53	8.62	.10	883	670	5530
13	2.08	B	*	–	–	5.04	–	–	.15	1007	184	3432
14	2.05	B	*	–	–	5.08	–	–	–	240	45	2958
15	2.03	A	1.70	.34	1.22	3.55	90.54	1.41	.19	1333	−185	5605
16	1.99	A	1.72	.35	1.32	3.53	86.84	10.75	.15	1498	946	4826
17	1.96	A	1.83	.28	1.08	3.44	98.90	15.01	–	2229	61	8740
18	1.91	B	2.22	–	1.38	4.8	–	36.81	–	499	219	4604
19	1.89	B	2.02	–	1.40	3.7	–	20.68	–	373	767	3152
20	1.87	A	1.75	.20	1.38	3.6	80.29	14.47	–	1201	329	4387
21	1.82	B	2.17	–	.86	3.78	–	26.57	–	994	1377	5105
22	1.81	B	2.02	–	1.38	4.27	–	24.62	.15	1652	−413	5048
23	1.81	B	†	–	–	4.06	–	–	.12	1357	−225	5000
24	1.81	B	2.14	–	1.13	3.57	–	33.04	.15	1047	288	4508
25	1.78	B	†	–	–	3.73	–	–	–	1454	1103	6340
26	1.77	B	2.35	–	1.35	4.62	–	48.33	–	1154	455	5330
27	1.76	B	1.69	–	–	3.98	–	–	.15	1729	546	6348
28	1.74	B	1.99	–	1.25	4.22	–	33.14	–	833	−672	3142
29	1.71	B	*	–	–	3.91	–	–	.15	1170	−81	4491
30	1.69	B	†	–	–	3.51	–	33.34	–	1006	781	5632
31	1.69	B	1.71	–	1.14	3.75	–	5.74	–	1349	466	3317
32	1.67	B	1.94	–	1.14	3.53	–	34.04	–	424	162	2330
33	1.66	B	*	–	–	3.7	–	–	.15	1257	711	5569
34	1.60	B	1.86	–	1.14	3.47	–	34.21	–	1601	−404	6609
35	1.54	B	*	–	–	3.77	–	–	.20	504	269	4409
36	1.46	B	1.57	–	1.21	4.17	–	19.80	.20	107	−53	2498
37	1.45	B	*	–	–	3.43	–	–	–	778	−964	5168
38	1.37	B	1.63	–	1.26	4.0	–	45.32	.20	556	442	3674
Average first group: 2.21				–	–	3.97	–	9.67	–	1471	747	5347
Average second group: 1.88				–	–	3.98	–	18.11	–	1156	344	5046
Average third group: 1.61				–	–	3.45	–	31.03	–	943	80	4474

* Farms having no rating.
† Price received for surplus not determined.

pounds of milk—and 11 of the 38 farmers sold more than this amount—this spread in price would make a difference of $1,575 in income.

Prices received for milk by the 38 farmers during the year 1932 were affected by six factors as follows: (1) *To whom sold;* (2) *grade of milk;* (3) *bacteria count;* (4) *butterfat test;* (5) *basic rating;* (6) *seasonal variations in production.*

To Whom Sold

Milk was bought by four different buyers, no two of whom paid exactly the same price. Differences in price of Grade B milk were due largely to variations in the proportion of surplus milk carried by the individual milk company. The greater the percentage of surplus milk which the company handled the lower the average or composite price paid for milk.

Grade of Milk Sold

Two of the buyers purchased Grade A milk from a limited number of farmers who were able to meet the requirements as to quality. The quantity was determined by the demand of the city consumer for that grade of milk; hence no more new producers were taken on than were needed. Thus, even though the Grade B producer has high quality milk, he continues to receive Grade B prices until his status is definitely changed. The Grade A producer usually has had special advantages in rating so that less of his milk went as surplus. He also had the advantage of premiums for low bacteria count.

Bacteria Count

The basic price for Grade A and Grade B milk is the same, except that in the case of Grade A, premiums are paid for low bacteria count. A premium of 58 cents was paid during July and August, 53 cents during June and September, and 33 cents during the rest of the year or an average of 40.5 cents per hundred pounds for the year for milk with less than 10,000 bacteria count per c.c. For milk with a bacteria count between 10,000 and 20,000 the premium averaged 30.5 cents, and for milk between 20,000 and 50,000, 25.5 cents was paid per 100 pounds. The highest average annual premium received by any farmer in the study was 40.4 cents per hundred. There was an opportunity for some producers by lowering the bacteria count of their milk to increase the yearly average price received for milk from 2 to 19 cents per hundred pounds.

Butterfat Test

Milk testing above 3.7 per cent brought an additional amount based on the average daily price of 92 score butter in Boston for the period covered by the payment. For example, with butter averaging 22 cents per pound during a payment period, milk testing 4.7 per cent fat would be paid an additional price of 22 cents per hundred pounds. Deductions were made at the same rate for milk testing less than 3.7 fat. This price basis is probably more favorable to low testing breeds.

Basic Rating*

Differences in rating account for a large part of the variation in milk prices received by individual farmers. All but nine of the 38 farms were under a rating system. The 16 Grade A producers had been on a special rating plan for some time. Most of them had at an earlier date established ratings somewhat comparable to the capacity of the farm, and had been able to maintain them by producing as much as the requirements during the rating period.

Thirteen of the Grade B producers had been changed during the year of this study from a modified surplus to a basic rating plan. Their ratings for the calendar year 1932 were based on the average milk production for September, October and November of 1931, and the average production for the same months of the previous year. Since their production was low during this season and since the milk companies carried large surpluses, the Grade B producers had low rating in comparison to the size of the farms.

After the establishment of the rating, it cannot be raised except by the production of a large surplus during the fall months. In general the Grade B men with low ratings could not profitably secure better ones, but the more fortunate Grade A producers with good ratings could maintain them.

While the rating has a very great effect on the price received for milk, there is very little the individual producer can do except to shift seasonal production. The purpose of the rating plan is to even up production, and probably over a period of years the individual farmer will be ahead if he plans to have a more constant and even output throughout the year.

Seasonal Production

As shown by Figure 1, both fluid milk and surplus prices were higher from September to November, 1931, than for the rest of the year. The lowest prices of the year occurred from January to March, 1932; consequently the average price received by an individual farmer depended on the seasonal variation in production.

The Grade A producer with a production close to his rating and carrying very little surplus, was able to secure a high average price for the year. The Grade B producers carried a surplus throughout the entire year, and their average composite price for 3.7 per cent milk was lower than the average for the Grade A men. Where production was very uneven and a considerable surplus was marketed, it was an advantage to have the large production come at the season of higher prices. In the case of a few producers who had large production during the low price season, the annual returns per 100 pounds of milk were lower than average.

The Grade A producers have been encouraged to eliminate the wide seasonal variation in production. The incentive has come through a

*A rating of 100 pounds means that the dairyman would receive a fluid milk price for each fifteen day average of 100 pounds of milk delivered, but only a surplus price for amounts over that.

rating system in which average prices were higher when production was constant and near the rated amount. However, this incentive has not been clear and definite enough to influence all Grade A producers.

On the other hand the Grade B producer until recently has not had sufficient inducement to eliminate spring seasonal surplus. While fluid and surplus prices have been lower at this season, they have not been enough lower to tempt some of the farmers away from large production in the flush pasture season.

Figure 1 shows that the average daily production for the year on 37 farms is very low just previous to the rating period. This is due partly to the difficulties of holding up production in the summer months

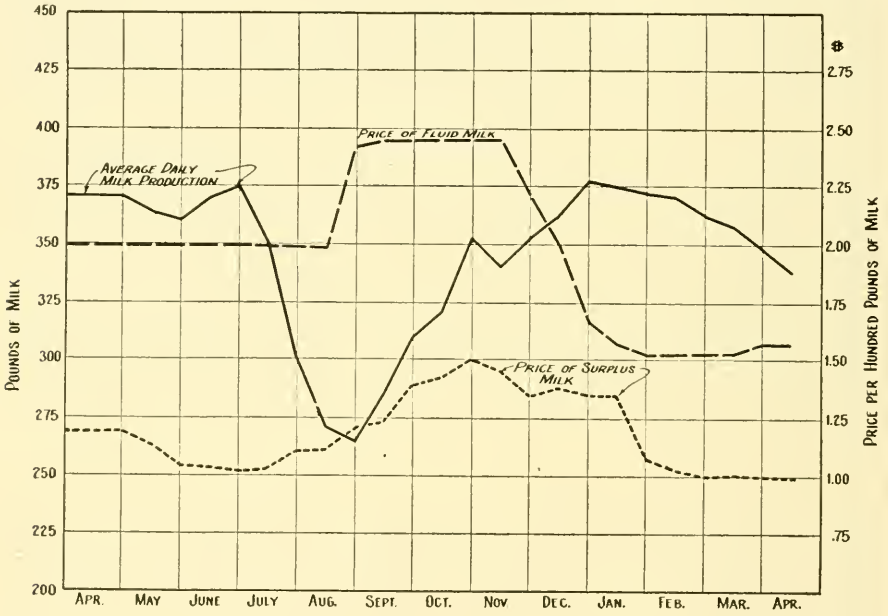

Fig. 1. A comparison of daily milk production and price received for fluid and surplus milk, 37 farms.

and partly to the necessity of drying off cows in preparation for heavy production when they freshen in or just previous to the rating period.

Under ordinary conditions, the basic rating plan had a tendency to shift the period of low production rather than to even up the output adequately. This is true largely because the large surplus at the rating season was made in the attempt to maintain a good rating. A few producers had planned a very large surplus at this time with the intent of raising their rating, but the usual result was that the rating was seldom advanced more than 10 pounds per day.

Under existing conditions several men increased production in the rating period, and then were not able to take full advantage of the rating established. For instance, as illustrated in Figure 3, one operator had four cows freshen in August and four in September. By producing as high as 300 pounds a day, he was able to establish a rating

of 187 pounds, but almost immediately his production fell below 187 pounds and continued to decline. He could have sold 13,000 pounds more milk as fluid if he had planned his production more carefully. There is no particular advantage in establishing a rating if it is not fully used thereafter.

It is costly and difficult for the farmer to shift materially the freshening dates of his cows; and since there is no assurance of the permanence of the rating period, the individual farmer makes a mistake if he aims too high.

In Figure 2, the example of a Grade A producer with even daily production, is typical of six farms in the group. Cows freshened on

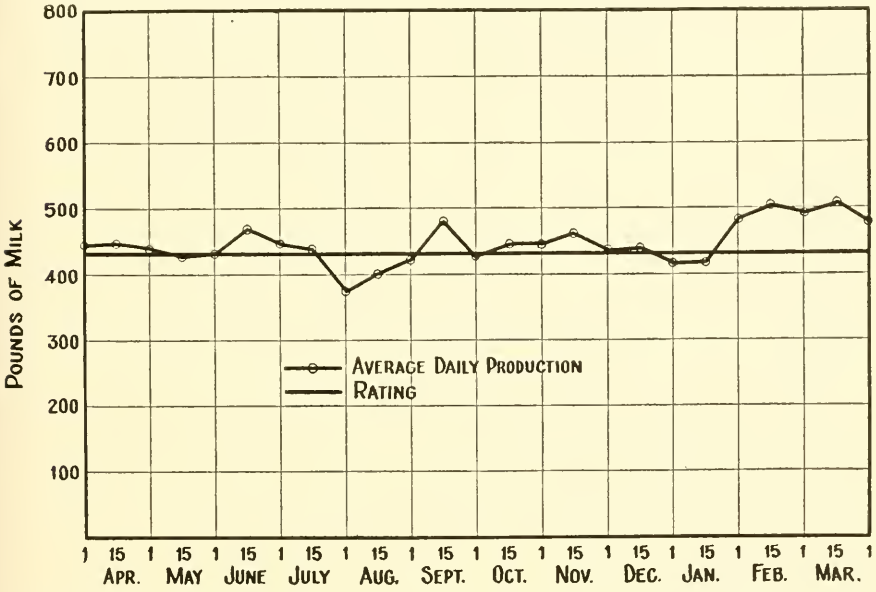

FIG. 2. Daily milk production on one grade A farm. (Typical of six farms with even production). Averaged by 15-day periods.

this particular farm as follows: three in April, one in May, four in June and four in early August, seven in September and seven in October; three in November, two in December, one in February and two in March. The operator took advantage of this rating, yet had little surplus. The average price for his milk not counting premiums for low bacteria count was $1.97.

Figure 3 shows an example of uneven production and is typical of 32 farms. In this instance one cow freshened in June, four in late August, four in September, two in October and two in November. The average price received for milk aside from premiums was $1.66. At times production was less than 30 per cent of the rating, yet 14 per cent of the milk went as surplus.

Even production is not easy to obtain, and with the best skill and planning the individual may fail. A more even output can result from

a better distribution of freshening dates, better pastures and intelligent feeding practices. However, on most farms even production is likely to cost somewhat more per unit. Cows freshening in midsummer may give a lower total; feeding costs to secure constant production may be higher; and there is the cost of adding cows to the herd for short periods to maintain the rating. Thus higher rewards for even production are necessary in order to stimulate dairymen to incur all these extra costs.

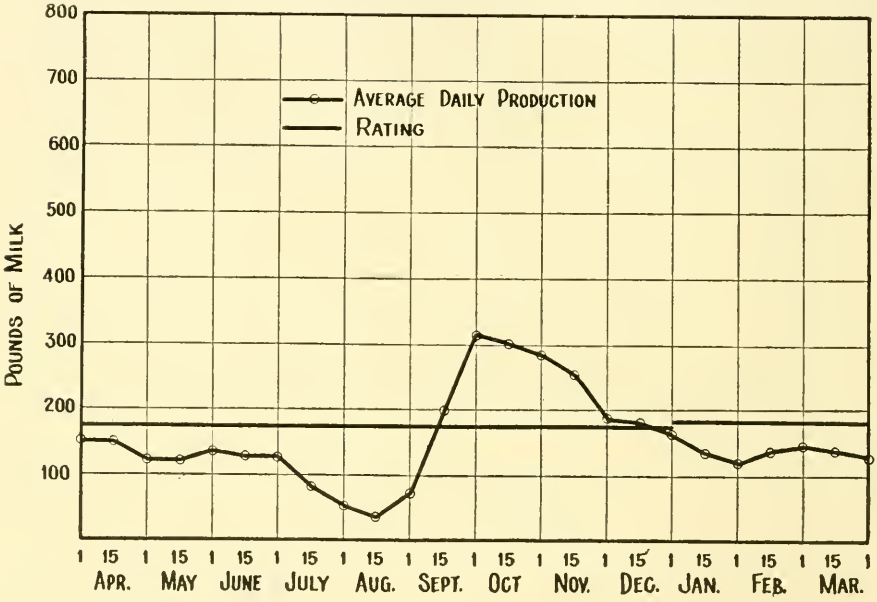

Fig. 3. Daily milk production on one grade A farm. (Typical of 32 farms with uneven production.) Averaged by 15-day periods.

Trucking Charge

Ten to 20 cents per hundredweight was deducted from the gross price to many operators to pay for hauling milk to the station. Others located nearer the station, were able to make their own delivery. If nearby men would cooperate by taking turns in hauling, doubtless they might save one-half to three-quarters of the present trucking cost.

Effect of Differences in Milk Prices

Grouping the farms according to the price received for all the milk sold and placing the same number in each of the high, medium and low groups as in Table 2, some interesting comparisons are possible. In the first group of 13 farms, all but one were Grade A producers. The average price received was $2.21 per hundred, and the average family labor income was $747.

Of the 13 farms in the medium group only four were Grade A producers, and largely due to a lack of premiums, the average price was $1.88 per hundred. The family labor income averaged $344.

The low priced group sold only Grade B milk, which averaged $1.61 per hundred. The average family labor income was $80.

It is difficult to estimate how much of the difference in income is due to the price of milk, because other factors which influence farm income were more favorable in the first and second groups.

The number of cows per farm averaged practically the same for the three groups, but the amount of grain fed and the quantity of milk sold per cow were highest in the top milk price group and lowest in the low price group. The first group fed 1,471 pounds of grain and sold 5,347 pounds of milk per cow. The last group fed 943 pounds of grain and sold 4,474 pounds of milk.

