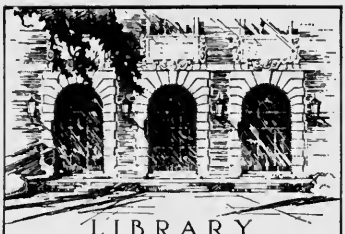

COST of PRODUCING MILK

In NORTHERN ILLINOIS

By R. H. WILCOX and C. S. RHODE

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COST OF PRODUCING MILK IN NORTHERN ILLINOIS

By R. H. Wilcox and C. S. Rhode[1]

THE QUESTION, what does it cost to produce milk, is one that interests not only producers but consumers and dealers also, especially in areas where milk production is an intensive business and consumers are concentrated in the larger cities. This study is the result of an effort to determine costs in the Illinois portion of the Chicago milkshed and to express them in such a way as to make them useful over a considerable period of shifting dollar costs.

Knowledge of the kinds and amounts of feed fed to dairy herds, the hours of man labor required per unit of milk production, and the percentage of the net cost which feed and labor constitute gives a basis for computing, with reasonable accuracy, the cost of milk production under varying price conditions. This study, like other recent studies,[2] shows that the cost of feed and man labor usually makes up 70 to 80 percent of the net cost of producing milk. While there have been periods when these percentages did not hold because of unusually high or low prices for feed and farm wages, such periods have been exceptional and of short duration.

SCOPE OF THE STUDY

The farms used for this study are located in twelve counties in the Illinois portion of the Chicago milkshed: Boone, DeKalb, DuPage, Jo Daviess, Kane, Kendall, Lake, Lee, McHenry, Stephenson, Will, and Winnebago. Ninety farms were included in 1936 and 99 farms in 1937.

Altho all these farms are potential sources of fluid milk for the Chicago market, 67 percent of them actually sold to Chicago distributors: 78 percent of those in Winnebago county did so, 38 percent in Stephenson, none in Jo Daviess, and all in the other nine counties. The dairies that sold to Chicago distributors produced 73 percent of the milk considered in this study.

The total milk production recorded for these farms during the two

[1] R. H. Wilcox, Associate Chief in Farm Management; and C. S. Rhode, Professor of Dairy Husbandry Extension.

[2] Recent cost studies have been made at the Experiment Stations in Michigan, Ohio, Pennsylvania, and New York.

years of the study was 31,479,726 pounds (166,560 pounds per farm, which is about 19,000 gallons). Of this amount, 90 percent was sold as fluid milk (73 percent to milk distributors and 17 percent to cheese factories, creameries, etc.); 1.7 percent was separated and sold as cream; 6 percent was fed to livestock on the farms; and 2.3 percent was used in the farm homes.

The number of cows per farm averaged 20, the annual milk production per cow 8,328 pounds.

The quantities of different feeds used and hours of man labor absorbed in producing milk are shown in Part I, as are also the percentages which these items were of the net milk costs. From these basic figures a method has been devised for computing representative costs of producing milk in northern Illinois under varying price conditions.

How some important practices and production methods affect milk costs is shown in Part II.

PART I—DETERMINING COSTS

Study made among selected dairymen. Most of the dairymen cooperating in this study were members of dairy herd improvement associations. That they were more efficient producers than the average dairyman is shown by the fact that their production per cow averaged 8,328 pounds annually, a high record compared with that of all cows in the area. In the Chicago milkshed cows averaging 7,000 pounds of milk a year would be more representative than those averaging 8,300 pounds. Numerous studies have shown that the unit cost of milk production declines as production per cow increases.

Milk cow used as unit of cost. In this study the milk cow has been taken as the unit for computing production expense, because it is a unit common to all herds regardless of how they are managed. In the area where this study was made a relatively large number of the dairy farmers purchase part or all of their replacement heifers and cows, whereas only a few raise all of them. The market value of the heifers raised for replacement was simply added to the capital in the milking herd after they had dropped their first calves. Neither the expenses of maintaining the young stock nor the expenses incurred in raising heifers were included as current costs of milk production.[1] De-

[1] On two of the farms in the study the increase in the total value of the young stock sold and kept for replacement about covered the cost of maintaining the entire herd. Where such conditions exist and costs are figured on the entire-herd basis, milk would appear to be produced at practically no cost, which of course would not be true.

preciation in the value of milk cows that had passed their peak of production was charged as an expense of production.

The feed, labor, and other expenses necessary to keeping the bull were charged separately to the milking herd and thus became a part of the unit cost per cow.

Interest at 5 percent a year on the capital invested in the milking herd was included as a cost of milk production. No charge was made for the operator's services as manager.

Level of Production Must Be Considered

As would be expected, it usually costs more to keep a herd in high production than to keep a herd of the same size in low production. According to this study, however, expenses do not increase in proportion to the increase in milk yield. The reason is, of course, that some expenses, such as those for buildings and equipment, change very little as the milk yield per cow increases and other items, such as feeds, which increase, do so less rapidly than milk yield. For example, the herds that were producing 8,000 to 9,000 pounds of milk per year per cow were fed only 11.7 percent more feed than those giving between 6,000 and 7,000 pounds per cow, but they produced 26.7 percent more milk per cow. Hours of man labor and most of the other expenses likewise did not increase as rapidly as did the milk yield.

The fact that the cows included in this study produced more milk than the average cow in the area, and hence could produce it somewhat more cheaply, must be taken into consideration when using the data in Tables 1 to 5 as a basis for computing the feed, man labor, and other items of expense for maintaining other herds. The expenses shown in these tables and discussed in the accompanying text are for cows giving about 8,300 pounds of milk yearly—the average production of the cows included in this study. The quantities of feed and labor, and the percentage of the total milk costs which are made up of feed and labor, are shown for the herds producing at this level and above or below it, in Table 6.

Feed Expenses

Of the net cost of producing milk, feed expenses made up about half (53.9 percent). In the years of the study, the farm price of a ton of feed was as follows: corn-and-cob meal, about $24; alfalfa hay, $15; silage, $5; and soybean oilmeal containing 41 percent protein, $38.

Grain and other carbohydrate concentrates. Corn and oats were the principal grains fed, almost equal parts by weight being used in the

TABLE 1.—AMOUNTS OF FARM GRAINS AND OTHER CARBOHYDRATE CONCENTRATES FED YEARLY PER COW TO 189 HERDS IN NORTHERN ILLINOIS IN 1936 AND 1937

(Herds were located in Boone, DeKalb, DuPage, Jo Daviess, Kane, Kendall, Lake, Lee, McHenry, Stephenson, Will, and Winnebago counties. Ninety farms were included in 1936 study, 99 farms in 1937. Herds averaged 8,328 pounds of milk per cow yearly.)