As another measure, the family incomes on all the individual farms were re-estimated on the basis of a common yearly average price for milk. (Table 3.) A composite price of $1.80 per hundred was taken as the average received for 3.7% milk. This was based on a 20 per cent surplus throughout the year.

Butterfat was figured at the average price for the year of 29 cents per pound with the usual additions or subtractions for butterfat tests above or below 3.7 per cent.

On this common price basis, about equivalent to a straight Grade B price, the position of the farms as to income would be completely changed. Three of the high income farms drop to a low ranking while some in the low income group rise in position though not in income. No doubt the men who receive a higher price for their milk would farm differently if they were on a straight Grade B basis, but it is well to note that the difference in price of milk received by farmers in the same area is an important factor in determining the income and management practices.

The individual farmer has limited control over the factors that make up the price he receives for his milk. If he is a Grade A producer, he can plan to have sufficient production at all times to take advantage of the fluid milk price. He can be especially careful to maintain his rating, though it is doubtful economy at present to attempt to increase it. He can attempt to have as high a premium as possible for low bacteria count.

If he is a Grade B producer, he can even up production as much as is consistent with the best use of his farm and labor. Some of the individual farmers may well produce considerable surplus even if the average price received is lowered. The decision as to this should be made on the marginal unit of milk produced. Given the farm, the roughage, the pasture, and the labor available, will it be profitable for the farm business as a whole to produce another 50 pounds or so of milk?

Since a new rating for Grade B producers is made each year, such increase of production as can be stimulated in the rating period without undue cost and without disrupting the evenness of production the rest of the year, would probably be to the farmers' advantage.

Table 3. *A comparison of family labor income on 38 farms with the estimated income on the farms if milk receipts were on a price basis* common to all farms.*

Farm number	Actual family labor income	Actual price per cwt. paid for milk	Average price of milk based on the assumed common price	Family labor income
	Dollars	Dollars	Dollars	Dollars
1	1721	2.15	1.77	139
2	1643	2.15	1.74	965
3	1423	2.42	1.89	786
4	1377	1.82	1.80	1336
5	1174	2.25	2.03	425
6	1103	1.78	1.80	1149
7	946	1.99	1.74	671
8	926	2.23	1.71	−104
9	829	2.13	1.92	642
10	781	1.69	1.74	871
11	779	2.16	1.74	−257
12	767	1.89	1.80	670
13	711	1.66	1.80	1188
14	670	2.09	1.74	265
15	603	2.31	1.92	353
16	546	1.76	1.86	712
17	466	1.68	1.80	578
18	455	1.77	2.06	828
19	442	1.37	1.86	827
20	329	1.87	1.77	125
21	318	2.34	1.92	−2
22	288	1.81	1.74	346
23	269	1.54	1.80	320
24	219	1.91	2.12	340
25	217	2.27	1.86	−34
26	184	2.08	2.18	214
27	162	1.67	1.74	242
28	61	1.96	1.71	−557
29	45	2.05	2.18	101
30	−53	1.46	1.92	105
31	−81	1.71	1.86	−213
32	−185	2.03	1.74	−934
33	−255	1.81	1.89	−156
34	−404	1.60	1.71	−285
35	−413	1.81	1.94	−248
36	−672	1.74	1.94	−503
37	−774	2.11	1.83	−1237
38	−964	1.45	1.71	−781
Average first group: 1091		2.03	1.80	652
Average second group: 385		1.91	1.89	375
Average third group: −294		1.78	1.91	−372
Grand average: 412		1.97	1.80	218

* Common price was estimated on the basis of the average of 3.7 per cent fluid milk and a 20 per cent surplus throughout the year. This was $1.80 plus or minus $.029 for each 1/10 per cent variation above or below the 3.7 per cent standard.

VARIATIONS BETWEEN FARMS IN MILK SOLD PER COW

Milk sold per cow during the year ending March 31, 1932, was lower than in the two preceding years as shown in Table 1. The amount of grain fed per cow on the average farm, was nearly 600 pounds less in 1931-1932 than two years earlier.

Possibly the reactions of different farmers to the drop in milk prices may have caused greater variations than usual in feeding practices and consequently in production. At any rate production ranged from 2,330 to 10,445 pounds per cow as shown in Table 4 in which the farms are arrayed according to the pounds of milk sold per cow. Grain per cow varied from 107 pounds on the farm having next to the lowest sales per cow to 2,811 pounds on the farm having the highest sales.

Some of the differences in production were due to size of cows, butterfat test, age of cows, disease, quality of pasture, quantity of protein fed, and total digestible nutrients; but probably the most important causes were quality of cows and the operator's skill with cattle. Thus the 13 farms having the highest production per cow had nearly all Holsteins and an average test of 3.67 per cent butterfat compared with 3.87 and 4.14 per cent for the 13 farms in the medium producing group and the 12 farms in the low producing group, respectively. With the higher testing groups went a larger proportion of the small high-testing breeds.

In spite of the higher test in the second and third groups, the price received per 100 pounds of milk averaged slightly less—$1.91 and $1.89 compared with $1.93 for the first group.

The highest producing group had a slight advantage in having 74.7 per cent of its cows in the most productive age period from 4 to 8 years. In the medium and low producing groups, 68.0 and 69.0 per cent of the cows were from four to eight years of age.

Tuberculosis or abortion affected the production of one herd in each of the first two groups and of three herds in the low producing group.

Capacity of Cows

The inherent capacity of the cows, wholly aside from care and feed, cannot be satisfactorily measured. Herd history and a classification of the cows, however, according to apparent capacity to produce may be taken as rough guides.

The cows were roughly classified* into three groups as to quality: (A) Cows of good type, sound and estimated to have capacity to produce 6,000 pounds or more milk (based on 3.7 per cent test); (B) Fair cows, showing lack of size for the breed and indicating lack of capacity to produce 6,000 pounds; (C) Poor quality animals showing lack of capacity, old or with unsound udders or other defects.

Forty-five per cent of the total on all farms were found in Group A, 27 per cent in B and 28 per cent in C. Fifty per cent of all the good cows and 21 per cent of all the poor ones were in the first group of 13 farms with high milk production per cow, and only 17 per cent of

*Mr. George Waugh, Dairy Extension Specialist, classified the individual cows.

Table 4. *Variations in milk production* per cow on 38 farms. Farms arrayed in the order of milk production per cow.*

Farm rank	Pounds of milk per cow	Pounds butter-fat per cow	Price of milk per cwt	Pounds of grain per cow	Pounds protein per cow exclusive of pasture	Pasture acres per cow equivalent to good pasture	Per cent of cows 4 to 8 years old	Family labor income
			Dollars					Dollars
1	10,445	364	2.24	2,811	708	1.72	80.0	926
2	8,740	301	1.96	2,230	589	1.74	65.6	61
3	7,067	251	2.16	2,166	631	1.18	80.6	779
4	6,848	272	1.76	1,729	631	2.46	100.0	546
5	6,609	229	1.60	1,601	595	1.26	56.2	−404
6	6,340	236	1.78	1,454	550	1.13	63.2	1,103
7	6,315	222	2.15	2,200	661	1.85	77.3	1,643
8	6,311	231	2.16	2,556	657	.76	51.2	1,721
9	5,632	198	1.69	1,006	464	2.50	73.1	781
10	5,606	199	2.03	1,333	674	2.54	60.7	−185
11	5,569	206	1.66	1,257	519	1.05	89.2	711
12	5,530	195	2.09	883	483	2.75	87.0	670
13	5,330	246	1.77	1,154	447	1.28	87.0	455
14	5,168	177	1.45	778	402	1.78	53.8	−968
15	5,105	193	1.82	994	440	1.20	46.3	1,377
16	5,048	216	1.81	1,652	494	3.00	75.0	−413
17	5,000	203	1.81	1,357	293	1.27	82.4	−255
18	4,922	203	2.31	1,060	454	2.15	69.2	603
19	4,839	194	2.42	1,090	374	1.43	65.2	1,423
20	4,826	170	1.99	1,498	541	.43	64.0	946
21	4,751	184	2.11	1,374	480	1.87	63.6	−774
22	4,667	194	2.13	1,344	499	1.32	83.3	829
23	4,604	175	1.91	499	369	1.71	66.7	219
24	4,508	161	1.81	1,447	518	2.23	72.7	288
25	4,491	176	1.71	1,190	472	1.06	88.9	−81
26	4,409	166	1.54	503	290	1.60	54.5	269
27	4,387	158	1.87	1,201	545	1.13	90.0	329
28	4,055	184	2.25	1,366	500	.95	68.8	1,174
29	3,674	147	1.37	566	378	2.06	45.4	442
30	3,596	149	2.34	735	339	1.43	80.0	318
31	3,580	140	2.27	535	351	1.47	61.1	217
32	3,432	173	2.08	1,007	380	1.76	81.8	184
33	3,317	124	1.68	1,349	460	.81	76.9	466
34	3,152	117	1.89	373	369	1.07	75.0	767
35	3,142	132	1.74	833	386	2.59	72.7	−672
36	2,958	150	2.05	240	384	1.32	71.4	45
37	2,498	104	1.46	107	152	.86	70.0	−53
38	2,330	82	1.74	424	323	1.16	34.9	162
Average first group:								
	6642	242	1.93	1,722	585	1.71	74.7	678
Average second group:								
	4795	186	1.91	1,137	433	1.62	68.1	266
Average third group:								
	3343	138	1.89	728	381	1.38	69.0	236
Grand average:								
	4968	190	1.91	1,208	495	–	70.6	398

* Milk production as determined by amount of milk sold.

the good cows and 41.5 per cent of the poor were in the group of 12 farms with low milk production per cow. In the individual herds the range of good, fair and poor cows was great. One herd was classified as having 97 per cent good, and another 97 per cent poor cows.

On several farms the herd history indicates real effort and determination over a long period of years to improve the capacity and quality of the cows. One operator had used pure bred herd sires for forty years, and others had used registered sires for 13, 15, 18 and 25 years. Three farms had in recent years purchased outstanding cows or bulls in order to build up herds. In the higher producing group, there was usually more evidence of past effort to improve capacity of cows, and in this group at present is the greatest interest and determination to increase production through better stock. Unfortunately, about one-third of the operators have made little or no progress in building up good herds.

Roughage

The effect of the quality of roughage on milk production was hidden on most farms by the variations in grain feeding. The cows in the high producing groups consumed annually an average of 1,628 pounds of high protein hay and 1,721 pounds of grain per cow in addition to other roughage such as common hay or silage; the medium group, 1,463 pounds of high protein hay and 1,137 pounds of grain; and the low group, 1,832 pounds of high protein hay and 728 pounds of grain. The amount of protein available for each cow through the feeding of this grain and roughage is estimated at 585, 433 and 381 pounds, respectively, for the high, medium and low producing groups. The first group more than made up for the lack of protein in the hay by feeding more grain than the other groups. Some operators in the first group probably fed more protein than necessary, but in the low producing group protein consumption was insufficient.

There were usually wide differences in quality of hay as harvested on individual farms, ranging from very good well-cured clover or alfalfa to partly damaged coarse native hay. On several farms these various qualities of hay were mowed away without reference to intelligent feeding. Consequently, in the winter the cows were subjected to sudden changes in quality of roughage. This affected production on some farms.

It is recommended that hay be mowed away so that the operator can mix the hay as he feeds it. The task of mixing in the winter, if the mowing away of different qualities of hay is well planned, will not materially affect total time on chores, and will help insure against loss of production.

Pastures

As in the case of roughage, differences in pastures were usually offset by variations in grain and succulent feeds used during pasture season. On four farms production during the summer was maintained by giving the milking cows ensilage because the pastures did not furnish enough feed. On one farm, milk production was increased by pasturing available fertilized tillage fields. On nine farms lack of pasturage

affected yearly milk production per cow. In these instances neither grain nor succulent feeds were used to supplement poor permanent pastures in August. In all other cases hay or a soiling crop was fed during August and early September.

While pastures are very important and are discussed in detail later, there is apparently little correlation between pasturage and milk production. Based on the estimated equivalent of good pasture per cow, the first group had only one-tenth of an acre per cow more than Group 2 and only three-tenths of an acre more than Group 3. Within each group, the variations were extremely wide.

Pastures in their present condition do not furnish sufficient roughage in July and August. Even where there is a relatively large area of good pasture per cow, the feed was not abundant in August. Consequently the skill of the operator in supplementing the short pasture, thus maintaining the condition of the cows and maintaining the milk flow, had more effect than pasture conditions alone.

Grain

In feeding grain it is not high production that counts but rather that production which will be most profitable from the viewpoint of the whole farm. And this most economic point of production will vary, depending on the value of the milk, price of grain, roughage and other factors.

When the farms were sorted into three groups on production per cow (Table 4), the average annual grain consumption per cow was 1,722, 1,137 and 728 pounds, respectively, for the high, medium and low producing groups. However, there was a wide range in grain feeding within each group. In Group 1 the range was from 883 pounds to 2,811 pounds; in Group 2 from 499 to 1,652 pounds; and in Group 3 from 107 to 1,366 pounds.

In the high producing group the ratio of grain to milk was 1:3.8, in the medium group 1:4.2, and in the low group 1:4.6.

A detailed study of grain feeding on individual farms offers interesting contrasts. On one farm with an average production of over 5,000 pounds, the grain consumption was only 883 pounds, or a ratio of one pound of grain to 5.7 pounds of milk. The operator supplemented pasture with good legume hay but did not feed grain during June, July, August and September. He fed grain at the rate of 1 to 3.5 for the rest of the year.

On another farm with an average production of 5,048 pounds, the average grain consumption was 1,652, or at the ratio of one pound of grain to three pounds of milk. This operator fed lightly of grain in the pasture season (about 1 to 8), but during the winter months fed at the ratio of 1 pound of grain to 2.2 pounds of milk. Such variations as this are due to the operator's attempt to offset the differences in quality of roughage and pasture.

Careless or unprofitable grain feeding was evident on more than half the farms. Some operators tended to feed the same amount of grain to all cows regardless of capacity or production—a practice that results in low returns per dollar's worth of grain. Others gave little

consideration to adjusting the grain ration to the quality of the roughage, and a few seemed to ignore the differences in costs of rations.

A number failed to check their feeding practices systematically. One man who thought he was feeding on the basis of one to 3.5 was actually feeding at the rate of one pound of grain to 2.8 pounds of milk, and within the herd his estimates were even more incorrect.

The amount of grain to feed cows under different conditions is a complicated problem. The solution on the individual farm is a challenge to the farmer's highest ability. Since the dairyman has the farm, the cows, and his own time, and since grain in New England is mostly out-of-pocket expense, he should be guided in his grain feeding by the profit. Will the last pound of grain result in enough more production to pay for it?

While this marginal method of analysis is simple when dealing with many enterprises, its application to dairy cow feeding requires accurate judgment and skill. In the region of this investigation it is believed that all dairymen need to study their feeding problems more carefully, and that fully half of them need to reorganize their feeding practices entirely.

Skill

In making regular visits to the farms, one could not fail to note great differences in the operators' interest in and skill with cows. These variations were reflected in great differences in the milk production program. As previously noted the quality of the cows, the amount of grain, the extent and quality of pastures, and the quality of roughage are all important in securing good milk production per cow; but the skill with which these factors are combined is after all the essential factor leading toward high milk production.

The skilled and interested dairymen had tended to build better herds. They had a better knowledge of feeding practices and adjusted grain feeding more intelligently to the economic requirements of the individual cows. They supplemented pasture in a more timely and intelligent manner. They had judgment in forestalling such troubles as "going off feed" or udder ailments. They were more regular in feeding and milking and took better care of the cows.

VARIATIONS IN LIVESTOCK SALES

The average dairyman in the wholesale areas of New Hampshire, in addition to his milk production also grows livestock for replacement and for sale. The calves are a joint product of the milk enterprise; but since replacements are needed regularly, the growing of at least a limited number of heifers is an integral part of the dairy industry, and represents a real cost in the production of milk.

The method and skill used in growing heifers, handling cows, and moving the older animals on without great depreciation are very important in the success of the individual dairy farm. The more intensive dairymen in southern New England find it to their advantage to purchase cows at their prime and keep them for only two or three lactation periods. Thus, the operators in the area studied have an opportunity to sell cows after three or four years of production in the herd. A few of the dairymen in this study have taken advantage of

this situation and regularly sell six or more animals a year to southern New England buyers.

In these few herds the best cows were usually held somewhat longer than others, yet ordinarily were sold before they had depreciated in value due to age. The operator occasionally had to plan his sales somewhat in accordance with the demands of the buyer, but would attempt to reserve his best young stock. One or more promising young cows were sometimes sold in order to move three or four older cows in the same deal. One operator had on hand at the close of the year, 14 three-year olds, 3 four-year olds, 3 five-year olds, 12 six-year olds and 2 eight-year olds. The average age was 4.8 years. In the next year his effort would be to move 10 or more of the older cows.

At the other extreme are dairymen who are raising about the same proportion of heifers, yet somehow use up, wear out and depreciate their cows so that the return from livestock is small. The cows they sell are usually discards and bring little money. In a few instances, in spite of a normal proportion of heifers to cows, the herd was maintained at a definite size with considerable difficulty.

To study the situation in some detail, the net income* from livestock was estimated on a per cow basis for each farm, and then the farms were arrayed in three groups in the order of this net increase. (Table 5.) The net increase per cow for the three groups averaged $24.77, $9.91 and −$2.15, respectively. The average total net increase from livestock per farm for the three groups was $645, $251 and −$20, respectively. There was an average of 27, 25 and 21 cows, respectively, in the high, medium, and low groups.

Of the 13 farmers in Group 1, six had followed a definite policy of raising good heifers and selling good sound cows. Five other operators had increased their inventory by having a number of heifers ready to freshen. The older cows were sound, but only a few had been sold at the close of this study. On two farms of the group a number of mature sound cows were sold soon after the study began and were replaced by purchased heifers. In these cases, the net increase from stock was at the expense of milk returns.

In the third group only 11 cows were sold as sound cows as compared to 83 in the first group. In the first group 23 per cent of the total number of cows on hand were sold as sound cows at an average of $84 per cow, and 10 per cent were sold as discards at an average of $33. In Group 3 on the other hand only four per cent of the total number of cows on hand were sold as sound cows and 21 per cent went as discards.

The ratio of heifers to cows was .5 to 1.0 in the first group, .41 to 1.0 in the second and .4 to 1.0 in the third. The first group was thus carrying .09 more heifers per cow than the second group and .10 more than the third.

The young stock in the first group consumed on the average 273 pounds of grain per year; in the second 268 pounds; and in the third 114 pounds, or in money value, $4.37, $4.29 and $1.82 per head. The

*The net increase in livestock is calculated by adding the sales to the value of livestock at the end of the year, and subtracting from this sum the value of livestock at the beginning of the year and the purchases.

TABLE 5. *Variations in income* from sales of dairy livestock on 38 farms. Farms arrayed in the order of the net increase** per cow.*

Farm rank	Net increase* per cow	Net increase* per farm	Number of cows sold as milking cows	Average price of cows sold as milking cows	Number of cows sold as discards	Average production per cow	Quality of cows Percent of cows classed ** as			Per cent of cows 4 to 8 years old inclusive	Number of heifers per cow	Per cent total gross income from livestock sales
							A	B	C			
	Dollars			Dollars								
1	46.51	921	20	80.00	–	6609	75	6	19	56.2	.40	48.90
2	35.89	709	7	77.24	1	10445	75	20	5	65.6	.39	9.29
3	32.80	615	18	67.77	1	3152	41	33	26	75.0	.70	43.84
4	25.01	988	9	82.88	3	6340	37	47	16	63.2	.95	13.06
5	24.61	1295	7	94.49	11	6331	46	36	18	51.2	.35	8.55
6	24.41	564	1	100.00	2	4826	28	44	28	64.0	.46	6.28
7	24.07	260	–	–	–	3432	27	54	19	81.8	.61	–
8	22.17	306	4	95.00	4	6848	23	23	54	100.0	.59	16.64
9	20.32	557	–	–	–	5330	66	24	10	87.0	.43	7.88
10	17.20	585	2	57.50	4	5105	34	27	39	46.3	.31	3.21
11	16.83	585	–	–	4	4751	58	27	15	63.6	.55	3.20
12	16.17	707	15	98.66	5	5569	46	46	8	89.2	.54	21.91
13	16.04	300	–	–	1	4409	31	50	19	54.5	.21	4.37
14	15.00	450	6	61.00	1	5632	69	27	4	73.1	.46	11.24
15	14.61	361	7	58.66	1	3142	50	27	23	72.7	.45	21.87
16	14.26	348	–	–	3	3674	9	–	91	45.4	.42	2.36
17	13.03	326	2	75.00	3	5048	25	9	66	75.0	.18	8.72
18	10.13	153	3	83.33	–	2958	36	64	–	71.4	.42	18.96
19	9.95	227	12	72.93	3	8740	72	28	–	65.6	.63	3.20
20	8.21	195	–	–	3	4839	52	35	13	65.2	.51	1.43
21	9.78	308	4	62.00	1	4055	31	22	47	68.8	.40	6.70
22	7.95	269	2	51.00	3	7067	97	–	3	66.7	.46	2.33
23	7.69	90	–	–	1	4604	66	25	9	80.6	.52	–
24	6.36	163	6	63.00	2	5606	68	21	11	60.7	.37	10.85
25	6.19	215	–	–	31†	4508	45	45	10	72.7	.29	46.50
26	5.63	160	7	57.30	–	3317	50	31	19	76.9	.18	8.22
27	5.63	75	4	81.25	–	4387	90	10	–	90.0	.52	18.18
28	5.50	120	–	–	4	5530	39	44	17	87.0	.36	2.89
29	4.76	81	–	–	5	3580	17	22	61	61.1	.52	9.28
30	2.77	131	–	–	10	2330	12	30	58	34.9	.69	4.30
31	2.54	82	4	75.00	7	4491	30	33	37	88.9	.47	13.68
32	1.53	38	–	–	6	6315	59	27	14	77.3	.19	4.88
33	.47	9	–	–	2	4667	39	44	17	83.3	.22	2.80
34	−.28	−5	3	61.66	–	5000	53	11	36	82.4	.56	16.87
35	−.69	−9	–	–	6	4922	44	–	56	69.2	.28	5.56
36	−9.55	−150	–	–	6	5168	15	46	41	53.8	.35	16.06
37	−10.61	−223	–	–	–	3596	40	15	45	80.0	.05	–
38	−27.85	−390	–	–	10†	2498	–	–	100	70.0	.62	51.05
Average first group:												
24.77	645	6.4	83.72	2.8	5627	45	34	21	69.04	.50	14.39	
Average second group:												
9.91	251	3.8	64.91	4.0	4860	51	26	23	69.0	.41	10.95	
Average third group:												
−2.15	−20	.9	72.63	4.6	4374	36	24	40	73.1	.40	12.19	
Grand average:												
11.18	300	3.76	74.12	3.78	4969	45	27	28	70.3	.44	12.50	

* Includes sales and inventory gains or losses.

** The net increase in livestock is calculated by adding the sales to the value of livestock at the end of the year, and subtracting from this sum the value of livestock at the beginning of the year and the purchases.

*** The cows were classified roughly into good, fair or poor cows by examining each animal. This was done by Mr. George Waugh, formerly dairy extension specialist.

† Condemned as T.B. cattle.

average cost of grain for young stock on a per cow basis was $4.32, $3.04 and $1.15, respectively, for the three groups. Deducting both grain and roughage consumed by young cattle, it is estimated that between groups 1 and 2 there would be a difference of approximately $18.50 per cow in receipts from sales of livestock.

Differences in the returns from livestock are largely due to four factors: organization of farm, health of the herd, quality of the stock and the skill of the operator. They are illustrated in a comparison of two farms.

Farm A had 29 cows and 31 heifers. During the year 10 cows were sold as discards for a total of $200. The net increase from livestock for the farm was $131 or $2.77 per cow.

Farm B had 38 cows and 38 heifers, and during the year sold nine sound cows for $746 and three discards were sold for $50. The net increase from livestock totaled $988, or $25 per cow. Thus one man uses up his cows and the other sells sound cows.

It is difficult to measure the costs entering into the production of the cows on these farms because, for a part of the time, the feed is both producing milk and developing the cow. However, after allowing for the value of grain and roughage consumed by youngstock, there still remains a difference of $18 per cow between the two farms in income from livestock. The operator of Farm B is a heavier feeder of grain to both youngstock and cows, and has better stock to begin with. He watches pasture conditions more carefully. He puts more into the cows, but they are large and in better condition when sold and also produce more milk.

Farm Organization

The problem of definitely planning the organization of the farm to sell considerable livestock as well as milk depends in no small measure on the nature of the farm. Under normal conditions in the Grafton County area milk production up to the capacity of the available labor has probably paid better than growing stock. However, the same labor can grow young stock in addition to caring for cows since there is ample time between milkings to feed and care for heifers. The only added labor cost is in the small amount of extra hired help to harvest the additional hay and roughage.

On one farm the available labor under existing conditions could take care of 38 cows, but this amount of stock would consume only about two-thirds of the roughage harvested and would not use all the feed in the back pastures. If the farmer had added more cows to use up the roughage and make use of the pastures, an extra man would have been needed. However, it was possible to carry about 35 to 40 head of young stock without hiring additional help. From the point of view of the farm organization, the young stock has been produced for a little more than the value of the feed used. That is, the production of these heifers did not require additional out-of-pocket expenses for labor, pasture and buildings. The 38 cows more than supply his present rating. The product from additional cows would only bring surplus prices. The net increase of livestock was $988 and the feed consumed by young stock was worth approximately $800. Thus,

the herd was maintained and in addition returns of about $200 over feed cost were realized in growing heifers.

In considering this farm and the skill of the operator, the present two-man organization with about 38 cows and 38 young cattle is probably a more satisfactory and profitable organization than a three-man farm with more cows and fewer heifers.

Another farm illustrates a different situation. The 30 cows and six young stock consume all the available pasturage and roughage. The available help could handle more young stock had there been more pasturage and roughage. Perhaps a young man might cut hay on other farms and thus carry more young stock, or he might reduce his operations to a one-man organization keeping 20 cows and 15 to 20 young stock. But since the operator is advanced in years, the present organization meets the situation satisfactorily.

Thus, the organization of these dairy farms as to number of heifers and cows can best be fitted to the particular farm and personnel. Even then a change in the relation of milk and cow prices may upset the most advantageous ratio of heifers to cows. It is to be noted that the selling of mature animals leaves the herd with a high proportion of young cows with resulting lower production per cow. Thus, shifting of cows out of the herd at their prime is at the expense of milk production.

Herd Health

Herd health was an important factor in returns from sales of livestock. Abortion was a problem in four herds, resulting not only in the necessity of discarding more cows than usual but also of selling at very low values. The county is practically free of tuberculosis, all herds having been tested, but during the year there was a loss on two farms in this study of 40 head. Since these condemned animals brought nearly their inventory value, and the operators were able to replace them at approximately the indemnity received, the livestock returns were not affected.

Physical injuries especially to teats and udders, malnutrition, mastitis and pneumonia were responsible for losses on some farms.

On 20 of the 38 farms herd health was excellent, and there were no serious losses due to either disease or accident. On the other 18 farms, losses ranged from minor udder troubles which depreciated the value of one or more cows, to serious losses in stock due to poor herd health and sanitation. On five farms, the health and condition of the herd were poor. Of course, disease, accidents and other difficulties may appear at any time in any herd, but it is evident that the men fundamentally interested in dairying tend to have less serious trouble than others. The more skilled men had some trouble with udders, but were usually able to cure this without loss of cows. On a few farms the milking animals seem to be used up as fast as heifers can be grown for replacements.

Quality of Cows

Since some men with good stock put their major efforts on milk production and did not definitely plan to sell extra cows, the correlation between quality of cows and livestock income is not marked.

It was evident, however, that outside buyers were more interested in the few herds where considerable progress had been made in breeding and growing out quality stock. Seven of the 13 herds with high net income from stock had maintained the same breed of cattle with a pure bred sire for an average of 14 years. Ten operators of this group fed grain in addition to roughage to calves and young stock, and the heifers were of fair size and condition at freshening time. On the other hand, 9 of the 12 operators in the group with low income from stock did not feed grain to young stock, and the heifers tended to be undersized at freshening time.

Skill

From calf raising through to selling the cows, differences in skill were very apparent. About one-fourth of the operators have an inherent liking for dairy stock. They tend to raise only the more promising heifers, and since they are observing and know how to feed, the animals sold are usually good cows. On the other hand, about one-fourth showed lack of skill and knowledge in raising heifers, and the cows were not attractive to buyers.

Income from livestock is important in Grafton County, and on most farms the production of more heifers than actually needed for replacement can be fitted into the organization.

To take full advantage of the opportunity of marketing sound cows, even those who have been successful in disposing of stock will probably need to put increasing stress on the health and quality of their herds. This will require a definite breeding plan and an intelligent and thorough program to protect the herd from disease. The men who have been handicapped in selling cows on account of disease or lack of quality, may well consider beginning the long and exacting yet interesting program of building a better and healthier herd. It can be done without large outlay of money.

Those raising additional heifers should of course have in mind that the value of cows when heifers are started is no indication of what the value will be when the animals are mature.

VARIATIONS IN ROUGHAGE

The lack of a well-planned roughage production program is a real weakness in the organization of most of the dairy farms and represents a considerable handicap to individual operators. As the farm community developed into a specialized intensive wholesale milk area, the cropping system on the individual farms tended to remain unchanged. Approximately 21 of the 38 farms have made some progress in late years, but only four approached the possibilities of a cropping plan to meet the needs of intensive dairying.

In order to study the roughage situation in detail, maps of tillage land were made for each farm. Just before haying, each field was examined to determine the approximate yield, the kind of grass, and percentage of clover. The estimated average yield of all hay land was 1.47 tons per acre, and individual fields ranged from three-quarters to two and one-half tons per acre. The soil varied from a light intervale to heavy clay entirely unsuited for corn, but the differences in yield

were related more to cropping system and management than to type of soil. Under good management large yields were obtained on both heavy and light soils.

In quality, approximately 82 per cent of the tonnage harvested contained little clover or alfalfa. (Table 6.) The remainder varied between 40 and 60 per cent clover and alfalfa. The legume hay by weight is estimated to be about 15 per cent.

On some farms it has been the practice to purchase standing hay on abandoned or temporarily unoccupied farms four to six miles away. This enables the operators to maintain a herd consistent with the

TABLE 6. *The area in hay on each of the 38 farms classified as to type of hay.*

Farm number	40–60% clover-alfalfa—rest timothy		Timothy grass—no clover		Early mixed grasses		Soiling or nurse crops hayed		Pounds of high protein hay per cattle unit
	acres	tons	acres	tons	acres	tons	acres	tons	
1	3	5	25	50	–	–	12	18	766
2	4	10	18	28	–	–	4	3	1171
3	3	6	3	6	9	18	–	–	1088
4	6	12	29	40	12	17	–	–	1040
5	–	–	6	12	34	48	6	12	884
6	12	30	24	33	8	12	10	18	2420
7	–	–	19	22	30	30	5	8	661
8	–	–	20	36	–	–	–	–	2017
9	2	6	11	16	5	5	7	7	1429
10	3	6	8	12	19	16	–	–	960
11	5	12	6	12	48	54	–	–	968
12	6	12	–	–	22	42	6	12	1778
13	20	40	35	52	5	5	7	7	1858
14	–	–	27	52	12	22	2	3	2728
15	–	–	2	3	31	40	2	4	1485
16	–	–	22	28	–	–	4	10	1447
17	3	8	18	36	–	–	10	20	2134
18	–	–	33	44	32	32	8	12	946
19	4	8	10	15	10	12	1	1	2722
20	5	7	23	32	–	–	3½	5	769
21	–	–	39	41	20	15	–	–	2970
22	4	8	26	24	8	14	2	4	1835
23	–	–	4	8	36	39	1	1	1280
24	2	2	19	27	11	16	–	–	889
25	–	–	8	12	37	34	–	–	748
26	12	25	43	82	3	4	3	6	1500
27	11	22	16	24	25	37	–	–	1542
28	6	12	9	12	5	4	4	5	1473
29	4	10	17	34	–	–	3	5	2829
30	15	28	23	33	3	3	7	10	736
31	2	5	4	8	10	18	3	6	2130
32	4	8	25	27	20	20	–	–	3414
33	2	3	2	3	23	23	1	1	2333
34	–	–	14	26	37	37	12	15	1000
35	3	6	26	46	6	4	–	–	1798
36	10	28	15	27	18	27	3	3	2370
37	–	–	2	3	1	1	5	10	1474
38	5	10	33	47	10	12	–	–	1583

amount of available labor or to build up their farms to capacity more quickly. The rapidly declining yields and the failing quality of the roughage on these back farms will eventually bring the operators back to adjusting their livestock programs to their own farms. It may be advisable to purchase standing hay for two or three years, but the operator should be planning to adjust his organization so that he will not be dependent upon the back farms for his roughage.