Farm grains	Pounds per cow	Other carbohydrate concentrates	Pounds per cow
Corn and corn-and-cob meal	892.2	Corn gluten feed	10.1
Oats	856.0	Dried brewer's grain	27.5
Barley	107.0	Wet brewer's grain	34.9
Speltz	4.5	Malt	54.2
Wheat	1.4	Malt sprouts	18.5
Rye	1.4	Molasses	3.2
Total	1 862.5	Total	148.4

ration (Table 1). About one-eighth as much barley as oats was fed. Other carbohydrate concentrates were substituted for farm grains when considered more economical.

These cows consumed, on the average, in a year about 2,000 pounds of carbohydrate concentrates, including farm grains.

Protein supplements. An average of 341 pounds of protein supplement was fed per cow annually (Table 2)—about 1 pound to every 6 pounds of grain and other carbohydrate concentrates. Dairymen

TABLE 2.—AMOUNTS OF PROTEIN MILL FEEDS FED YEARLY PER COW, NORTHERN ILLINOIS, 1936 AND 1937

Kind	Pounds per cow	Kind	Pounds per cow
Soybean oilmeal	111.2	Cottonseed oilmeal	25.0
Bran	80.5	Ground soybeans	12.0
Commercial mixed feeds[a]	80.0	Alfalfa meal	1.5
Linseed oilmeal	30.0	Middlings	1.0
		Total	341.2

[a] Weighted average protein content of all commercial mixed feeds was 24.8 percent.

gave soybean oilmeal first place among the protein supplements because it supplied cheaper protein than any other feed on the local market.

Hay and other dry roughage. On a weight basis, alfalfa hay made up about half the dry roughage fed. Soybean hay came next, but only about a third as much of it as of alfalfa hay was fed (Table 3). Approximately a tenth of all dry roughage was corn fodder and stover.[1]

[1] As used in this bulletin corn fodder is the entire corn plant, grown primarily for forage; stover is the cut and husked cornstalk.

TABLE 3.—AMOUNTS OF HAY AND OTHER DRY ROUGHAGES FED YEARLY PER COW, NORTHERN ILLINOIS, 1936 AND 1937

Kind	Pounds per cow	Kind	Pounds per cow
Hay		Hay (continued)	
Alfalfa	1 456	Bluegrass	2
Soybean	521	Pea-vine	1
Mixed clover and timothy	304	**Other dry roughage**	
Clover	134	Corn fodder	158
Timothy	100	Corn stover	153
Oat	34	**Total dry roughage**	2 863

Corn stover was used both in the barn and in the drylot, but it was not always possible to measure how much was eaten and how much served as bedding. The full amount given to the cows was therefore computed as feed.

Silage and harvested green roughage. Each cow was fed on the average 7,048 pounds of silage and harvested green roughage each year (Table 4), practically all of which was silage. In both 1936 and 1937 small quantities of green corn fodder were cut during late August and fed to supplement late summer pastures.

Pasture. On the average a milk cow was on pasture 160 days (Table 4). The amount of grain and hay that pasture will replace in the cow's ration depends on the condition of the pasture. During the

TABLE 4.—SILAGE AND GREEN ROUGHAGE FED YEARLY PER COW, AND NUMBER OF DAYS COWS WERE ON PASTURE, NORTHERN ILLINOIS, 1936 AND 1937

Kind	Feed per cow	Percent of total
	lb.	
Silage	6 945	98.54
Green corn fodder	101	1.43
Green alfalfa	2	.03
Total	7 048	100.00
	days	
Pasture	160	.....

course of this study the pastures on each farm were inspected monthly while the dairy cows were on them, and a charge was made against the cows in accordance with the grade of the pasture. Pasture that was good enough to replace all the grain and hay in a cow's ration was graded "good"; if it replaced about half the grain and hay it was graded "fair"; if it replaced but a small amount of feed it was graded "poor."

Labor Expenses

The man labor required to milk, feed, and care for the dairy herd, and to keep the dairy buildings and equipment clean, totaled 118 hours per cow yearly. The cost of this labor was 18.5 percent of the net cost of producing milk. At this time hired men in the area were being paid $45 to $50 a month in cash and were furnished room and board or a house and enough other perquisites to bring their total monthly compensation to a cash equivalent of $65 a month.

Expenses Other Than Feed and Labor

Thirteen items besides feed and man labor enter into the cost of maintaining a dairy herd, but these thirteen items made up only 27.6 percent of the net cost of producing milk on these farms.

One of the additional items was for hauling milk to the local concentration point. When a farmer is paid for his milk subject to delivery at a concentration point, it is necessary to include a hauling charge in his cost of production whether he hauls the milk himself or not. Otherwise there is no complete basis for comparing cost of production with price received.

Of all the records of commodities used in the care of the milk cow, that for straw was least satisfactory. Farmers showed less interest in finding out how much bedding was used in the dairy barn than how much feed was fed. The investigators did, however, make a careful estimate each month of the weight of straw used as bedding on each farm and found that an average of 880 pounds was used per cow per year. Straw was the bedding material used on all farms except two, on which wood shavings were used. When corn stover was fed in the barn, no attempt was made to measure the amount of stover that was left for bedding after it had been picked over—all of it was counted as feed.

An item for general overhead expense was included because on every farm there are several expenses that are difficult, if not impossible, to charge directly to any one branch of the business. Following are examples: real-estate taxes on the land around the house and buildings, labor for cutting weeds along the road and fence rows, labor for keeping in good condition the roads from the highway to the house and barn, farm-bureau dues, and telephone service.

Included as miscellaneous are several small expenditures made from time to time for such things as strainer pads, fly sprays, limestone for the barn floor, breed-association dues, registry and transfer fees, whitewashing the barn, and washing powders.

Deductions From Cost

There are certain returns from the dairy herd that are in the nature of by-products. The most important of these are manure, calves, and cow hides. The empty feed sacks also have value. All returns other than from milk were deducted from the gross cost to obtain the net cost of maintaining the cow (Table 5).

The value of the loads of manure hauled to the fields from the barn and from the herd lots was computed at 75 cents a load. The amount of manure estimated, from feed input, to have been dropped on the pasture was credited at the same price.

When calves from cows in the milking herd were three or four days old, a market value was placed on them and this amount was then deducted from the gross cost of keeping the cow. From the time the appraisal of each calf was made, the feed, labor, and other expenses for the calf were kept separate from those for the cow.