A notable exception to this may be the growing of potatoes on back farm land. The heavy fertilizing of this crop in rotation will probably maintain hay yields, and a permanent cropping system can thus be built on this use of the land.

The amount of high protein hay available per cattle unit varied from 661 to 3,414 pounds, with an average of 1,610 pounds. Clover hay, alfalfa hay, annual legume forage crops and aftermath or rowen were considered as high protein hays in this study. The farmer with the lowest quantity had not seeded any new pieces in three years, and the operator with the highest had two-thirds of his tillage land in alfalfa.

The amount of high protein hay depended in general on the acreage seeded down each year. Those operators seeding down over two-tenths acres per cattle unit each year averaged 2,057 pounds of high protein hay per cattle unit, and those seeding down two-tenths acres or less got only 1,507 pounds. On the average about one-seventh of the tillage land was seeded down each year, and 1,636 pounds of protein hay were available per cattle unit.

Seven of the operators began haying about June 20, and with good weather had considerable hay in the barn by the 27th. Most of the hay in this group of farms was harvested between July 1 and 10. Only seven men had not finished by July 15. On these farms haying dragged along for several weeks, three finishing about the middle of August. Most of the hay on all but these seven farms was harvested early enough to be of good quality.

Field observations indicate that on the light soils, which constitute about 90 per cent of the tillage land, short rotations with not over three years in hay brought best results in quality of hay and yield. More than three years in sod resulted in hay yields which were low and poor quality. On the heavier soils, yields and quality held up well for at least five years if the fields were top-dressed with manure.

On one farm with very light soil the operator has followed a five-year rotation of corn, oats and three years of hay. Over a period of years he has been able to build up hay yields so that in the season 1931, the average was 1.8 tons per acre. On a farm with similar soil, a longer rotation resulted in lower average tonnage because the yields were low in fields that had been in hay over four years. One operator has been able to extend somewhat the period of good hay yields by liberal application of commercial fertilizers.

On eight of the sixteen farms without silos, little land is plowed and seeded down each year. These have the lowest hay yields and are in the low income group. On the other eight farms without silage, land

is plowed each year and stocked down, and the yields and quality of hay are better.

Seeding down at least one-fifth of the tillage land each year will undoubtedly result in a larger tonnage of higher quality hay. On nearly every farm, this shorter rotation can be adopted with only a small out-of-pocket expense for additional seed. The additional plowing* and fitting of land in most instances can be done by the available labor and teams. Over a period of years the investment in additional seed would be returned many fold in higher yields of better quality hay.*

Seeding down a larger acreage in a shorter rotation, as strongly recommended, can be done more easily and practically and the expected results will be more certain if the layout of the farm fields is given considerable thought.

In making maps of the tillage land it was found on one farm with 40 acres of tillage that 18 individual pieces had been plowed and stocked down. Natural barriers made some small fields mandatory; yet fields, four to seven acres in size were possible. By combining these with the smaller areas a definite four-year rotation could be conveniently carried on. Evidence indicates that the various field operations require considerably more time per acre on small fields.

A real saving in labor is possible if certain fields are grouped and are considered as one even though they are separated by natural barriers. This eliminates much travel to and from the buildings with different machinery.

In laying out fields with the intent of growing roughage more systematically in a rotation, several problems should be considered: the possible use of corn silage, clover and alfalfa mixtures, annual legumes and perhaps the pasturing of tillage fields.

Mr. Abell has shown that silage increases the carrying capacity of the farm and that the higher the proportion of tillage land in corn silage, the greater the carrying capacity per acre. The data from the 38 farms in this study tend to support Mr. Abell's conclusions. It would seem desirable, where silo and machinery are available, to have from one-fifth to one-sixth of tillage land in silage. If sod land is broken up each year and planted to corn for silage and then is stocked down after corn, a rotation can be maintained and high quality hay produced.

Annual legumes can be used to advantage on some of the farms. Where new seedings are sown with oats or barley as a nurse crop, for example, the addition of peas or vetch to oats will raise the quality of the resulting hay and not materially interfere with the new seeding. Or if ten acres are available for corn silage each year in a rotation and if seven acres will fill the silo, Hungarian millet and soybeans could be put in the remaining three acres—preferably on the three acres least suited to corn.

Where no corn is grown, as much as one-fith of the tillage land could be seeded to Hungarian millet and soybeans and then seeded to clover and alfalfa mixture after the annual hay crop has been harvested.

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*New Hampshire Experiment Station Bulletin 273 by M. F. Abell.

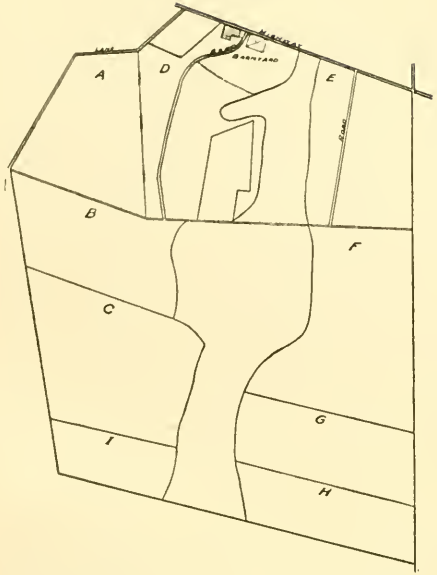

Fig. 4. Map of farm as now operated.

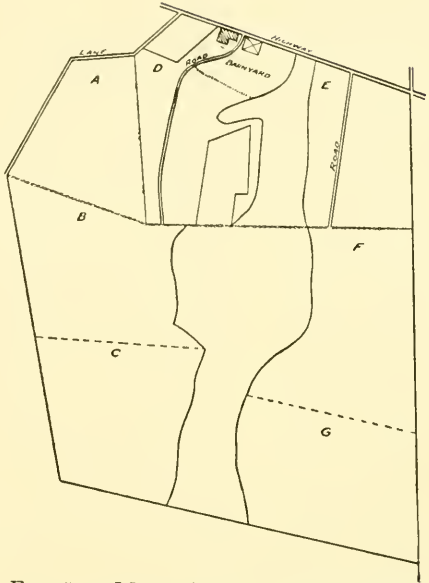

Fig. 5. Map of farm with suggested rearrangement. (Five approximately equal fields).

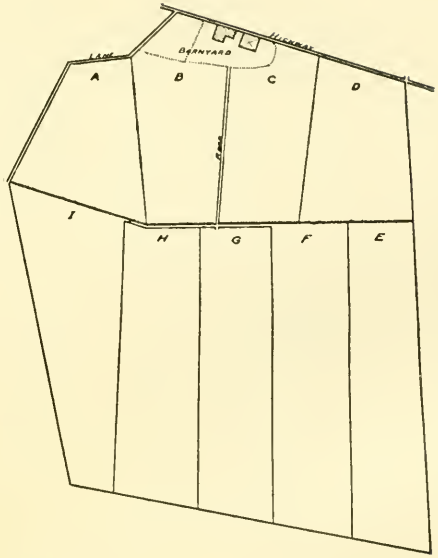

Fig. 6. Map of farm with suggested arrangement of fields if some areas were tiled. (Pasturing fields in rotation).

The use of an annual legume without provision for permanent seeding of clover and grass is open to criticism. The permanent seeding with its several crops is more economic per ton of hay produced. The annual crop should be supplementary to the permanent hay program.

The pasture problem on the individual farm needs to be studied along with the cropping system. In many instances, some of the tillage land might well be pastured. This is preferable to hauling green feed to the barn or to any other barn feeding method.

To illustrate the possibilities of improving the farm layout and cropping system, the operator of the layout shown in Figure 4 produced nine tons of oat hay, 12 tons of clover, 10 of rowen, 42 of grass hay and 100 of silage. It is estimated that a total of 164 tons dry weight, including 49 tons total digestible nutrients and four and one-quarter tons of digestible protein, were harvested. Under the present system corn is put on the same land two years in succession and some of the sod land has been down six years.

The fields could be combined and rearranged as shown in Figure 5 to make five 10-acre fields, enabling the operator to follow a five-year rotation with 10 acres of silage, 10 acres of oats and vetch, 10 of clover and 20 of mixed hay. In a few years this system should result in 20 tons oats and vetch, 20 of clover, 30 of mixed hay and 100 of corn. It is estimated that these crops would contain 185 tons dry matter, 63 tons total digestible nutrients and six and one-half tons protein. The tonnage of protein hay, the total yields of dry matter, of carbohydrates and of protein would thus be increased.

Eventually the wet area not used in the rotation could be brought into the cropping plan. These fields could be drained at small cash expense if the operator applied his own labor at odd times. (Fig. 6.) In this case, a six-year rotation could be worked out with perhaps a provision for pasturing the last year in the rotation before plowing for corn. The advantages of this plan would be in the long, easily worked fields conveniently accessible from the farm road and buildings, the development of 10 acres of especially good pasture in the rotation, the increase in amount of high protein hay, and a more systematic use of the barnyard manure and lime applications. This type of cropping development to take care of the pasture and roughage needs is strongly recommended to the producers of the area.

VARIATIONS IN PASTURES

Adequate pasturage through the season for a herd of 20 cows is estimated to be equivalent in feeding value to over 30 tons of hay and four tons of grain. The market value of these would be over $500, or $25 per cow at present low prices. While no farm in the group was without pasture, most farms needed to feed roughage in the form of green feed, silage or hay for a long or short period to make up for its inadequacy. This additional roughage to supplement poor pastures resulted in a greater harvest labor peak and greater expense in operating the farm. Dairymen with inadequate pastures are operating at a considerable handicap, and need to make drastic changes in their organization.

There was a total of 4,105 acres of land available for permanent pastures on the 38 farms; that is, this area was fenced and cows were at liberty to travel over it in search for feed. (Table 7.) All this was surveyed as to type and depth of soil and type of cover—whether open, covered with brush or fully stocked with timber, sod covering and kind of growth in the open places. On the whole, the pastures had been greatly neglected in recent years.

Most farms in the area have always been handicapped by inadequate pasturage, and due to growth of brush and timber many farmers

Table 7. *The pasture area on each of the 38 farms classified as to type of soil and brush or timber growth.*

Farm number	Acres former tillage or open pasture with good soil, brush-free	Acres good soil but brush-covered	Acres rock outcrop, thin soil or light sandy soil	Acres wooded or swamp	Total acreage in pasture
1	10	10	50	25	95
2	45	–	5	–	50
3	4	50	5	14	73
4	11	35	5	30	81
5	20	–	30	30	80
6	10	4	50	5	69
7	5	–	15	20	40
8	24	60	–	25	109
9	5	30	–	75	110
10	70	10	–	–	80
11	20	30	50	10	110
12	10	10	–	10	30
13	40	10	–	150	200
14	40	40	30	70	180
15	13	15	30	2	60
16	19	20	5	45	89
17	3	20	10	110	143
18	10	18	75	50	153
19	20	15	–	175	210
20	10	5	35	90	140
21	25	35	20	55	135
22	15	10	20	145	190
23	5	15	–	70	90
24	5	2	75	–	82
25	4	8	2	83	97
26	20	50	20	110	200
27	20	50	10	–	90
28	5	6	10	5	26
29	10	15	–	10	35
30	14	5	25	85	129
31	20	15	10	225	270
32	10	15	30	40	95
33	7	–	25	50	82
34	50	20	10	5	85
35	14	60	15	20	109
36	40	10	35	25	110
37	23	–	30	60	113
38	5	20	40	10	75

have had to feed more and more roughage during a considerable part of the pasture season. In a few instances the gradual loss of pasturage may eventually lead to the loss of the entire farm. If the number of cows must be reduced to 10 in a region where 20 are required to give the operator an opportunity for an adequate income, there is great danger of abandonment.

The total pasture area consisted of five and one-half per cent former tillage land now open and growing good grass; 11 per cent good soil now open and growing good pasture grasses; 17½ per cent having good soil but now covered with brush; seven and one-half per cent light sandy soil generally covered with grass but not productive after July 1; 11 per cent rocky, light soil, rock outcrop, or swamp, and 44 per cent timber with little, if any feed.

From these data it was estimated that about 31 per cent of the present pasture area is potentially good pasture land and with planning and with considerable labor in brush cutting, juniper eradication, and fertilizing could be converted into good pasturage. The remaining 69 per cent would not be of much importance as grazing land.

The area of potentially good pasture ranged from two-tenths to three acres per cow, with an average of 1.52. It is estimated from the pasture data that about three-fourths of the farms are short in this respect and even though the operators reclaim all the good soil, there will still be a need for a pasture program which will include tillage fields.

Every pasture had its June flush; but thereafter the grasses grew more slowly, resulting in a distinct shortage of feed in July and August on most farms. The pastures were generally on hillsides or hill tops. Frequently they contained small areas that had once been tilled but on account of location or rocks had been abandoned in recent years. Certain other areas were open and had an excellent stand of pasture grasses. On much of the area not covered with timber, growths of hardhack, alder, or juniper varied from a few scattered clumps to solid stands. Thus some pasture land, potentially good, grows little feed.

The situation varied greatly. One of the better pastures with 100 acres available had 20 acres of good grass, 30 acres of open land with good soil but partially covered with hardhack and other small brush, and 50 acres of woodland. Another pasture of 70 acres included 20 acres of good open pasture and 50 acres of good open land but which was covered with juniper and hardhack. A third pasture of 100 acres, on the other hand, had only five acres of good grass and 20 acres of open land with good soil but grown up to brush. In every case the growth of brush or juniper was gradually gaining on the grass.

The pastures were conveniently located within a quarter of a mile from the barn except on three farms where the operators were using abandoned back farms four or five miles away. Milking sheds had been built in the pasture and equipped with milking machines, and the men traveled back and forth by truck twice daily.

One man with inadequate permanent pasturage fertilized tillage fields rather heavily with chemicals and pastured them under a definite plan. On account of fertilizer, one field furnished an abundance

of feed for two weeks early in May without seriously curtailing the yield of hay. Some of the other fields were pastured after early haying. He was thus able to supply cows and young stock with adequate pasturage and roughage; otherwise, he would have had to keep fewer cows or purchase considerable roughage.

The usual pasture season including fall grazing on tillage fields is about 130 days in this area. But it is difficult to determine the returns from each pasture on account of much supplementary feeding and differences in milk production. The number of days in which milking cows received all their roughage from pasture varied from none to 168. The average was 92 days. Although this indicates something of the great variation, it is to be noted that some herds had an adequate supply of feed throughout the season, while others did not have a sufficient amount. The quality which the pasture furnished was at certain seasons very poor.

On four farms the pastures were greatly overstocked, and cows were regularly fed silage in the barn. Several operators relied on their pastures too long in late summer and consequently milk production was decreased.

The pasture season was extended five to 20 days on a number of farms by fall feeding the mowing lands. The cows harvested the aftermath more cheaply than the operator could.

As a further comparison the capacity of the pasture on each farm was estimated roughly on the basis of its equivalent of good pasture. This was found to range from four-tenths to three acres per cow, with an average of 1.6 acres per cow. On nearly all farms, it was necessary to supplement with green feed, silage or hay. This was done in a very skillful and timely manner on some farms, but failure in this respect contributed toward low milk production per cow on other places.

Time of freshening on these farms offsets somewhat the lack of pasturage during late summer. Since 42 per cent of the cattle freshen during September, October and November, the drain for feed on the home pastures was partially relieved by placing these dry cattle in back pastures prior to freshening. This practice may relieve the situation somewhat at present, but when the demand for even production is greater, a different practice will have to be followed.

It is doubtful if some of the back pastures have sufficient good feed even for dry cows in August. On one farm the owner followed a plan of grazing tillable fields and permanent pasture in rotation. Commercial fertilizer, applied to a tillable field in April, made it ready for pasturage May 2—eight days earlier than average.