TABLE 5.—AVERAGE COST OF MAINTAINING A MILK COW FOR ONE YEAR IN HERDS IN NORTHERN ILLINOIS, 1936 AND 1937

Item	Cost
Maintenance expense	
Feed	$ 73.75
Man labor	25.32
Horse labor	.79
Hauling milk and cream	7.88
Buildings	9.59
Equipment, light, and power	3.08
Depreciation on cows	3.36
Share in mortality expense	1.69
Interest on investment in cow	4.54
Taxes and insurance on cow	.73
Bull expense	4.16
Veterinary and medicine	.55
D.H.I.A.[a] dues and tester's board	2.27
General overhead expense	7.08
Bedding and miscellaneous	4.29
Gross cost	$149.08
Deductions from cost	
Manure	$ 5.54
Calves	6.70
Hides, empty sacks, etc.	.04
Total deductions	$ 12.28
Net cost per cow	**$136.80**
Some relevant statistics concerning herds studied	
Production per cow	
Milk, pounds	8 328
Butterfat, pounds	302
Value of milk produced per cow	$152.92
Feed prices	
Corn-and-cob meal per ton	$ 24.38
Alfalfa hay per ton	15.05
Number of herds and cows	
Herds in study, average of two years	95
Cows per herd, average	20

[a] Dairy herd improvement association.

If a change in stock was made, it was the usual practice of farmers in this area to buy cows and heifers about to calve or with calves at their sides. The study shows that in the course of a year 96 living calves were dropped for every 100 cows in the milking herd. This proportion of living calves is high. It is accounted for by the relatively high turnover of cows by purchase and sale (33.7 percent) and by the loss of 1.9 percent of the cows by death.

No Charge Made for Management

In computing the cost of milk, no item was included for the operator's management; only his manual labor was included and charged at the rate of the hired man's wages.

When any application is made of the data in this study, it is necessary to add a management charge in order to get the full cost of producing milk. On many farms the dairy herd provides the main source of income. Even when it does not, the operator's time is worth more than that of a hired man, and each enterprise on the farm must in the end return enough above bare costs to give the farmer some return for his managerial ability.

The question that is debatable is not whether a charge should be made for management but rather how large the charge should be. If the cows in the herd are producing on the average 8,000 pounds of milk a year and a $20 charge is made against each cow for the operator's management, the expense of management would add 25 cents to the cost of 100 pounds of milk.

Expenses for 100 Pounds of Milk

The figures obtained in the study made it possible to measure the quantities of feed and labor used by cows at different levels of milk production. They were also detailed enough to show the percentage of the net cost that feed, labor, and other items constituted.

Since the quantities of feed and labor required to produce a unit of milk are not the same for high-producing and low-producing cows, the cost records were grouped separately for herds producing at four different levels: 8,000-8,500 pounds of milk per cow a year, the average of all herds in the study; 9,000-9,500 pounds, 7,000-7,500 pounds, and 6,000-6,500 pounds (Table 6).

The greatest differences in feed consumption at the different levels of production were in quantities of hay and pasture; there were smaller differences in the quantities of protein feed and silage, and there was very little difference in the quantities of grain. Herds in the highest

TABLE 6.—FEED AND LABOR REQUIRED TO PRODUCE 100 POUNDS OF MILK IN HERDS WITH DIFFERENT LEVELS OF PRODUCTION PER COW, NORTHERN ILLINOIS

Item	Requirements in herds with annual yield per cow indicated			
	9,000-9,500 pounds	8,000-8,500 pounds	7,000-7,500 pounds	6,000-6,500 pounds
Number of herds	31	47	25	24
	lb.	*lb.*	*lb.*	*lb.*
Farm grain	24	23	24	25
Protein meal	4	4	4.5	3.5
Hay	31	34	43	44
Silage	77	85	98	93
	days	*days*	*days*	*days*
Pasture	1.8	1.9	2.0	2.6
	hr.	*hr.*	*hr.*	*hr.*
Man labor	1.3	1.4	1.5	1.8
Percent feed and labor expenses were of net milk cost	72.5%	72.4%	71.7%	71.0%

of the four production groups produced a unit of milk with the least feed of any of the groups.

The percentage of the net cost that was made up of feed and labor varied only from 72.5 for milk from the herds in the high-producing group to 71.0 percent for the milk from the herds in the low-producing group, a difference that is not significant.

Computing Current Milk Costs

If feed and labor costs are computed at current prices and then the total cost of producing milk is figured on the basis of the percentage that these costs are of all expenses, the assumption is that the cost of all items other than feed and labor fluctuates with feed prices and farm wages. For example, the expenses for the bull and the credit to be allowed for manure are then considered as changing with a change in feed and labor costs.

The data collected in this study show that as a matter of fact 60 percent of the costs other than feed and labor did fluctuate with feed and labor costs (15 percent changing with feed costs and 45 percent tending to fluctuate with farm wages), and that about 40 percent fluctuated independently of feed and labor.

Since, however, costs other than feed and labor make up only a relatively small part of the net cost of producing milk,[1] a scheme

[1] Recent studies have shown that feed and labor costs constitute from 70 to 80 percent of the net cost of milk production. Of the remaining 20 to 30 percent of the net cost, only roughly 8 to 12 percent (i.e., 40 percent of 20 to 30 percent) does not fluctuate with feed and labor costs.

for estimating the cost of milk based on feed and labor costs can be used without introducing a large element of error.

Early Illinois method. Some years ago a formula was developed at this Station which has been found very practicable.[1] Applied to the present data it would work as follows.

Take the basic quantities of feed and labor applicable to a given herd (Table 6, page 507). Determine their cost and to it add a percentage that will take care of the cost of all items other than feed and labor. The percentages that must be added are shown below:

Herds producing—	*Add, perct.*
9,000-9,500 pounds of milk per cow yearly	37.9
8,000-8,500 pounds of milk per cow yearly	38.1
7,000-7,500 pounds of milk per cow yearly	39.5
6,000-6,500 pounds of milk per cow yearly	40.8

Example: The cost of producing 100 pounds of milk in herds averaging 7,000-7,500 pounds of milk per cow would be determined thus:[2]

Farm grain	24 pounds	@	$40 a ton	$.48
Protein meal	4.5 pounds	@	60 a ton	.14
Hay	43 pounds	@	25 a ton	.54
Silage	98 pounds	@	10 a ton	.49
Pasture	2 days	@	12 cents a day	.24
Man labor	1.5 hours	@	50 cents an hour	.75
				$2.64
Add 39.5 percent of $2.64				1.04
Total net cost				$3.68

While this method of computing milk costs is reasonably accurate, it requires a good many calculations. Current prices must be determined for each feed and a current value placed on the hourly labor.

Simpler method expressed in charts. A quicker, simpler method of applying prices to feed and labor under changing price-levels seemed desirable. The one worked out here and translated into charts (Figs. 1 to 4) has been developed by (1) using the price movements of an important grain, such as corn, as the measure of fluctuations in the cost of feed and other items that tend to fluctuate with feed; and (2) using the movements of monthly cash farm wages as the measure of fluctuations in the cost of man labor and other items that tend to fluctuate with man labor. Since all other items entering into milk costs make up only a small portion of the total costs and fluctuate with the

[1] This method was demonstrated by F. A. Pearson in Illinois Bulletin 216, *The Cost of Milk Production Computed on the Year Basis* (1919).

[2] The cost per 100 pounds may also be computed by dividing the cost of feed and labor by 71.7 percent (see Table 6, page 507).

general price-level, it is possible to fit the charts to one price-level and then add or subtract an amount from the computed cost to compensate for a change in the price-level.

These charts[1] are constructed on a price-level of 140 (1935-1939 = 100) for the things farmers buy. They can be used to compute the approximate cost of milk when the local price of corn is between 50 cents and $1.70 a bushel and the cash wage of farm labor is between $30 and $150 a month. All that is necessary is to take a string or a ruler and connect the price of corn (*shown on the scale at the left*) with the monthly cash wage of farm labor (*shown on the scale at the right*), and the figure where such a line cuts across the center scale will show the approximate cost of producing 100 pounds of milk.

If, for instance, the cows in a herd produce an average of 7,000 to 7,500 pounds of milk annually (Fig. 3), and if the local price of shelled corn is $1.10 a bushel and the monthly cash wages of a hired man are $100 a month, it would cost about $3.68 to produce a hundred pounds of milk when the price index is at 140.

To adjust to any other price-level it is necessary only to add 2 cents a hundred pounds to the cost, or subtract 2 cents from it, for every 10 points the index is above or below 140. If the price index is 130, the cost would be only $3.66 ($3.68−2 cents).

In these charts and in the following formulas no charge is included for the operator's management.

Formulas for the simpler method. Those who may prefer to work out costs arithmetically can do so by using the following formulas instead of the charts. The formulas are based on the same index of prices as the charts (140). The same amount (2 cents a hundred pounds) must be added to or subtracted from the computed cost for each 10 points the price index rises above or falls below 140.

Cows producing 9,000 to 9,500 pounds of milk yearly

Cost of 100 pounds of milk = (Local price of shelled corn per bushel × 1.6) + (monthly cash hired man wages ÷ 94) + 26 cents ± adjustment for change in price-level

Cows producing 8,000 to 8,500 pounds of milk yearly

Cost of 100 pounds of milk = (Local price of shelled corn per bushel × 1.7) + (monthly cash hired man wages ÷ 85) + 27 cents ± adjustment for change in price-level

(Continued on page 514)

[1] The authors are indebted to Professor E. J. Working, of the Department of Agricultural Economics, for his help in developing the formulas for Figs. 1 to 4. The index of prices which farmers pay for commodities (1935-1939 = 100) is published currently in *Illinois Farm Economics,* Department of Agricultural Economics, University of Illinois, Urbana.

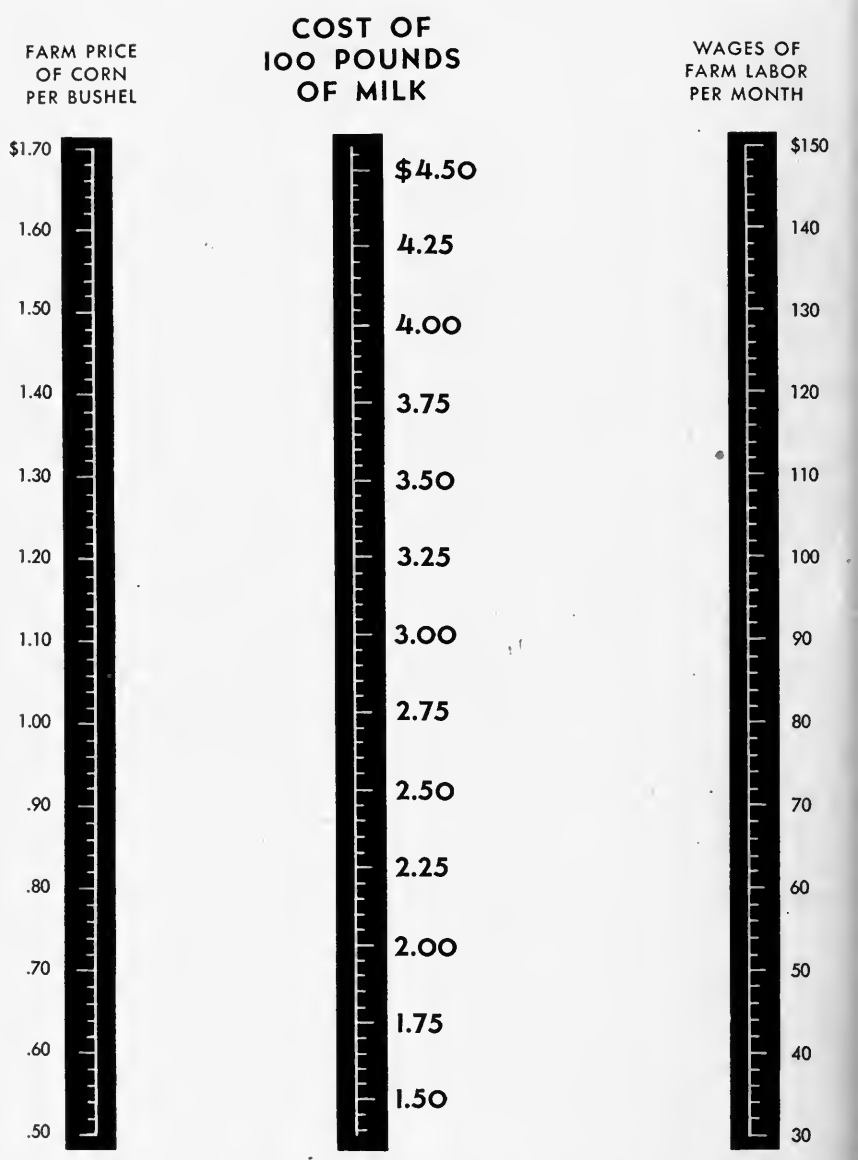

Fig. 1.—With a string or ruler connect price of corn (*left scale*) wit farm wage (*right scale*). The figure where the line cuts across the cen ter scale is the approximate cost of producing 100 pounds of milk i northern Illinois herds giving 9,000-9,500 pounds per cow yearly.