Another farmer with poor pasture and with 20 per cent of his cows freshening during July and August, did not try to supplement his pasture until September 1. Milk production of the herd decreased as a result, in spite of the freshening of several cows. His pasture was adjacent to tillable fields which could have been used to pasture a soiling crop or aftermath if it had been planned earlier in the summer. The increase in milk production could have been obtained at a very slight cost. The price of milk at this time warranted greater production.

On the farm diagramed in Figure 4, the owner did not have sufficient permanent pasture to furnish feed during the summer. Until the pasture can be put in shape to produce more feed, it is suggested that

the farm be operated with a six-year rotation on six 10-acre fields. The rotation would be corn, oats, clover, grass two years and pasture one year. It is strongly urged that in such cases the better soil be cleared of brush and the entire pasture then be divided into two approximately equal grazing areas.

The use of tillable fields for pasturage is not new on this farm. It is suggested that the fields be pastured only one year and then plowed for corn the next year. While serving as pasture they can advantageously be alternated with the permanent grazing area. Taking field F as an example, fertilizer or manure would be applied to part of the 10 acres in early spring, putting this land in shape for pasturing in early May ahead of the permanent pasture. It would be pastured for about 12 days after which one part of the permanent area would be ready. About eight days later the remaining part could be pastured. Rotating the herd from the tillable fields to the permanent pasture would be repeated throughout the summer as long as each area produced sufficient grass.

The length of time each is pastured depends upon the rate of growth of the grass and the number of cows. The cattle should be moved to a new field before the grasses are grazed too closely. As the summer progresses it may be essential to rely on additional tillable fields. Field E could then be fenced with temporary fencing and pastured in rotation with Field F for the rest of the season. The fencing of fields would not be a serious problem as the posts for the temporary divisions could be driven during the spring and three wires put on at slack times.

Continued improvement will eventually give 20 acres of good permanent pasture. This increase should release one tillable field, enabling the owner to cut more roughage and possibly keep more cows through the winter. Thus, improved permanent pasture will increase the capacity of the farm.

On every farm the operator could well use his labor at slack times in clearing hardhack, juniper and brush on the potentially good pasture soil, but labor or expense on poor thin soil should be avoided.

Fertilizing will tend to stimulate grass production in late summer when pasture is usually short. By dividing the permanent pasture and grazing each half alternately, the total pasturage can be increased and spread over a longer period.* Tillage land that is difficult to work may be added to the permanent pasture.

Rotated tillage land may also be used. In a six-year rotation, for instance, the last year in hay may be used, or the oats may be pastured. In some few cases where permanent pastures are very short the last two years in hay or both the oats and the last year in hay can be pastured. Small convenient areas near pastures or buildings can be sown to sweet clover or special grasses such as Japanese millet and pastured when other feed becomes short.

Each dairyman has a special problem, but he will find it profitable to work out a long, continuous and adequate pasture program. This will reduce labor on roughage harvest and help maintain milk production at high levels and with low costs.

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*Circular No. 35.

VARIATIONS IN OUTPUT PER MAN

Accomplishments in production can best be measured by the results obtained—by the output rather than by the energy expended.

When the 38 farms are arrayed in the order of the output* units per man and then divided into three groups, Group 1, consisting of 13 farms, ranged from 281 to 452 units per man and averaged 359; Group 2 with 13 farms ranged from 203 to 273 and averaged 236; Group 3 ranged from 103 to 193 and averaged 165 units per man.

The average family income for the first, second and third groups, as shown in Table 8, was $620, $494 and $53, respectively, indicating considerable correlation between accomplishments per man, as measured by output units and family labor income.

The average output per man as represented in sales** from Group 1 was 80,189 pounds of milk, 110 bushels of potatoes, 11 bushels of beans, $191 worth of livestock and $370 in miscellaneous receipts. In contrast with this the output per man in the third group was 37,116 pounds of milk, one bushel of beans, —$14 worth of livestock and $171 in miscellaneous receipts. The second group sold from the farm an average of 55,061 pounds of milk, 25 bushels of potatoes, seven bushels of beans, $142 worth of stock and $370 worth of miscellaneous income per man.

It is interesting to note that Group 1 averaged 31 cows per farm as compared to 24 for the second group and 19 in the third. Production per cow in the first group averaged 6,137 pounds and in the second and third groups, 4,741 and 3,948 pounds, respectively. Thus, Group 1 produced about 1,400 pounds more milk per cow than Group 2 and 2,200 pounds more than Group 3. Group 1 also attained higher output per man than the other groups through the use of better methods, better stock and more grain per cow.

The farms averaged 807, 488 and 332 total output units, respectively, for Groups 1, 2, and 3. This would indicate that on those farms where total output was large, the labor could be used to better advantage.

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*Output units are used here in place of man work units that have usually been taken in other studies to measure size of business and labor efficiency. Man work units are based on the number of days labor usually needed per acre of each crop and per unit of each class of livestock. This gives a common denominator for measuring the whole farm business. Dividing the total man work units on a given farm by the number of men working on that farm gives a rough measure of the work accomplished per man.

For the conditions prevailing in Grafton County, the authors believe that a direct measure of production is a better measure of the work accomplished than the acres of various crops grown and numbers of various kinds of livestock cared for. Accordingly the following were selected as amounting to an output unit or the equivalent of a day's work for one man during 1931-1932.

300 lbs. of 3.7% milk, adding 4 lbs. for each .1 point decrease and subtracting 4 for each .1 point increase in fat.
25 bu. of potatoes.
3 bu. of beans.
$10 net increase in livestock.
$5 other income without use of a truck.
$10 income with the use of a truck.

**Sales and inventory gains and losses.

TABLE 8. *Variations in total output per man* on 38 farms. Farms arrayed in the order of output per man.*

Farm rank	Output units* per man	Total output units per farm*	Number of cows	Milk production per cow	Net increase of value of livestock	Crop acres	Hours of labor on stock per cow	Hours of labor on roughage per cow	Hours of labor on stock per 1000 pounds milk	Hours of labor on roughage per1000 pounds milk	Family labor income
				Lbs.	Dollars						Dollars
1	452	1320	52.6	6311	24.61	69	88	27	13.9	4.2	1721
2	447	690	24.8	6315	1.53	45	105	23	16.6	3.7	1643
3	441	651	30.0	5632	15.00	51	133	21	23.6	3.7	781
4	408	917	33.8	7067	7.95	92	122	34	17.2	4.9	779
5	371	804	28.4	3317	5.63	29	115	14	34.8	4.1	466
6	348	1042	28.8	8740	9.95	81	130	35	14.8	4.0	61
7	337	1012	43.0	5569	16.17	115	107	28	19.3	5.0	711
8	336	729	27.4	5330	20.32	79	126	45	26.7	8.4	455
9	323	942	39.9	6340	25.01	90	106	35	16.8	5.5	1103
10	322	752	34.7	4751	16.83	48	92	15	19.4	3.2	−774
11	307	525	25.0	5048	13.03	75	91	27	18.0	5.3	−413
12	291	777	19.7	10445	35.89	58	202	18	19.3	1.8	926
13	281	329	13.0	4922	−.69	37	177	19	36.1	3.8	603
14	273	545	32.2	4491	2.54	85	102	18	22.7	4.0	−81
15	268	434	21.8	3674	21.00	30	110	14	29.9	3.8	442
16	249	541	31.5	4055	9.78	63	112	26	27.7	6.5	1174
17	249	478	13.8	6848	22.17	45	215	38	31.3	5.6	546
18	248	559	23.7	4839	8.21	24	104	13	21.5	2.6	1423
19	245	754	34.0	5105	17.20	66	97	22	19.0	4.3	1377
20	244	530	34.7	4508	6.19	69	108	22	24.0	4.8	288
21	229	343	18.7	4409	16.04	48	116	21	26.4	4.7	269
22	225	488	25.6	5606	6.36	54	142	21	25.3	3.8	−185
23	212	425	23.1	4826	24.41	61	152	28	31.5	5.8	946
24	210	455	24.7	3142	14.61	52	141	20	44.8	6.5	−672
25	208	573	21.8	5530	5.50	64	114	29	20.6	5.2	670
26	203	219	11.7	4604	7.69	43	180	30	39.2	6.4	219
27	193	419	19.8	6609	46.51	28	140	39	20.1	5.9	−404
28	189	221	17.0	3580	4.76	41	107	15	29.9	4.3	217
29	186	404	17.3	5000	−.28	58	177	37	35.3	7.4	−255
30	177	207	13.3	4387	5.63	19	109	26	24.8	5.8	329
31	175	612	47.2	2330	2.77	93	119	17	51.0	7.4	162
32	174	305	15.7	5168	−9.55	54	148	29	28.8	5.6	−964
33	171	469	18.9	4667	.47	35	159	33	34.1	7.0	829
34	165	344	21.0	3596	−10.61	43	151	12	41.9	3.3	318
35	157	367	18.7	3152	32.80	29	124	27	39.5	8.5	767
36	151	202	10.8	3432	24.07	35	170	21	48.7	6.0	184
37	138	207	14.0	2498	−29.28	30	182	14	73.1	5.5	−53
38	103	224	15.1	2958	10.13	28	137	52	46.4	17.6	45
Average first group:											
	359	807	30.9	6137	14.71	67	123	26	21.3	4.4	620
Average second group:											
	236	488	24.4	4741	12.44	54	130	23	28.0	4.9	494
Average third group:											
	165	332	19.1	3948	6.45	41	144	27	39.5	7.0	53
Grand average:											
	255	548	24.9	4968	11.33	54	132	25	29.3	5.4	398

* Output unit is a rough measure of the farm output as determined by the sales from the farm. See page 34.

On the farms with small output, there were periods when the operator could not use his time to advantage in production.

A study of the time put upon enterprises and practices throws light on how some operators obtained high output per man. The daily amount of time used in doing chores was estimated periodically and from this the total time used was calculated on an annual basis.* The average time used on chores per cow in the first, second and third groups was 123, 130 and 144 hours, respectively. (Table 9). This is not a large difference, yet on a 40-cow farm, the difference between Groups 1 and 3 would account for 84 ten-hour days.

In the time required to produce the roughage for the stock, the difference between the groups does not seem to be significant. On this phase there were used 26, 23 and 27 hours per cow, respectively, by Groups 1, 2 and 3. When time on livestock and roughage production is combined—thus roughly representing the labor directly on milk and stock production—there is a difference of only four hours per cow between Groups 1 and 2, but 22 hours per cow between the first and third groups. Through better barn arrangement, better methods and better organization, the first two groups are able to care for stock and produce roughage for the stock in two days less labor per cow.

Since time per cow does not actually measure accomplishments, and there is a difference in intensity of care, the time used on livestock and roughage was determined on a basis of hours per 1,000 pounds of milk. This may discriminate against the high testing breeds, yet the variation in total chore hours per cow was equally great in the high and low testing breeds. When this basis was used to measure the total hours spent on chores, it was found that the average in the first, second and third groups was 21, 28 and 40 hours, respectively. The average on roughage production for livestock was 4.4, 4.9 and 7 hours. When chores and time on roughage are combined, the labor requirements averaged 25.7, 32.9 and 46.5, respectively, for the first, second and third groups.

Since an average of 132 hours per cow was used on livestock and only 25 hours per cow in producing roughage, the importance of making a detailed study of chores is evident.

Barn Chores

The time spent daily on barn chores on the 38 farms ranged from 5.2 to 21.2 man hours. The average was 11.8 man hours per farm. This is approximately 45 per cent of the total work hours available and 60 per cent of the time actually devoted to operating the farms. Although using such a large share of the operator's energy and time, chores have usually been taken for granted and only a few have definitely and systematically striven to reduce the time required.

If chores can be done with dispatch, the operator has more free time for field operations; otherwise horses, tractors, equipment and hired labor are not used to the best advantage and productive work is greatly limited.

*The co-operators estimated the time required to do the individual operations that make up the daily chores.

TABLE 9. *Variations in time required in chore work on 38 farms. Farms arrayed in the order of chore hours per cow.*

Farm rank	Chore Hours													
	Total		Milking		Feeding				Cleaning Stable		Watering Cows		Miscellaneous	
					Grain		Hay and Silage							
	Per cow	Per 1000 pounds of milk	Per cow	Per 1000 pounds of milk	Per cow	Per 1000 pounds of milk	Per cow	Per 100 pounds of milk	Per cow	Per 1000 pounds of milk	Per cow	Per 1000 pounds of milk	Per cow	Per 1000 pounds of milk
1	78	13.5	36.6	5.8	2.9	.5	4.7	.7	13.8	2.2	–	–	1.8	.3
2	87	17.2	43.8	8.7	1.9	.4	12.3	2.4	16.6	3.3	–	–	12.4	2.4
3	90	18.9	61.4	12.9	3.4	.7	10.3	2.2	9.6	2.0	–	–	4.8	1.0
4	96	18.9	59.8	11.7	3.5	.7	10.5	4.7	6.0	1.2	9.0	1.8	7.6	1.5
5	99	22.0	51.6	11.5	4.8	1.1	10.6	2.4	6.5	1.4	3.2	.7	11.2	2.5
6	99	33.8	67.9	20.5	6.7	2.0	6.0	1.8	15.0	4.5	–	–	16.3	4.9
7	103	16.2	68.0	10.7	5.8	.9	13.7	2.2	7.8	1.2	3.8	.6	3.6	.6
8	103	16.2	62.1	9.8	3.8	.6	10.4	1.6	13.6	2.2	–	–	12.9	2.0
9	104	25.6	46.3	11.4	3.0	.7	13.1	6.1	16.9	4.2	10.8	2.7	1.8	.4
10	104	29.0	58.4	16.3	.3	.8	13.1	3.6	20.6	5.7	–	–	9.1	2.6
11	104	23.8	58.7	13.4	5.1	1.2	10.3	3.3	17.3	3.9	7.7	1.8	5.0	1.1
12	105	18.8	56.5	10.1	3.6	.6	17.7	3.7	14.6	2.6	–	–	12.4	2.2
13	107	23.9	55.7	12.3	1.5	.4	25.1	5.6	20.1	4.4	–	–	5.3	1.2
14	107	21.0	46.2	9.5	14.3	2.9	23.8	4.9	17.4	3.6	–	–	5.5	1.1
15	108	29.5	54.3	14.8	2.8	.8	15.7	4.3	21.4	5.8	9.4	2.6	4.9	1.3
16	113	19.7	68.3	12.4	1.6	.3	21.0	1.2	11.8	2.1	6.3	1.1	9.4	1.7
17	116	26.3	64.1	14.5	6.2	1.4	11.0	2.5	11.2	2.5	11.0	2.5	18.9	2.8
18	117	50.2	78.3	33.6	8.0	3.4	12.3	5.3	8.3	3.6	3.2	1.4	6.9	3.0
19	120	16.9	64.4	8.1	6.6	1.0	26.3	3.7	10.8	1.5	6.1	.8	5.4	.8
20	121	38.3	51.4	16.3	5.5	1.7	9.1	2.9	21.3	6.7	21.9	6.9	11.8	3.7
21	126	14.4	82.6	9.4	5.4	.6	17.8	2.0	13.7	1.6	–	–	6.3	.7
22	128	22.8	85.3	15.2	2.3	.4	16.5	2.9	10.2	1.8	10.2	1.8	3.6	.6
23	132	27.7	85.0	16.4	4.1	.8	13.0	2.5	26.4	5.1	6.5	1.3	8.1	1.6
24	134	45.5	41.6	14.0	5.7	1.9	36.2	12.2	13.7	4.6	23.8	8.0	13.7	4.6
25	135	24.1	85.4	15.2	1.7	.3	16.7	3.0	17.6	3.1	–	–	13.6	2.4
26	137	43.5	89.9	28.6	2.5	.8	11.1	3.5	17.2	5.5	11.8	3.7	4.3	1.4
27	138	21.8	83.7	15.7	6.2	1.2	21.8	4.1	17.3	3.2	5.0	.9	3.9	.7
28	141	21.4	86.4	13.1	6.1	.9	16.4	2.5	17.0	2.6	7.7	1.2	9.5	1.4
29	143	29.7	90.1	18.7	6.7	1.4	20.0	4.1	15.4	3.2	4.4	.9	6.7	1.4
30	148	41.2	92.9	26.1	7.4	2.1	24.4	6.8	20.4	5.7	–	–	1.9	.5
31	157	33.7	105.5	22.6	4.6	1.0	12.6	2.7	17.9	3.8	4.5	1.0	12.0	2.6
32	167	48.6	87.0	20.4	3.2	.9	6.3	1.8	49.8	14.5	3.2	.4	17.2	5.0
33	175	35.5	123.6	25.1	5.2	1.1	19.7	4.0	20.3	4.1	–	–	5.7	1.2
34	175	35.1	90.3	18.1	4.9	1.0	22.7	4.5	25.5	5.1	14.8	3.0	17.1	3.4
35	177	71.0	109.5	43.8	6.1	2.4	7.3	2.9	27.7	11.1	13.4	5.4	13.3	5.3
36	177	57.1	98.0	21.3	5.8	1.3	23.4	5.1	17.6	3.8	11.6	2.5	20.9	4.6
37	198	19.0	113.5	10.9	10.5	1.0	21.6	2.1	22.3	2.1	7.8	.7	22.8	2.2
38	241	31.3	124.7	18.2	13.1	1.9	39.6	5.8	15.4	2.2	18.6	2.7	2.9	.4
Average first group: 98	21.4	55.8	11.9	3.6	.8	12.1	3.1	13.7	3.0	2.6	.6	8.0	1.7											
Average second group: 123	29.2	69.0	16.0	5.1	1.2	17.7	3.9	15.5	3.6	8.5	2.3	8.6	2.0											
Average third group: 170	37.1	100.4	21.2	6.6	1.4	19.6	3.9	22.2	5.1	7.6	1.6	11.2	2.4											
Grand average: 129	29.0	74.4	16.2	5.1	1.1	16.4	3.6	17.0	3.9	6.2	1.5	9.2	2.0											

When chore hours on the separate farms were arrayed on the basis of man hours per cow, the chore time requirement ranged from 78 to 241 hours. As shown in Figure 7, six farms used less than 100 hours per cow; 21 farms, the largest group, between 100 and 140 hours; and one farm more than 200 hours.