(Cost of management not included. Based on a price-level of 140 (1935-1939 = 100 for things farmers buy. See page 509 for way to adjust to other price-levels.)

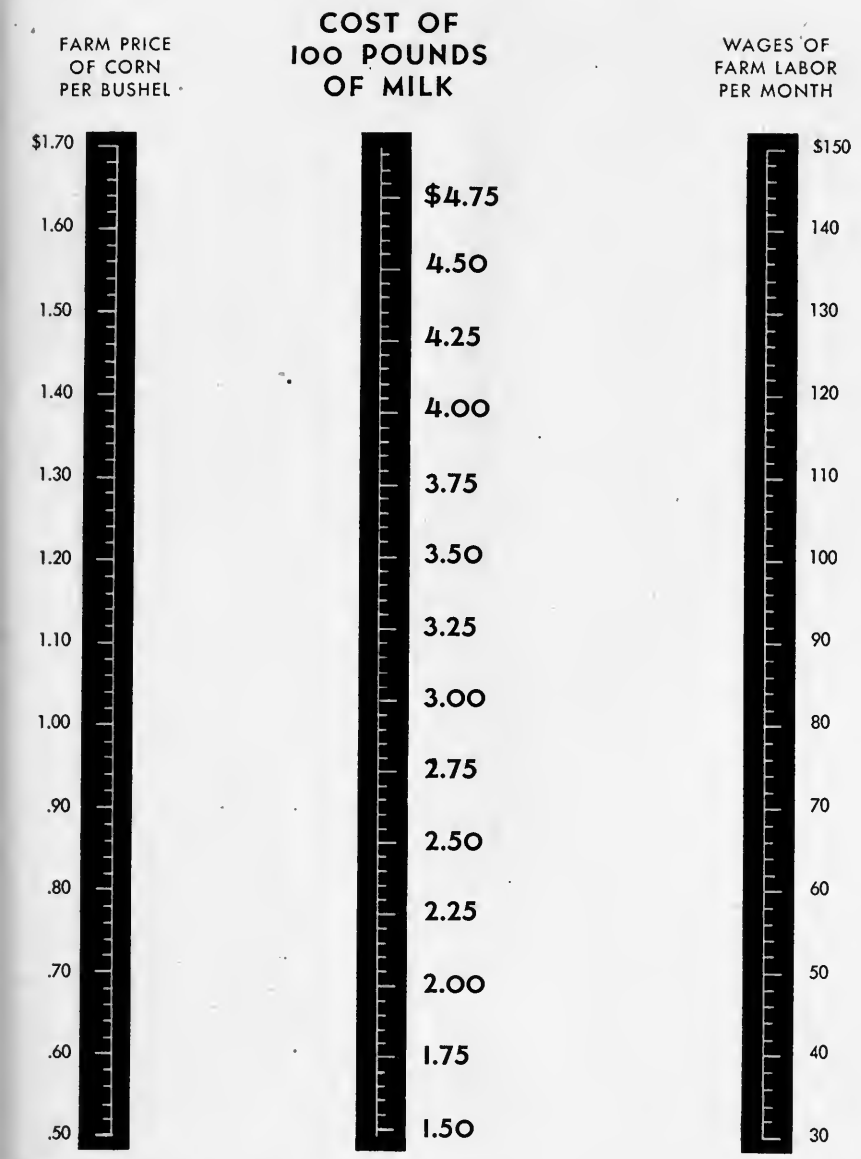

Fig. 2.—With a string or ruler connect price of corn (*left scale*) with farm wage (*right scale*). The figure where the line cuts across the center scale is the approximate cost of producing 100 pounds of milk in northern Illinois herds giving 8,000-8,500 pounds per cow yearly.

(Cost of management not included. Based on a price-level of 140 (1935-1939 = 100) for things farmers buy. See page 509 for way to adjust to other price-levels.)