In the case of the six farms which spent less than 100 hours per cow on chores, all had fairly convenient barns equipped with drinking cups. On three farms the cows were stabled above the basement and cleaning the stable took very little time. Two operators gave their cows only meagre care. In the group of 11 farms spending more than 140 hours per cow, seven were handicapped by inconvenient barns, and one man with high-producing stock cared for them intensively. On 12 of the 38 farms either the operator or hired help were not naturally quick in doing chores.

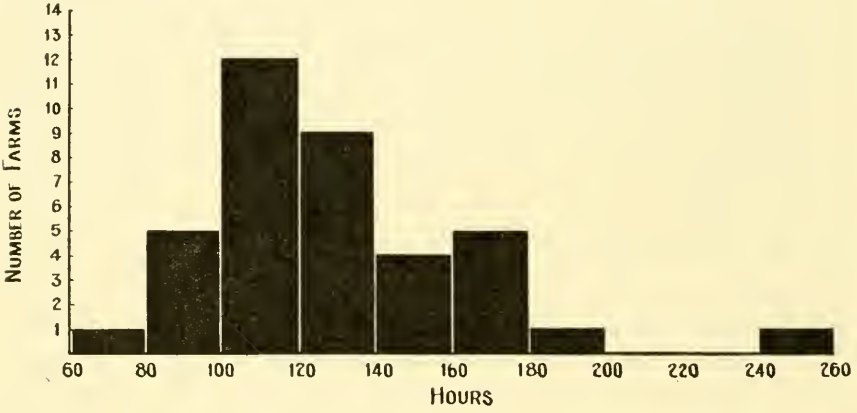


Fig. 7. A comparison of man hours on barn chores per cow on 38 farms.

Obviously unless the time saved through better methods is actually put to work on productive enterprises, the results may accrue in the form of more leisure rather than greater total output or greater financial returns. On some farms more leisure is of greater importance. For instance on one farm where the time between the beginning of chores in the morning and finishing at night was approximately 15 hours, it is estimated that at least one and one-half hours could be saved daily by better organization and by partial rearrangement of the barn. The time saved could better be used in the form of a shorter working day and more leisure. In another instance the shortening of chore time would enable the operator to get along with less hired labor.

To account for the wide differences in the time required per 1,000 pounds of milk to do the barn chores, a detailed description of the many factors on each farm would be essential. No one farm appears to be either high or low in all the practices or operations that make up the total chore time. If all the farms were arrayed according to the chore time required per 1,000 pounds of milk and then divided into three groups of 13, 13 and 12 farms, respectively, in the low, medium and high groups, the milk production per cow would be 4,905

pounds, 4,788 pounds and 5,231 pounds. There is little correlation between milk production and time required per 1,000 pounds of milk. The low time group tended to have better arranged stables and to be quicker in the individual operations. This is stated as a tendency, as there are notable exceptions to each of these factors. The wide range on individual farms is shown in Figure 8.

By breaking the time on chores into the separate practices, a more intimate picture can be had of the factors involved in the efficiency of chore work.

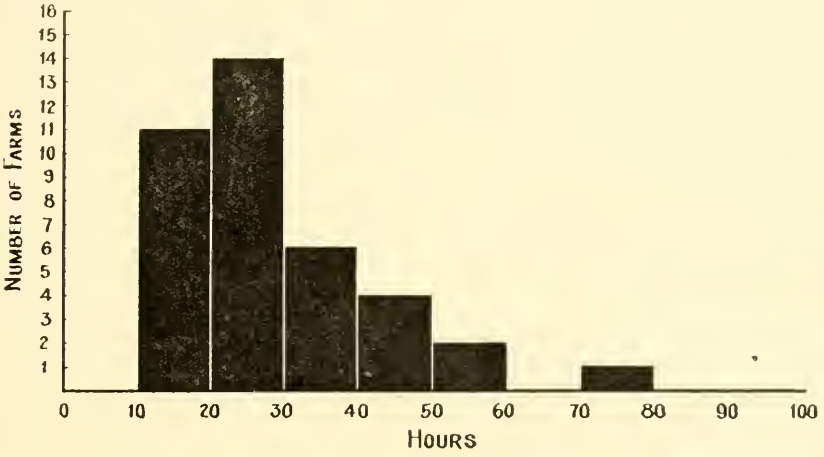


FIG. 8. A comparison of man hours on barn chores per 1,000 pounds of milk on 38 farms.

Milking. The time required to milk varied from 36 to 125 hours annually per cow and from 5.8 to 43.8 hours per 1,000 pounds of milk. On the 16 farms where milking was done by hand, an average of 82 hours per cow and 19.4 hours per 1,000 pounds of milk were used during the year; where milking was done by machine, the average time was 65 hours per cow and 13.3 per 1,000 pounds of milk.

Within the machine group, the time on milking ranged from 37 to 90 hours per cow and from 5.8 to 29 hours per 1,000 pounds of milk. On some farms the available labor and the use of the machines had been carefully adjusted so that both machines and men were employed to the best advantage. In other cases the men have not adjusted themselves to the use of the machines and little or no time is saved at each milking. In several instances, the benefit from the use of the machines is taken in the form of less strenuous labor rather than in time.

Feeding Grain. Feeding grain is a minor chore generally taking little time, and yet the range of .3 to 14.3 hours annually per cow required for this task is indicative of the general difference in chore efficiency on individual farms. Those with low labor had the grain handy and used a cart.

Feeding Roughage. Feeding roughage was also variable in time requirements per cow and per 1,000 pounds of milk. The 16 farms feed-

ing only hay as roughage averaged to require during the year 3.4 hours per 1,000 pounds of milk and 14.2 hours per cow to feed hay to the cattle. The labor used ranged from 1.2 hours to 6.7 hours per 1,000 pounds of milk and from six to 24 hours per cow. Barn arrangement on the farm with 6.7 hours per cow made it necessary to handle the hay several times before feeding it; on the farm with 1.2 hours per cow, the hay mow and feed manger were so arranged that very little handling was necessary.

The operation of feeding silage varied from .28 hours to 4.3 hours per 1,000 pounds milk and from 1.3 to 29.7 hours per cow. Those operators who had low time requirements per cow used feed carts for carrying ensilage. In most barns by a little rearranging of the stable, a feed cart could be used and considerable walking and time saved.

The time for roughage feeding as a whole varied from 4.7 to 39.6 hours per cow and from .7 to 12.2 hours per 1,000 pounds of milk. The average for all farms was 3.6 hours per 1,000 pounds and 16.4 hours per cow.

Cleaning stable. The time required to clean the stable varied from 6 to 50 hours annually per cow. Fourteen farms used less than 15 hours per cow, 20 used between 15 and 25 hours, and the remainder more than 25 hours.

On the 15 farms where the manure was dropped to the basement the time required to clean the stable tended to be less than where carriers were used. Carrying manure in a scoop shovel and throwing it out the window accounts for the higher labor requirements on three farms. In some cases scuttles were hard to open or the stable cleaning operation had to be combined with watering.

In one instance where the time requirement was low, the operator followed a definite procedure. A long rod with a hook on the end hung at one end of the barn back of the cows, and a special long-handled shovel stood at the other end. Beginning at one end of the stable the operator opened all of the scuttles back of the cows with the long hook. At the other end of the tie-up he exchanged the hook for the long-handled shovel and returned, shoveling the manure into the basement. He then walked the length of the tie-up using the shovel to close the scuttles, left the shovel in its original position, and returned with the long hook, hanging it in place for the same routine the next time. Thus, by having a special tool designed to do a definite task, and then systematically completing the task requiring the use of that tool, the operator was able to do the work quickly.

Watering. As a daily chore, watering on 13 farms required no time as water was available to the cows at their stanchions either in drinking cups or by filling the concrete mangers with water. On the other 25 farms, the time used in watering varied from 3.2 hours to 23.8 hours per cow and from 0.6 to 8 hours per 1,000 pounds of milk. This does not include building fires for water-heating purposes. The installation of inexpensive water-cups can be justified on the basis of time saved on chore work, not to mention the effect on production of continuously available water.

Chores on individual farms. It was noted that operators who had worked out good methods in several chore operations were using very

cumbersome and time-consuming methods in other practices. As an example one operator used a feed cart for grain yet used individual baskets for feeding ensilage. By using a cart for ensilage, he could have done the task in one-half the time and one-tenth the travel. In a few instances, the time consuming method was due to barn arrangement, but generally the dairyman was not conscious of the fact that he was making hard work of the operation. Since most barns were built over 80 years ago, the average dairyman has found it necessary to adjust himself as well as possible to the barn he happens to have.

On several farms chores were studied in considerable detail to get an intimate picture of how operators were able to accomplish so much. A record was taken on one farm with 60 cows and about 40 head of young stock. Fifty-five cows were being milked. Two men did all the chores, and since the product was sold as Grade A milk, the stable and the cows were well-cared for. The men began at 4.30 a. m., took 30 minutes out for breakfast and completed the chores at 10 a. m. This included hauling the 24 hours' accumulation of manure and spreading it on the fields. Beginning again at 3 p. m., the evening chores were complete at 6 o'clock. Approximately 16 man hours were required to do the chores, or about 16 minutes per day per cow.

In milking 55 cows, a total of six man hours were used in the two milkings. This is 6.7 minutes per cow or 36.6 minutes per 100 pounds of milk. Three single units were used, and the operator was especially dexterous in putting milkers on and off. The milkers were on the cows an average of 4.5 minutes per cow per milking, and very little milk was obtained from hand stripping. From first to last, the milkers were actually in operation on the cows about 90 per cent of the time. Two extra milker pails with light tin covers were conveniently located so that when one pail was full, the top of the full pail and the tin cover of the extra one could be quickly exchanged and the milker immediately put into operation on the next cow.

The operator planned his work so that two pails would be filled at about the same time, and thus he could carry both pails to the milk room in one trip. The milk room was inconveniently located on a floor above and to one end of the barn. One man operated the milking machines, cleaned the udders of the cows, and carried milk to the milk room while the other man did the hand stripping. In taking care of the milkers the operator usually massaged the udders and pulled down on the teat cups a short time before taking them off. He attributed the quickness in milking to the fact that he kept the machines in good repair and the teat cup rubbers tight.

On another farm where the milking was done quickly, one man operated the two double units and washed the udders while the other man did the hand-stripping and carried the milk to the nearby convenient milk room. In this case also extra milker pails were used in order to keep the milking machines in operation a larger proportion of the time. The machines were left on the cows an average of 6.6 minutes per cow per milking or 2.1 minutes longer than in the case of the other farmer. The milkers were in operation on cows 86 per cent of the time, but were changed from one cow to another more slowly than on the other farm.

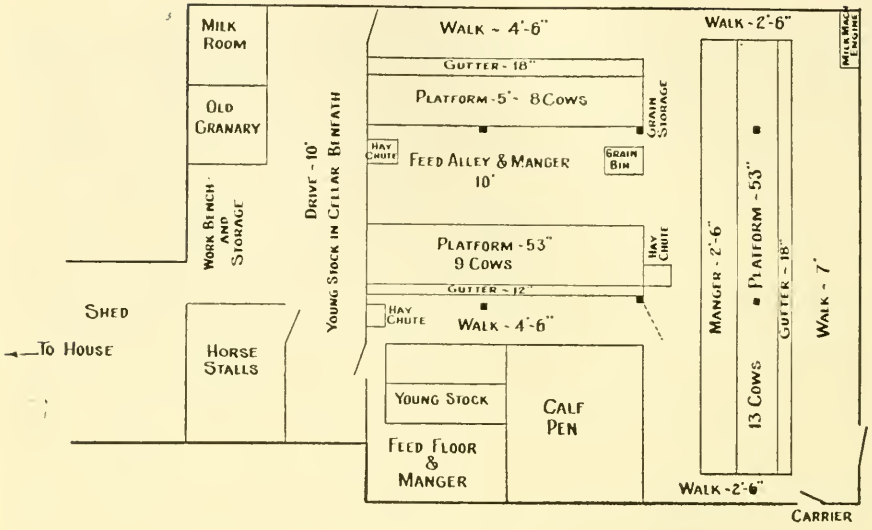


FIG. 9. Present barn arrangement on one farm.

On two farms the travel of the operator in doing the chores was recorded by laying down a string on a barn plan as shown in cut on front page. A study of the resulting picture and measurement of the string indicates that on one farm, the one and one-quarter miles of walking in one evening to clean the stable, water the cows, and milk, could be materially lowered. This would necessitate some re-location of stock and some minor changes in barn arrangement.

The arrangement of barns will be discussed in more detail in a later bulletin, but one illustration here will serve to show the need of re-arranging some of the older ones. Figures 9 and 10 show the present and the suggested arrangement of tie-ups, calf pens and milk house. At present a large amount of space per cow is allowed for walks and feed alleys. The operator walks 2,050 feet at each milking from the cows to the milk room. The proposed rearrangement of the milk house and tie-up would reduce this traveling by two-thirds. The time spent in feeding grain would be materially reduced by using a feed cart. By building a hay chute, the roughage could be dropped from the mows directly into the feed alley. This rearrangement would place all the cattle on one floor and save an hour a day in doing the chores.

Roughage Production

Efficiency in roughage production is more important than the time per unit indicates because much of the work comes at a peak period and may result in hiring extra labor. Efficiency in this field work may enable the operator to carry more cows with the same energy or perhaps to take care of the same number of cows with less drudgery.

The labor required for producing all roughage ranged from 13 to 52 hours per cow with an average of 25 per cow. The 13 farms requiring the least amount of time per cow on roughage production averaged

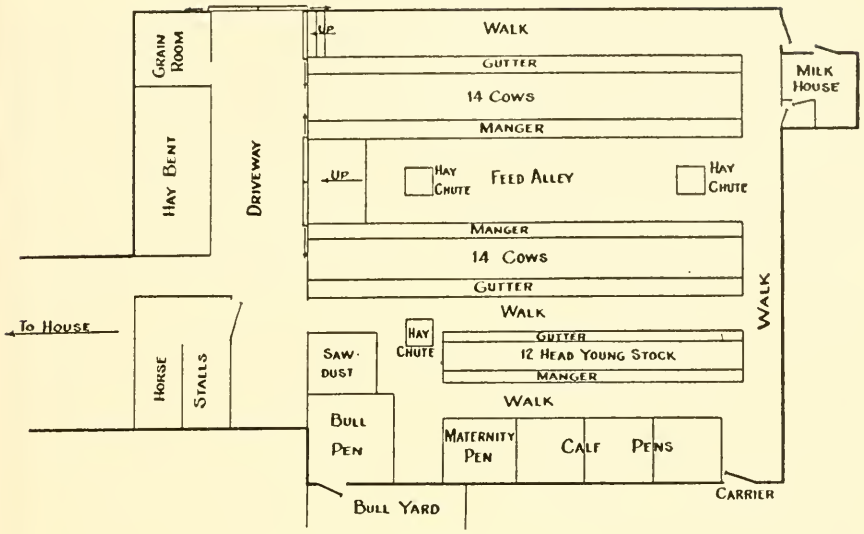


FIG. 10. Suggested rearrangement of barn.