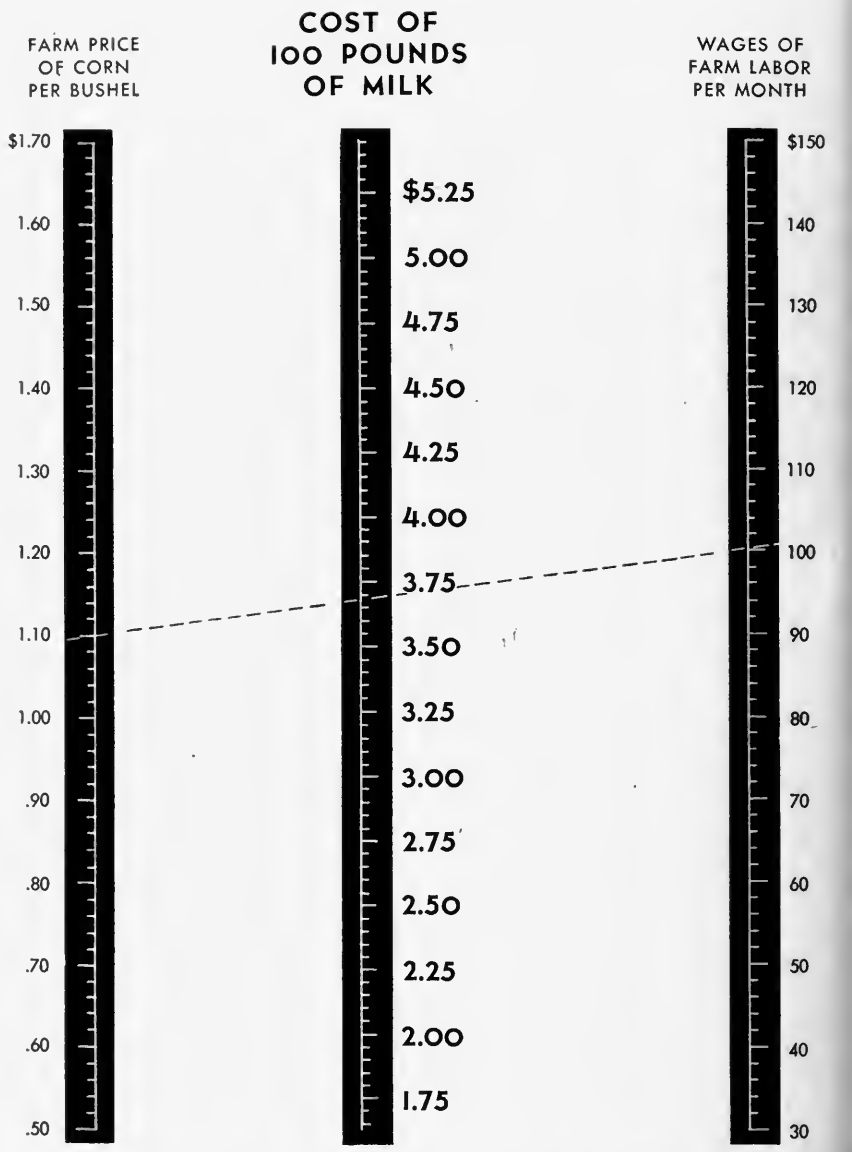

Fig. 3.—With a string or ruler connect price of corn (*left scale*) with farm wage (*right scale*). The figure where the line cuts across the center scale is the approximate cost of producing 100 pounds of milk in northern Illinois herds giving 7,000-7,500 pounds per cow yearly.

(Cost of management not included. Based on a price-level of 140 (1935-1939 = 100) for things farmers buy. See page 509 for way to adjust to other price-levels.)

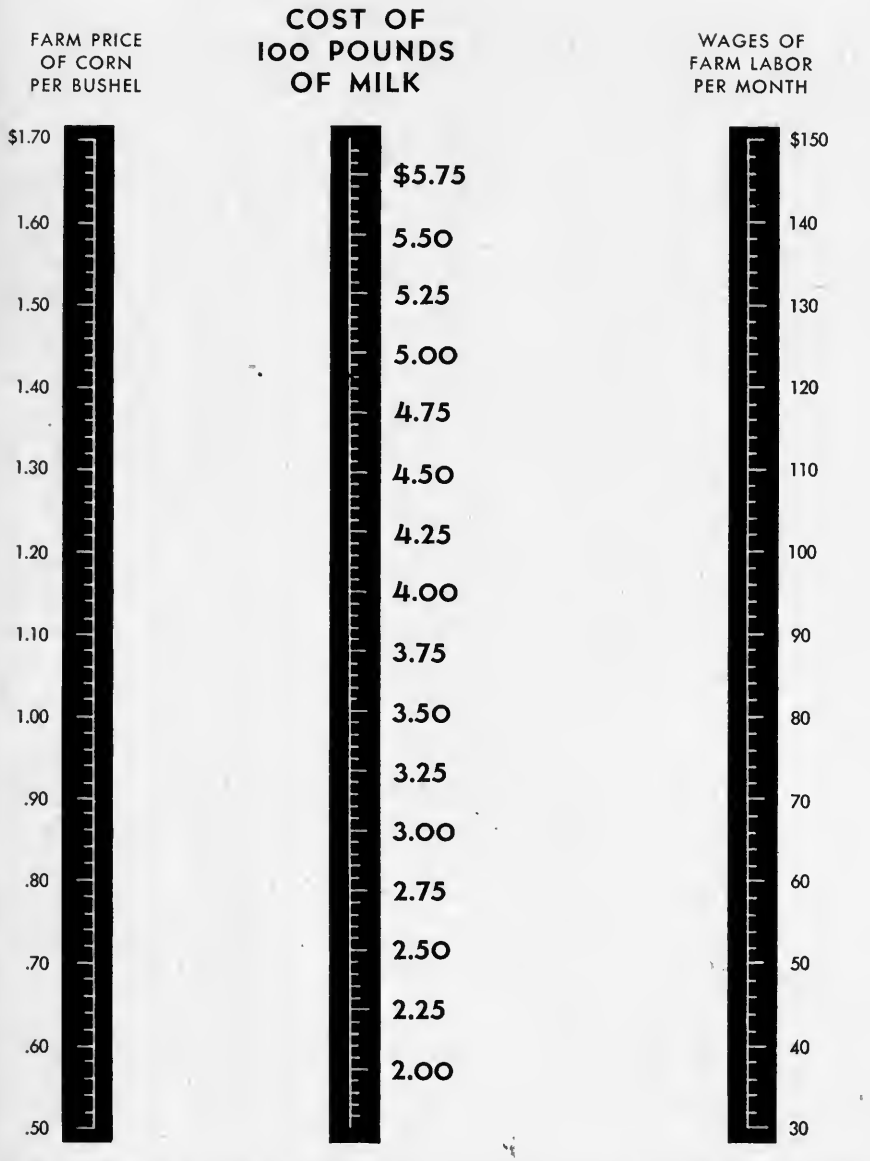

Fig. 4.—With a string or ruler connect price of corn (*left scale*) with farm wage (*right scale*). The figure where the line cuts across the center scale is the approximate cost of producing 100 pounds of milk in northern Illinois herds giving 6,000-6,500 pounds per cow yearly.

(Cost of management not included. Based on a price-level of 140 (1935-1939 = 100) for things farmers buy. See page 509 for way to adjust to other price-levels.)

(Continued from page 509)

Cows producing 7,000 to 7,500 pounds of milk yearly

Cost of 100 pounds of milk = (Local price of shelled corn per bushel × 1.9) + (monthly cash hired man wages ÷ 77) + 29 cents ± adjustment for change in price-level

Cows producing 6,000 to 6,500 pounds of milk yearly

Cost of 100 pounds of milk = (Local price of shelled corn per bushel × 2.1) + (monthly cash hired man wages ÷ 74) + 30 cents ± adjustment for change in price-level

An example of how costs may be figured by the formula method is shown, in condensed form, in the following equation for cows giving 7,000 to 7,500 pounds of milk, when corn is $1.10 a bushel, labor is $100 a month and the price index is 140:

($1.10 × 1.9 = $2.09) + ($100 ÷ 77 = $1.30) + $.29 = $3.68

Figuring costs at other production levels. When the yearly production level of the cows of a herd falls between the levels used in calculating costs (Figs. 1-4 and formulas), the determination of production costs will require further calculation.

Example: The cost of producing 100 pounds of milk in herds averaging 7,825 pounds of milk per cow yearly would be determined thus:

1. Take the production level below and that above 7,825 pounds and get the midpoint of each (7,250 and 8,250 pounds)
2. Determine what percentage the difference between 7,250 and 7,825 pounds, or 575 pounds, is of the difference between 7,250 and 8,250 pounds (the answer is 57.5 percent)
3. Find the difference between the cost of producing milk at the 7,000-7,500-pound level and the 8,000-8,500 level, using either the charts or the formulas (if the cost at the 7,000-7,500 level were $3.68 and that at the 8,000-8,500 level were $3.32, the difference between the two would be 36 cents)
4. Multiply the difference found in Step 3 by the percent found in Step 2 (36 cents × .575 = 21 cents)
5. Subtract the result from the cost of producing milk at the 7,000-7,500-pound level ($3.68 — 21 cents = $3.47)

PART II—EFFECT OF SOME PRODUCTION FACTORS ON MILK COSTS

Milk Production per Cow

The average annual milk production of the dairy herds included in this study varied from less than 4,500 pounds per cow on one farm to over 11,500 pounds per cow on another, no two farms having the same yearly production.

If a charge of $20 a year per cow for the operator's management

TABLE 7.—COST OF MILK AND PROFIT PER COW IN DAIRY HERDS WITH DIFFERENT LEVELS OF PRODUCTION PER COW, NORTHERN ILLINOIS, 1936 AND 1937

Range in milk production per cow	Average milk production per cow	Cost of 100 pounds of milk	Net profit per cow	Number of herds
lb.	*lb.*			
10,000 and over	11 092	$1.55	$38.75	23
9,000-9,999	9 437	1.55	27.70	35
8,000-8,999	8 544	1.59	26.94	47
7,000-7,999	7 580	1.74	18.56	45
6,000-6,999	6 744	1.88	15.11	29
Under 6,000	5 392	2.11	−4.34[a]	10

[a] Loss.

were to be added to production costs, it would be necessary for the average cow included in this study to give 8,500 pounds of milk a year in order to produce an income equal to the cost of her maintenance in 1936 and 1937. To equal it without a management charge, she would have to yield 7,400 pounds a year.

It is evident that if some dairymen are to make a profit, they will have to get more milk per cow. There are two ways to do this. One is to have and to breed efficient cows; the other is to select the feeds carefully and give increasing amounts so long as the difference between feed cost and price of milk yields a profit. For the relation between milk production per cow and milk costs in the herds in this study see Table 7.

Obviously the cost of feed and labor and the capital invested in a cow must not be too high in relation to milk prices and the amount of milk obtained from her if she is to be profitable. It should be remembered also that some items of cost in cow maintenance (building costs, dairy herd improvement fees, etc.) usually remain the same regardless of the amount of milk produced and that others vary but little with varying production.

Size of Herd

In dairying, as in many other businesses, the efficiency of each unit of man labor increases as the volume of business is stepped up. In other words, large herds require less man labor per cow than small herds. In the dairies in this study, ranging in size from 6 to 42 cows, the man labor required to produce the milk and get it to the buyer declined 1¾ hours per cow with each cow added to the herd. (This figure was arrived at after eliminating any influence that may have been exerted by such factors as quantity of milk produced per cow, or kinds and amounts of feed fed per cow, and the like.) In herds of 10 to 30 cows the addition of a single cow lowered the cost of milk production about 4 cents a hundred pounds.

Use of Milking Machines

Milking machines were used on 28 percent of the farms in this study.[1] To provide a basis for measuring the effect of using the machines on milk costs, the records of those herds on which milking machines were used were paired with the records of herds in which milk production per cow was comparable but on which machines were not used. (Pairing of herds eliminated any influence which volume of production per cow might have had on milk costs, while the effect of herd size was statistically eliminated.)

The milking machines saved an average of 18 hours of man labor yearly per cow; or, stated in another way, they enabled these men to produce 10 more pounds of milk with every hour of their labor. In order to do this, it was necessary to invest capital in the milking machines and pay out money for power and other operating expenses (Table 8). Nevertheless, machines saved these men $2.30 a cow, or

TABLE 8.—RELATIVE ECONOMY OF MILK PRODUCTION WITH AND WITHOUT MILKING MACHINES, NORTHERN ILLINOIS, 1936 AND 1937

(As shown by two-year study of 26 farms with machines paired with 26 farms with approximately same production per cow operated without milking machines)[a]

	Farms with milking machines	Farms without milking machines	Increase for farms with milking machines
Milk production per cow, pounds	8 107	8 101	6
Yearly man hours per cow	116	134	−18
Equipment investment per cow	$10.00	$3.21	$6.79
Equipment expense per cow	2.83	1.09	1.74
Cost of 100 pounds of milk	1.66	1.70	−.04
Cows per herd	20	15	5

[a] The size of the herd was statistically eliminated.

about $45 a herd. When man labor is scarce and wages are high, the savings made possible by milking machinery may easily rise to two or three times this figure.

Season of Year

The unit cost of producing milk is considerably less in summer than in winter owing to differences in the ways of feeding and managing the herd. The season in which a dairyman produces the major portion of his milk will therefore affect his yearly unit cost. This is largely a matter of herd management and under his control.

[1] A very much larger proportion of dairymen now (1945) use milking machines.

TABLE 9.—AVERAGE SEASONAL COST OF MILK, LOCAL PRICES OF MILK SOLD, AND PROFIT PER COW, NORTHERN ILLINOIS, 1936 AND 1937

(Figures are from monthly cost and production records of 173 herds)

Season	Cost per 100 pounds of milk produced	Price per 100 pounds of milk sold	Monthly cost per cow	Monthly profit per cow	Pounds of milk per cow
Summer (May-Sept.)	$1.41	$1.71	$10.14	$2.16	3 595
Winter (Oct.-Apr.)	1.82	1.90	12.52	.55	4 817
Year	1.65	1.82	11.57	1.19	8 412

During the two years 1936 and 1937 prices of feed grains and protein supplements in July, August, and September were approximately 10 percent above their January-to-July level; and hay prices from August thru December averaged about 8 percent above those of the previous January thru April. Man labor was charged at the same wage summer and winter. Under these conditions, the average cost of producing 100 pounds of milk was $1.41 for the period when the cows were on pasture and $1.82 for the time that they were on winter feed (Table 9). The summer price received for milk was $1.71 and the winter price $1.90. Under the cost and price conditions that existed in 1936 and 1937, herds producing milk at the level of those in this study made an average monthly profit of $2.16 per cow during the five summer months and 55 cents per cow during the seven months of barn feeding.

Milk production per cow was highest in March, April, May, and June because more cows freshened in March than in any other month of the year and because of desirable weather and feed conditions that prevailed, and usually prevail, during May and June. However, the herds yielding the highest yearly profit per cow (26 percent of the herds in this study) were those in which production was *fairly even thru the year,* not rising in April, May, or June as high as 110 percent of the monthly average production, nor in any month of the year falling below 93 percent of the monthly average (Table 10). On these farms the yearly profit per cow was $22.25; whereas it was only $6.26 in the herds where April, May, and June production rose as high as 130 percent of the monthly average and dropped in September, October, and November to about 75 percent of the monthly average (28 percent of the herds).