16.1 hours per cow, and the 12 farms requiring the most averaged 36.6 hours per cow. (Fig. 11).

For the purpose of studying the time requirements in roughage production, the labor of producing roughage was roughly separated into (1) that of producing hay, including the plowing for new seeding, (2) that of producing silage; and (3) that of hauling and spreading manure.

Hay Production. In the production of hay the time required per ton ranged from 3 to 13 man hours. Eleven of the operators used

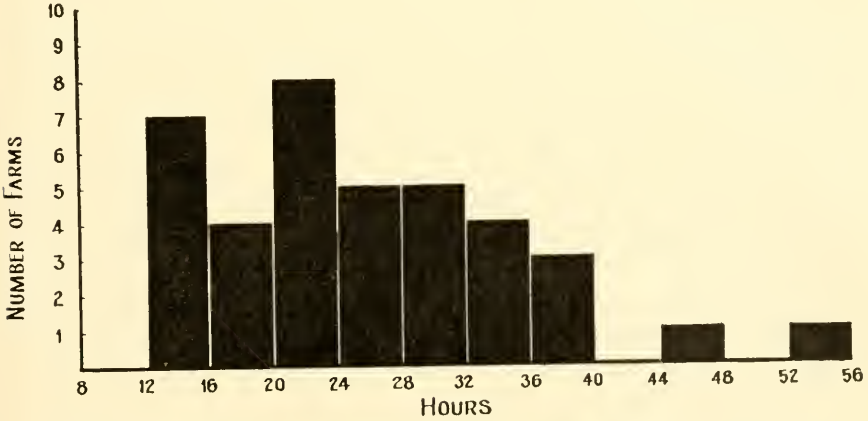


FIG. 11. A comparison of man hours on roughage per cow on 38 farms.

more than five hours per ton to harvest hay and of these, three hauled hay a considerable distance, four did a lot of unnecessary hand work in fussing with hay, two failed to organize the haying crew to best advantage and two were handicapped by lack of equipment. The seven men with less than three man hours per ton in harvesting the first crop, had good crew organization, good equipment, sufficient power and they pushed the haying when the weather permitted.

The use of large amounts of labor in curing and fussing with hay is a hangover from the methods in use a half century ago and has disappeared on most farms.

In a few instances the operator, though physically able himself, permitted a less capable hired man to take key positions in setting the pace for all other workers.

Silage Production. Twenty-one farms produced silage. The labor requirements varied from 1.6 hours to seven man hours per ton of silage. Those operators with low labor requirements secured good yields per acre, had easily worked fields, had adequate equipment and good organization of the help at silo filling time. Poor yields and lack of push at harvest time account for the high labor costs per ton on the other farms.

Manure

The time used in hauling and spreading manure, when estimated on the basis of six tons per animal unit, varied from 0.4 to 2.3 hours per ton. The farm operators who hauled the manure to the fields in spreaders every day used a small amount of time per ton since the dressing was loaded directly from the carriers. Twenty-five hauled from the storage pit and spread on the fields. Some of the operators hauled manure in the winter, making large piles in the more distant fields and spreading these in the spring with a spreader. While this practice may take more time per ton, the added labor in the winter comes at a time when it is available. Two operators followed the practice of making small piles of manure at equal distances on the fields and spreading these piles by hand in the spring. In both cases the time requirement was higher than the average, and the practice is questionable since the manure leaches badly and cannot be distributed evenly.

The problem of distributing the manure to the fields efficiently and with little loss in fertilizing value should be given careful consideration on each dairy farm. In addition to time-consuming handling and spreading, leaching of the manure is so bad on some farms that no doubt from one-third to one-half its fertilizing value is lost.

Thus far we have discussed the time requirements for individual tasks. This gives some indication of why it is possible for some men to accomplish so much. The man who can do each task quickly and well is in a position to accomplish a great deal, but the time on each task does not show how well he uses his total available time for productive purposes.

Some of the men did the chores quickly in order to have more time for other farm work in which they were interested. A few hustled

through their chores to get away from the farm in which they were not primarily interested. Some took considerable time for separate tasks because of lack of organization and good methods, while in other cases special interest in the job resulted in longer time on each operation.

Certain of the operators tended to use their own labor to advantage by steady employment of their time over a longer period than others. On those farms growing silage, for example, an average of 28 hours per cow were required in roughage production, while on farms not growing silage only 20 hours were required per cow. But since the silage and hay do not compete for labor, silage could be grown in addition to hay, thus, making better use of the available labor.

Cash Crops

When cash crops such as maple sirup or potatoes were carefully fitted into the dairy organization so that little additional hired labor was required, the output per man was increased.

Seven of the operators made maple sirup and thus had employment for their available labor in early spring before field work began. The year was unfavorable for sirup and only 559 gallons were harvested where normally 1,500 would be expected. Very little extra hired labor was employed, and the major cost was the time of the regular labor in a slack season. About $1,000 worth of sirup resulted from the employment of 1,452 hours of man labor, 332 hours of horse labor, the burning of 35 cords of wood, the use of $3,000 worth of special equipment and the use of the sugar orchard. The wood largely represents labor employed at odd times in the winter. If the operators were able to do the sugar work without neglect of the other enterprises, they were ahead financially even though the returns per hour of work were low.

Three men produced potatoes on a commercial scale. A comparison of one of these with another growing no cash crop will indicate how the potato grower is able to have this added production without much additional hired labor.

Both farms carry about 35 cows. The potato man secured a slightly greater milk yield per cow. He put about 500 hours less on stock and 80 hours less on roughage, but used 800 hours on potatoes. Thus by cutting time on chores, by hiring the equivalent of two months more labor and by working somewhat more strenuously himself at potato harvest time, he was able to produce about 3,000 bushels of potatoes in addition to slightly more milk.

Most dairymen can increase their efficiency in chores and in other farm activities by giving more attention to better and easier methods. Each man in the light of his particular situation, his farm, his present barn and field arrangement, his own skill and physical and financial abilities, can improve his situation by questioning present methods. Much can be done without the expenditure of money.

VARIATIONS IN CASH EXPENSES

The wide variations in cash expenses on the 38 farms at least indicate great diversity of management. On some of the small semi-self-sufficing farms the cash expenses were small and the gross income low. Cash expenses tend to be high on the more intensively worked farms and on the farms where the management is more aggressive, for the good manager is willing to buy feed, fertilizer, and seed as long as an additional unit will definitely raise his net income. His expenses are thus higher but his net income is also greater.

In order to place each farm on a more comparable basis as to size, the expenses per $100 of gross income were estimated for each farm. The cash expenses (Table 10) ranged from $26.76 to $93.83 per $100 of gross income, feed expense from $2.93 to $36.44. The operator who purchased the low amount of grain would have been ahead if he had bought more. The one who spent over one-third of the gross receipts for grain may not have purchased more feed than was economic under his conditions.

Except in extreme cases it is difficult to determine from a study of expenses whether too little or too much grain has been fed. A closer scrutiny of the detailed feeding on some farms, as shown by the field man's records and observations, disclosed opportunities for certain farmers to save expenses by a more intelligent purchase and use of grain. Often a high cost ration was being fed to dry cows and heifers when a lower cost fitting ration would have been adequate.

Fifteen of the 38 farms had less than $10 hired labor expense per $100 gross income. Hired labor cost one operator $38 for each $100 of gross income. He employed more labor than his organization would justify and he would be better off had he reduced to a one-man farm and done nearly all the work alone.

Taxes took from $1.52 to $18.84 for each $100 in gross income. These differences are due in part to differences in tax rate, but more largely to intensity of operation. One town has a very low tax rate. As would be expected, the aggressive manager had greater sales from the farm and the taxes per $100 in income were lower.

COMBINATION OF FACTORS ON INDIVIDUAL FARMS

After studying these individual factors it may be profitable to note the combination of factors on individual farms for the year ending April 1, 1932.

The 38 farms are listed in Table 11 according to family labor income and a tabulation for each farm gives the number of cows, production per cow, price of milk, farm and crop acreage, quality of hay, miscellaneous income, expenses, and other factors which have definite effects on net returns. A study of these reveals a variety of ways by which individual farmers secured incomes in this particular year. Some obtained low net returns in spite of ranking well in a few of the above factors.

The operator with the highest income had poor pastures, low amount of protein hay per cow, and large cash expenses, but had a large herd, good production per cow, relatively high milk price, good returns from livestock sales and very high output per man. The operator with the

TABLE 10. *Variations in cash expenses on 38 farms. Farms arrayed in the order of the total cash expenses. (Not including personal or household expenses.)*

Farm rank	Total expense	Expense per $100 Income									
		Total cash expense	Feed expense	Labor expense	Livestock purchases	Farm machinery repairs	Building repairs	Gasoline and oil	Miscellaneous expense	Taxes	Fire Insurance
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
1	955	26.76	9.92	7.56	–	.28	–	.28	5.24	3.47	–
2	1150	40.18	19.64	.49	.87	.35	.52	.35	5.34	9.61	3.00
3	807	40.27	7.83	5.94	–	3.29	–	3.39	5.34	13.47	1.00
4	892	43.58	2.93	3.66	12.70	.49	–	1.22	16.61	5.96	–
5	784	43.87	25.29	.22	–	.28	–	3.08	7.27	7.72	–
6	1380	44.62	6.69	17.26	1.29	.48	1.94	7.82	3.10	5.04	.97
7	2386	45.52	10.89	16.98	–	.38	–	3.15	8.62	4.83	.67
8	1718	46.39	24.01	2.86	–	.81	.22	1.89	8.29	6.51	2.08
9	1331	46.60	16.98	22.76	–	1.22	–	2.34	1.40	1.89	–
10	2196	47.02	19.74	9.40	3.32	.32	6.96	2.42	3.34	1.52	–
11	578	47.77	16.94	9.50	–	.25	1.24	–	–	18.84	.83
12	2492	48.16	12.74	23.83	–	.39	–	2.59	6.57	2.05	–
13	969	49.06	22.78	1.52	–	.61	–	3.04	13.01	7.09	1.01
14	1058	49.10	22.41	2.00	7.75	.46	.84	1.86	7.84	5.48	.46
15	1844	50.59	14.81	4.53	–	1.51	–	6.58	13.55	9.19	.41
16	2597	50.62	18.87	14.17	.49	1.38	–	3.06	6.42	6.24	–
17	653	50.82	18.29	6.22	–	2.57	1.87	–	16.81	2.72	2.33
18	3012	53.97	14.69	11.23	3.58	1.56	–	2.54	13.15	5.95	1.25
19	713	54.10	6.37	13.66	–	1.14	1.14	–	14.95	13.81	3.03
20	2616	56.33	20.71	10.77	1.16	.43	–	2.24	8.96	8.83	3.23
21	2226	58.52	9.57	26.89	.24	.52	–	4.44	6.10	8.10	2.66
22	3754	58.72	21.05	16.77	–	1.80	.47	4.36	6.46	6.43	1.38
23	2903	59.54	17.62	18.46	–	3.22	2.56	10.58	4.14	1.93	1.02
24	2238	60.27	23.65	20.47	1.64	.59	.86	1.40	2.24	8.38	1.05
25	3996	60.41	24.78	11.82	–	.56	1.62	1.15	12.58	6.47	1.44
26	2313	60.76	26.27	3.28	–	2.57	1.26	6.72	16.55	2.39	1.97
27	4761	62.03	19.62	22.25	2.87	2.29	1.06	3.31	4.48	5.09	1.06
28	2010	63.35	24.71	7.60	10.43	3.12	7.66	–	3.88	5.80	.16
29	1241	63.87	12.09	7.98	–	.46	–	.51	30.98	11.84	–
30	6018	65.19	36.44	10.20	1.62	1.88	1.04	1.30	7.88	4.47	.35
31	2147	70.67	30.28	13.69	.33	1.25	3.29	–	11.65	9.38	.79
32	1862	74.99	11.72	17.20	18.12	.80	–	2.01	14.94	9.26	.93
33	6549	78.08	30.36	16.69	16.33	.24	.55	2.86	4.04	6.39	.61
34	4256	78.18	11.61	11.66	44.30	.64	–	1.38	2.37	5.09	1.12
35	2931	79.02	17.23	19.09	5.39	1.08	5.39	2.70	19.76	7.66	.73
36	1381	79.23	19.39	13.20	17.78	1.15	7.17	4.30	14.80	12.05	–
37	2497	90.27	14.71	37.96	6.15	1.08	5.42	.72	6.15	12.65	5.42
38	4685	93.83	24.47	17.14	5.01	2.04	.82	1.60	34.55	8.19	–
Average first group:											
	1357	43.83	15.11	9.38	1.39	.70	.84	2.43	6.47	6.77	.74
Average second group:											
	2302	55.67	21.05	12.33	1.14	1.41	.82	3.46	9.98	6.61	1.56
Average third group:											
	3362	74.89	19.92	16.22	10.69	1.33	2.70	1.72	12.96	7.52	.93
Grand average:											
	2313	57.69	18.11	12.55	4.25	1.14	1.42	2.56	9.72	6.95	1.08

next highest income had half as many cows, about the same production per cow, same price for milk, nearly as high production per man, a large income from miscellaneous sources and low cash expenses. The operator with lowest income had a small herd of 16 cows, fair production per cow, low price for milk, no net increase from stock, poor pastures, and low output per man.

A general idea of the range of factors on individual farms can be had when the 38 farms are grouped according to family income. The first group of 13 had incomes over $700, the second group, from $175 to $700, and the third below $175. The averages in these groups were $1091, $372 and −$294, respectively.

Within the first group are two farms having only 19 cows and one with more than 50 cows. The average for the group is 30 cows. In the second and third groups the average is about 23, the number ranging from 11 to more than 40 in the second, and from 13 to 35 in the third. The second group had no advantage over the third in size of the cow herd.

The reason for the higher net returns in the second group compared with the third must be in advantages in some of the other factors. In this case these are mainly the higher price received for milk, higher miscellaneous income, and lower expenses.

The first group tended to have higher milk production per cow, better price for milk, larger net increase in livestock, less protein hay but heavier grain rations per cow, greater output per man and higher expenses.

VARIATIONS IN PERSONNEL

As this study progressed the authors were impressed again and again with the possibilities of improvement in the management of many of the farms. To be sure, some of the variations are not within the control of the farmer, as, for example, the difference in price of milk due to being in Grade A or Grade B territory, and the differences due to soil and farm topography. As far as income is concerned, some of these differences are at least partially evened up by capitalizing farms with good locations and good soil at proportionally higher values. But after making due allowance for these uncontrollable factors, there are still marked variations which can be accounted for only by differences in the effectiveness with which the managers do their work.