For several reasons the herds with fairly even production thruout the year made more profit per cow than the other herds despite the fact that more of the milk from the even-producing herds came in the

winter months when costs are high. The main reason these herds made more profit was that their milk brought a higher average yearly price, as Paragraph 3 below explains. Paragraphs 1 and 2 list other reasons.

1. The even-producing herds were, in many respects, better managed. The cows were selected more carefully, they were fed more nearly constant amounts of grain and protein concentrates thruout the year, and the cows that were bought or sold were bought or sold with an eye to obtaining even yearly production and to maintaining high production per cow. The result was that these herds averaged 720 pounds more milk per cow per year than the other herds (8,860 compared with 8,140).

2. The owners of the even-producing herds knew how to keep their costs down. Even tho feed and labor were higher per cow in these herds, the cost of milk was only 2 cents more per hundred pounds than it was in the other herds. The summer milk, especially that in the late summer months, was produced so much more cheaply in the even-producing herds than in the other herds that some of the high winter costs in the even-producing herds were offset.

3. Since the high-cost months (the winter months) were also the high-price months, the owners of the even-producing herds received an average of $1.90 a hundred pounds for their milk, whereas the owners of the other herds got an average of only $1.70 a hundred, the peak of their production coming in early summer when milk prices are at their seasonal low. Thus milk that cost the owners of the even-producing herds only 2 cents more a hundred pounds to produce brought them 20 cents more a hundred pounds on the market.

TABLE 10.—RELATION OF EVENNESS AND OF UNEVENNESS OF PRODUCTION TO PROFIT PER COW, 1936 AND 1937

Month	High seasonal variation in production		Low seasonal variation in production	
	Milk per herd daily	Percent of monthly average	Milk per herd daily	Percent of monthly average
	lb.		*lb.*	
January	442	104	499	99
February	452	106	504	100
March	470	111	514	102
April	517	122	515	102
May	551	130	520	103
June	551	130	555	110
July	424	100	501	100
August	370	87	470	93
September	326	77	489	97
October	311	73	485	96
November	317	75	490	97
December	361	85	508	101
Yearly profit per cow	$6.26		$22.25	

Month of Year

The cost of producing milk was lowest during June and July and highest in January, February, and March (Table 11). In January the feed cost of producing 100 pounds of milk was $1.10, nearly twice that in June, when the cows were on pasture. A charge of 5 cents per cow per day was made in both years for the best pasture. This daily charge was scaled down when the forage on pastures declined.

May pasture was best in both 1936 and 1937. Its quality accounts for the high feed charge of 76 cents per 100 pounds of milk in that

TABLE 11.—COST OF MILK AND PRICES RECEIVED, BY MONTHS, NORTHERN ILLINOIS, COMBINED DATA FOR 1936 AND 1937

Month	Average gross cost per 100 pounds of milk				Price received per 100 pounds	Milk per cow
	Feed	Man labor	All other	Total		
						lb.
January	$1.10	$.36	$.43	$1.89	$1.89	702
February	1.09	.36	.46	1.91	1.90	652
March	1.08	.35	.42	1.85	1.81	722
April	1.05	.34	.43	1.82	1.71	724
May	.76	.27	.42	1.45	1.59	789
June	.57	.23	.41	1.21	1.58	777
July	.68	.25	.43	1.36	1.67	693
August	.81	.26	.46	1.53	1.83	657
September	.85	.26	.45	1.56	1.95	639
October	.84	.29	.44	1.57	1.98	656
November	1.02	.36	.45	1.83	2.03	630
December	1.05	.36	.43	1.84	2.04	679

month compared with the 57-cent charge in June, when many pastures were not as good as they were in May. The high unit cost of feed in August and September was not, however, due to a high pasture charge but to the larger amounts of grain and other feeds which were fed because pastures were so poor during those months.

SUMMARY

Milk production per cow averaged 8,328 pounds yearly in the northern Illinois dairy herds included in this study—a high milk yield compared with that of all cows in the area.

Proportional costs in milk production. Feed expenses constituted 53.9 percent and man labor 18.5 percent of the net cost of producing milk. Thirteen other items made up the other 27.6 percent of the cost.

The higher producing cows required less feed and labor per unit of milk produced than the lower producing cows. The greatest feed variation was in hay and pasture; there was less difference in the amounts of protein feed and silage, and very little difference in the amounts of grain used.

Fifteen percent of the costs entering into the production of milk, other than the costs of feed and labor, were found to fluctuate with feed costs and 45 percent with farm wages.

Formulas for estimating costs. The above facts concerning feed and labor costs supplied the basis for working out formulas and graphs by which the cost of producing milk in this area with cows of different levels of production can be computed closely enough for most practical purposes. The only variables in the formulas are the local price of shelled corn and the monthly cash wages of a hired man.

Some causes of variations in cost. Within limits, high production per cow reduces the unit cost of production. Milk from cows giving between 9,000 and 10,000 pounds of milk yearly was produced at a cost of $1.55 a hundred pounds in 1936 and 1937. The cost was $2.11 a hundred pounds from cows giving less than 6,000 pounds yearly.

In the larger herds milk was produced at less cost per 100 pounds than in the smaller herds. In herds of 10 to 30 cows the addition of a single cow caused enough saving of man labor and other costs per unit of milk to lower the cost of production about 4 cents a hundred pounds.

Milking machines enabled a group of these men to produce 10 more pounds of milk with every hour of their labor. The machines saved them $2.30 a cow a year, or about $45 a herd.

Under the cost and price conditions that existed in 1936 and 1937 the 173 herds for which monthly records were available made an average monthly profit of $2.16 per cow during the five summer months, against only 55 cents a cow a month during the seven months of barn feeding. The average yearly profit per cow in those herds was $14.20.

The herds in which high seasonal variations in milk production were kept down were more profitable than those in which production was allowed to vary widely. Those herds in which April, May, and June production rose as high as 130 percent of the annual monthly average and in which in September, October, and November it dropped below 75 percent of this average, returned a profit of only $6.26 per cow. Those in which production did not in any month go more than 10 percent above or below the monthly average for the year made a yearly profit of $22.25 per cow. In only one-fourth of the herds were fluctuations kept within these limits.

Seasonality of production was influenced mainly by the time of year the cows freshened and the feeding program followed. The greater profits that result when production is kept fairly even thruout the year (three to four times those when seasonal production is extremely variable) should be an incentive for producers to level out wide fluctuations by giving more attention to management practices that will prevent them.

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