High achievement in dairying requires a diversity and high quality of skill, a wide knowledge of technical agriculture, constant energy and ability to plan and to execute the plans such as only a few possess. The varying degrees in which men fall short of having these qualities in balance accounts to no small extent for the great differences in production per man and in milk production per cow. Some who are especially interested in cows tend to let the crop work slide. Others who are good crop men may have little interest in their stock. Still others are not able to apply themselves to either task at full capacity because of lagging interest. Such men tend to have no objective and merely drift along doing chores and other work absent-mindedly, making no

TABLE 11. *Variations in important factors on 38 farms.*

Farm number	Family labor income	Average number of cows	Pounds of grain per cow	Pounds of milk per cow	Price of milk per cwt.	Net livestock increase per cow	Crop acres per farm	Pounds high protein hay per cattle unit	Pasture quality	Crop sales	Miscellaneous income	Total output units* per farm	Output units* per man	Total expenses
	Dollars				Dollars	Dollars				Dollars	Dollars			Dollars
1	1721	52.6	2556	6311	2.160	24.61	69	766	Poor	–	310	1320	452	7537
2	1643	24.8	2260	6315	2.149	1.53	45	1171	Poor	–	891	690	447	2689
3	1423	23.75	1090	4839	2.423	8.21	24	1088	Fair	2113	–	559	248	3309
4	1377	34.0	994	5105	1.823	17.20	66	1040	Fair	940	334	754	245	3361
5	1174	31.5	1366	4055	2.248	9.78	63	884	Poor	–	–	541	249	2145
6	1103	39.9	1454	6340	1.782	25.01	90	2420	Poor	47	6	942	322	4476
7	946	23.1	1498	4826	1.988	24.41	61	661	Poor	20	13	425	212	1709
8	926	19.75	2811	10445	2.237	35.89	58	2017	Excel lent	–	228	777	291	4878
9	829	18.9	1344	4667	2.127	.47	35.5	1429	Fair	15	722	469	171	1707
10	781	30.0	1006	5632	1.688	15.00	51	960	Good	–	267	651	441	2209
11	779	33.8	2166	7067	2.159	7.95	92.25	968	Fair	6	767	917	408	5556
12	767	18.75	373	3152	1.890	32.80	29	1778	Good	–	543	367	157	2586
13	711	43.0	1257	5569	1.660	16.17	115	1858	Good	817	1166	1012	337	7484
14	670	21.8	883	5530	2.091	5.50	64.25	2728	Poor	53	848	573	208	2718
15	603	13.0	1060	4922	2.307	–.69	37	1485	Poor	200	478	329	281	1280
16	546	13.8	1729	6848	1.755	22.17	45	1447	Fair	395	435	478	249	2178
17	466	28.4	1349	3317	1.682	5.63	29	2134	Poor	–	2·32	804	371	6293
18	455	27.4	1154	5330	1.770	20.32	79	946	Poor	–	601	729	336	2824
19	442	21.8	556	3674	1.372	21.00	30	2722	Fair	–	1532	434	268	2253
20	329	13.3	1202	4387	1.86·	5 63	19.5	3970	Poor	–	50	207	177	2067
21	318	21.0	735	3596	2.340	–10.61	43.25	769	Poor	–	–	344	165	1379
22	288	34.7	1047	4508	1.805	6.19	68.83	1835	Good	–	100	529	244	4528
23	269	18.7	504	4409	1.538	16.04	48	1280	Poor	–	160	343	229	1380
24	219	11.7	499	4604	1.909	7.69	43	889	Fair	–	73	219	203	796
25	217	17.0	535	3580	2.270	4.76	41	748	Fair	77	269	221	189	1291
26	184	10.8	1007	3432	2.080	24.07	35	1500	Fair	161	12	202	152	701
27	162	47.25	424	2330	1.669	2.77	92.75	1542	Fair	15	320	612	175	4782
28	61	28.8	2229	8740	1.958	9.95	80.75	1473	Good	502	1339	1042	348	7444
29	45	15.1	240	2958	2.052	10.13	28	2829	Fair	–	130	224	103	946
30	–53	14.0	107	2498	1.463	–29.28	30.15	736	Poor	125	295	207	138	2108
31	–81	32.25	1190	4491	1.705	2.54	85	2130	Fair	324	58	545	273	3060
32	–185	25.6	1333	5606	2.032	6.36	54	3414	Fair	–	32	488	225	3482
33	–255	17.3	1357	5000	1.808	–.28	58	2333	Poor	150	78	404	186	2217
34	–404	19.8	1601	6609	1.600	46.51	28	1000	Fair	–	300	419	193	5048
35	–413	25.0	1652	5048	1.814	13.03	74.75	1798	Good	252	81	525	307	2833
36	–672	24.7	833	3142	1.739	14.61	52.21	2370	Good	106	668	455	210	2990
37	–774	34.75	1374	4751	2.110	16.83	48	1474	Good	550	75	751	322	5038
38	–964	15.7	778	5168	1.455	–9.55	54	1583	Poor	–	226	305	174	2134
Average first group:	1091	30.3	1547	5716	2.026	16.85	61.44	1311		304	404	725	306	3819
Average second group:	385	21.8	943	4912	1.907	9.82	44.83	1727		68	568	416	236	2284
Average third group:	–294	25.	1093	4695	1.79	6.97	57.13	1890		169	300	498	221	3507
Grand average:	412	25.7	1197	4968	1.969	11.32	54.40	1636		181	427	548	255	3195

* Output unit is a rough measure of the farm output as determined by the sales from the farm. See page 34.

real effort to build up the dairy organization for more efficient production. A few have the skill, interest and the incentive to grow crops more and more efficiently and to develop and care for better cows. Then, too, there is a great difference in the physical ability to work due to health or age or other causes.

Even this small group of 38 farms included a great diversity of personnel: the young man just getting underway, handicapped by inexperience and lack of capital, but energetic, skillful and interested; the older man who has won his place with skill and energy over a period of years but now finds it best to curtail somewhat his own physical contribution; the keen, skillful, interested man in the prime of life who thinks and lives his farm business; the man who does not consistently set himself to work in production; and the man who has plenty of energy and ambition but whose objective somehow is not clear and whose labor is misdirected. These differences in personnel are reflected in the output per man, production per cow and all the other factors.

Knowledge of Farming

The knowledge of farming of the 38 operators was above the average. Several were better informed than the actual results indicated, since they were working under handicaps of poor health, insufficient finances, or lack of complete control of the farm. However, there were great variations. In roughly classifying the 38 operators, 17 were considered as having a good knowledge of farming, 15 fair, and six limited knowledge.

Skill with Cows

Some men seem to have an inherent skill with cows, although background and experience no doubt contribute to its development. The handling of good stock kindles the interest of the man who really likes cows, and this interest is an important factor. The ability to care for and feed cows to the best advantage requires far more skill, knowledge and judgment than is generally recognized. The highly skilled men in this group of farms liked cows, knew how to feed them economically, observed them closely, and headed off serious trouble by quick action on minor udder trouble or other ailments. Knowing good cows, they were able to retain the better animals and build up better herds. Some of the difference in production of cows on different farms is, no doubt, traceable to unmeasurable differences in how operators care for and manage them.

In a very rough way, the 38 operators may be grouped as to skill with cows as follows: very skilled, 8; skilled, 12; fairly skilled, 8; and those displaying little skill, 10. Of the men who have little skill, it is thought that half of them would have been fairly skilled if they had had the opportunity. There is nothing especially inspiring or interest-kindling in caring for a herd of low producing poorly fed cows. The man who has come up through this kind of a situation is likely to have little interest in dairying even though circumstances keep him on the farm. While one is always under the necessity of starting from where he is there is still an opportunity for these men to become skilled and interested dairymen through contact with good cows and skilled

operators. They may definitely handicap the opportunities and abilities of their children if they do not.

Skill in Crop Production

The management of tillage area to secure best returns from use of land, power, fertilizer and man labor is not to be overlooked. Differences in cropping systems and in efficiency at harvest time have previously been noted, but in addition many details of management requiring skill and knowledge of doing the right thing at the right time account for differences in yield and in labor and material cost.

For instance, delay in starting spring work probably resulted in poorer stands of grass on several farms. Failure to use the best adapted mixture of seed and to thoroughly fit the soil resulted in poor stands of clover. Delay in cultivating corn probably cut the yields in several instances.

In skill in crop production, the 38 farmers were roughly classified as, very skilled, 8; good, 11; fair, 13; and with little skill, 6.

Ability to Plan

Differences were extreme in ability to plan and to direct the farm work. At one extreme were men who seemed to have an objective in mind and who directed their efforts efficiently in that direction. Judgment was used in the distribution of labor so that the most essential things were done first. On the other hand, some men were drifting along, were behind with their work and did not seem able to organize labor to advantage in getting definite tasks done. However, a few who usually seemed without definite plans were excellent organizers when it came to a special job like haying. It would seem as if they were lacking the ability to visualize and project the work over a period of time, but that the concrete definite task brought out certain other abilities in organization. Probably the chief differences between individuals in planning ability were clearness of objective, constant application at the essential things and capacity to work effectively.

Aggressiveness in Farming

Individuals also differed considerably in the physical efforts which they exerted in the operation of their farms. Wholly aside from variations due to age or health, there was a difference in the intensity with which men projected the work. It is difficult to explain or to account for all the difference. There was little urge for strenuous effort on the part of one or more who were secure financially and did not have dependents, but most of the lack of drive was where the financial need was great and where the well-being of the farm family would be improved if the labor and other resources of the farm were better directed so as to yield a higher net income. In a few cases, the operator had probably come up through a self-sufficient agriculture and had not adjusted himself to the requirements of modern dairying.

Of the 38 operators, eight were classified as having a good knowledge of agriculture, good ability in planning, very good skill with cows and very good skill with crops. Seven of these were in the group with the highest incomes, five in the group with the highest production per cow and five with highest output per man.

Accumulated Skill

The differences resulting from variations in skill and interest are accumulative. The good manager who has some skill and is interested gradually secures better crop production and increases the quality of the dairy herd; and as the farm becomes more productive and the herd develops in capacity, the man grows in ability and experience in operating a better farm and in managing high quality stock. This provides the opportunity to build up the output of the farm and to extend and develop the interest, skill and capacity of the man.

Thus, in several instances the present position of the dairyman results from 20 or more years of careful planning and continuous efforts toward a definite objective. The skills and interest acquired, together with the accumulation of physical factors in the form of a better farm and better cows, make a combination which the ordinary beginner or the uninterested man cannot now approach.

Some of the younger men are now in the process of acquiring the skill and experience in getting together and developing the factors of production that, given a reasonable break, should eventually result in a high degree of dairy farm success. Unfortunately, others are accumulating neither skill nor physical assets, and unless they give more thought and take more interest in the farm can never get together the combination that will enable them to succeed.

It is to be noted that the children, as they take their fathers' places, have the opportunity to begin about where the father leaves off. The children of skilled dairymen have had the opportunity to become skilled and interested in good cows, to learn how to grow crops efficiently; and if they inherit their parents' accumulation of physical assets already well arranged for production, they are able to start fairly well up the ladder. On the other hand, the children of the drifting farmers are handicapped in opportunities of acquiring skill and worthwhile experience and in gaining interest and ambition.

Granted that skill, knowledge, interest and planning ability of the operators account for much of the variation in output per man, production per cow and other factors, it may be futile to discuss the problem unless something can be done about it.

How may all the dairymen in the community become more skilled? How may they gain a fuller knowledge of farming? How can they become interested in their special work and more ambitious to build a better farm business? How may they develop more ability in planning the work and directing labor? These are questions difficult to answer, and yet they are of great importance to the community.

A community grows in skill and develops special knowledge very slowly. Then, of course, each individual is different, and all are limited by inheritance in the extent to which they can develop any particular characteristic or ability. Dr. Kirtly Mather recently stated that each man's development is bounded by a circle of definite inheritance, but that few men have made much progress in filling the circle of their inherited possibilities. This seems to be very true in the case of the dairymen. Some men are falling short of their capacity.

Probably the best place for acquiring skill is the farm which is operated by a very skilled dairyman with good cows. If all the young

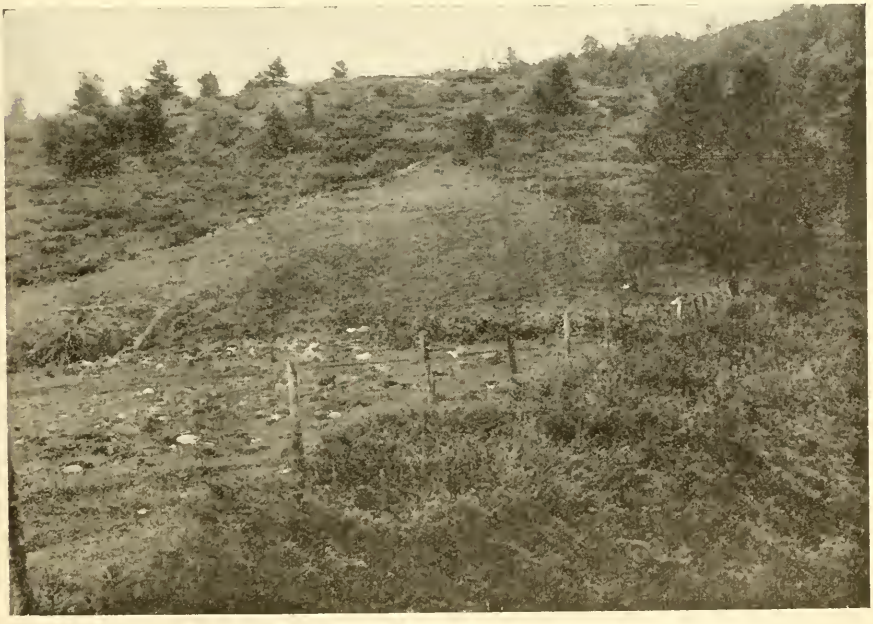
men who may eventually farm in this area could have the opportunity of working under such a man for a period long enough to acquire skill and catch the interest in handling good cows, the results would be most far-reaching.

In acquiring technical knowledge many opportunities are available, through the schools, the state college, the extension service, the local men who are well-grounded in technical agriculture, and through reading.

One difficulty here is the great human handicap. It was noticeable that most of the highly skilled men were eager for more knowledge and ready for new experiences to gain new skills, while some of those that had little skill displayed less eagerness for new information.

It may well become the objective of the whole community to increase the interest and the skill of the young men and to kindle their ambition to become really skilled dairymen. The community would thus gradually accumulate larger physical assets in improved farms and better stock and greater intellectual and spiritual values.

All of the essentials to human progress, such as our health, our homes for the transmission of our heritage, and our facilities for physical, mental and spiritual recreation and enjoyment—all the things needed for the more abundant life—are dependent in large measure upon the efficiency and skill with which our labor is organized and directed to control the forces and to utilize our natural resources.



Pasture in Grafton County cleared of the juniper which has ruined many other grazing areas.

SUMMARY

1. Thirty-eight wholesale milk farms in northern Grafton County were studied in detail during the period April 1, 1931, to March 31, 1932. By frequent visits, the management and farm practices were noted on each farm.

2. In addition, the financial records were available for the two previous years. The family labor income on these farms averaged $1093, $944 and $282, respectively, for the three years ending March 31, 1930, 1931 and 1932.

3. The skill of the individual dairyman in producing crops, in handling cows, and in aggressively attacking the more important projects accounts for much of the difference in production per man, production per cow, and livestock returns.

4. Differences in price received for milk varied from $1.37 to $2.42. The great variations which account for some of the differences in net income were due to: purchaser to whom sold, grade of milk, bacteria count, butterfat test, basic rating and seasonal variations in production.

5. Low production of milk on some farms resulted from poor pastures, lack of timely supplementing of dwindling pastures, lack of sufficient protein in yearly ration, poor quality of cows and unskilled handling.

6. Most dairymen were handicapped by inadequate cropping programs. High protein hay made up only about 15 per cent of the total harvested. Both yields and quality of hay could be improved on most farms by systematically seeding down a larger acreage each year.

7. Most pastures were inadequate. Many were grown up to hardhack, juniper, sweet fern or brush. A better pasture program is greatly needed. This may include elimination of hardhack and other growth on the good soil, division of permanent pasture to permit grazing on one-half at a time, and the use of rotated tillage fields.

8. Some dairymen were able to offset, but at considerable cost, the effect of low protein roughage and inadequate pastures on milk production by skillful grain feeding in winter and by green feeding in summer.

9. Chore work in caring for cows varied from 78 to 241 hours per cow. The men with low chore hours per cow had more convenient barns, used better methods, and organized the work more skillfully. Detailed chore records indicate that some dairymen are very skilled and efficient in barn work. On one farm two men took care of 60 cows and 40 head of young stock. However, even the most efficient in some one practice are often inefficient in some other respect.

10. The benefits from greater efficiency in chore work may accrue in the form of more leisure, larger output or less hired labor.

11. On individual farms the output per man as measured by output units varied from 103 to 452. This difference is due largely to the more constant use of available labor on productive enterprises, better management of labor, more adequate equipment, higher quality cows, more skill in arranging a cropping system and in a more adequate pasture program.